

Cropping system intensification and nutrient dynamics in the great plains: implications of cover
crop and nitrogen fertilizer management

by

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AN ABSTRACT OF A DISSERTATION

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Abstract

Understanding how land management decisions impact the agronomic outputs, ecology, and soils in agroecosystems can empower farmers to make the best choices for their own operations. No-till has revolutionized agriculture in Kansas, with approximately 12 million acres under no-till recorded in 2022. However, cover crops have not gained the same traction in the state. This is likely due to the perceived financial and systemic risks associated with cover crops. Despite gaining national interest, there is still limited understanding of how cropping systems respond to the inclusion of cover crops at more local levels. The goals of the cover crop studies were to better understand nutrient dynamics and ecologic response to cover crop management in northeast Kansas. The final chapter is an exploratory study on the effects of long-term fertility management, looking at the Magruder Plots in Stillwater, Oklahoma.

The first experiment explores the relationship between cover crop selection and nitrogen dynamics in a wheat-corn-soybean rotation. The study took place from 2020-2025 within a long-term cover crop experiment at Ashland Bottoms. The treatments included a chemical fallow check (CF), cover crops (legume, grass, legume/grass mix, a diverse mix), and double-crop soybeans (DSB, [*Glycine max* (L.) Merr.]) planted after wheat (*Triticum aestivum* L.) and before corn (*Zea mays*) in a no-till wheat-corn-soybean rotation. Five nitrogen fertilizer rates (0, 45, 90, 180, and 270 kg ha⁻¹) were applied to the corn within each treatment. Corn development was monitored throughout the growing season, and soil nitrogen was analyzed before planting cover crops, after terminating cover crops, and after corn harvest to determine total nitrogen balance in the system. There was a significant interaction effect ($P < 0.001$) of fallow replacement and nitrogen rate for most response variables. System yields were generally highest after the CF and

DSB treatments, driven by corn yields. Additional nitrogen may overcome corn yield drag following some cover crops, but moisture use after cool-season cover crops is still a concern.

The next experiment explored the potential ecosystem services of a late-terminated cereal rye cover crop before corn. Although cover crops in Kansas are typically terminated 2-4 weeks prior to cash crop planting, there may be situations where late-burndown or planting into a living cover crop may be necessary, and some advocates of regenerative agriculture promote planting green as the most desirable practice. Three different termination dates were tested – 4 weeks prior to planting (early), 3 days prior to planting (late), and at planting (green), as well as a check treatment with no cover crop planted. Insect assessments did not indicate a significant effect of termination timing on beneficial insects. There were significant yield losses observed in cover crop treatments some years, especially where corn was planted green. Cover crop biomass in 2022 was 64% lower than what was observed in 2021, and cover crop biomass in 2023 was 84% lower than in 2021. The control and early termination treatments resulted in significantly higher yields than the late and green treatments in 2022, but only the green treatment resulted in significantly reduced grain yields in 2021. The late termination and planting green treatments resulted in a 1.38 and 3.75 Mg ha yield penalty in 2021 and 2022, respectively. In 2023, corn grain yields were not statistically different between treatments, and the average yield in 2023 was 32% lower than the highest yields in 2021. Cereal rye biomass was lowest in 2023, perhaps due to limited precipitation during the cover crop growing season. Corn root biomass was significantly affected by cereal rye termination timing, with the lowest values in planting green plots. This could be linked to increased instances of *Pythium* leading to radical root rot. Yield losses after planting green may be attributed to increased seedling disease, immobilization of soil nitrogen, and stored soil water uptake by the living cereal rye cover crop.

The final experiment is an exploratory study on the long-term effects of soil fertility management on inherent soil properties. Soil mineralogy is historically thought to be an inherited soil quality originally derived from parent materials. However, recent studies suggest that soil acidification from agricultural land use may be altering soil minerals in shorter time scales, challenging the view that mineralogical changes only occur at the deep time scale. The objectives of this research were to stress the importance of basic soil mineralogy knowledge for agronomists and to address whether long-term soil fertility management increases the proportion of highly-weathered clay minerals. Soil samples were pulled from the historic Magruder plots in Stillwater, Oklahoma at Oklahoma State University. The plots were moved in 1947 and consistently managed since then. There are six fertility treatments applied to continuous wheat plots. Soil cores were pulled from each plot down to one meter. Samples were prepared for clay mineralogical assessments and x-rayed using the Jackson (1975) method. In the surface samples, organic carbon was highest in the manure plot, base saturation was highest in the manure plot and NPK with lime amendment plot, and pH was lowest in NP and NPK plots. Mineralogical differences were not observed in the XRD patterns or in thin soil thin section, but chemical analyses indicate increased weathering in NP and NPK plots.

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Dedication

“They laughed at him!”

A proud tale of my great-grandfather shared with me by my grandmother.

Many years ago, my great-grandpa Carl Norris had bought a section of land considered to be plain terrible and unproductive. The folks in the small Pennsylvania town laughed at him, thinking his investment was a complete mistake. However, grandpa was a steward of the land and knew what he was doing. That very year, he planted clovers as a cover crop, tilled them into the soil in the spring, and had his most productive season yet.

This is dedicated to my grandmother, Joyce Ann Reed. Thank you for sharing your love of farm life with me from an early age. I will always deeply cherish the memories of our summers together at Paul and Eva’s farm.

Chapter 1 - Review of Relevant Literature

Empowering farmers in their decisions

A deep understanding of conservation agriculture practices such as no-till and cover crops, and different approaches to incorporating them into cropping systems have the potential to empower farmers to make decisions on their own operations with the general goal of improving their system resilience to extreme weather and building soil health. This first literature review explores the outcomes of no-till, cropping system intensification, and cover crops in agroecosystems.

How no-till agriculture revolutionized semi-arid cropping systems

When talking about soil health and justifying the need for improved land management practices, we often look back on the dust bowl. After western expansion led to intense cultivation of Mollisols in the Great Plains, economic hardships and drought led to increased crop production in marginal lands and abandonment of soil conservation practices, exacerbating crop failures and further degrading soils (National Drought Mitigation Center, n.d.). However, as many know, a drought driven by La Nina in the 1930s led to what we now refer to as the dust bowl – a devastating drought that led to extreme dust storms in the Great Plains. The extreme amounts of dust and soil loss were accredited to human land degradation (Baumhardt et al., 2015; Cook et al., 2009). Amid the disaster, Hugh Hammond Bennett influenced the public and ultimately the government to form the Soil Erosion Service, which would eventually become the Natural Resource Conservation Service (NRCS, n.d.). Historically, the federal government provided relief for farmers and other citizens affected by the drought. Today, the NRCS and other organizations – at the federal, local, and private level – promote and sometimes incentivize soil conservation practices. Poorly suited lands may be taken out of production and some

financial support has been provided federally to promote no-till and cover crops. In the southern Great Plains, the state of Kansas is a leader in no-till agriculture. Since the 2022 census, Kansas is currently outpacing Oklahoma and Texas in terms of no-till acres. Compared to 2.9 million in Texas and 2.1 million in Oklahoma, Kansas boasts 11.7 million acres of no-till in the state (U.S. Census Bureau, 2022a; U.S. Census Bureau, 2022b; U.S. Census Bureau, 2022c).

The documented benefits of no-till

Whether it is culturally popular or rare in a given region, the benefits and risks associated with no-till continue to be explored and extensively studied globally. For example, a meta-analysis by Cai et al. (2022) compared soil organic carbon (SOC) sequestration under no-till versus conventional tillage. Although SOC sequestration was limited to the surface soil, SOC losses greatly diminished over time in response to no-till practices. In the northeastern U.S. in New York, a 20-year tillage study published by Nunes et al. (2018) found that systems under continuous no-till had higher values of biological and physical soil health indicators compared to conventionally tilled systems. . The no-till systems had increased organic matter (OM), soil respiration, and active carbon compared to the conventionally tilled systems – indicating that the no-till systems were hosting a more functional carbon cycling microbial community (Nunes et al, 2018). Soil health indicators from no-till were associated with increased grain yields in this. Another 15-year study from the lower Mississippi river basin reported long-term benefits of no-till on SOC sequestration and soil aggregation (Amorim et al., 2024).

Another no-till study located in the semi-arid southern Great Plains region reported that the best no-tillage practices in their study resulted in the highest yields for continuous wheat (*Triticum aestivum* L.), which were also more profitable in the long run (Wiese et al., 1993). However, in the wheat-sorghum [*Sorghum bicolor* (L.) Moench] rotation, relying on herbicides

alone may not be sufficient for managing weeds and resulted in lower yields in the no-till treatment compared to sweep plowing. A similar study from the same region reported the following year reported that tillage systems did not affect yield or soil water storage in wheat systems, but reduced tillage after sorghum with no tillage after wheat was the highest yielding system compared to reduced tillage after every crop phase (Unger, 1994). More recently it was reported that in addition to improved yields, no-till has also been found to be more profitable than conventional till, with 153% higher yield and \$146 ha⁻¹ greater return in no-till sorghum compared to the sorghum produced with conventional tillage (Vandever et al., 2023).

In cotton (*Gossypium*), reduced and no-till practices have been found to enhance yields after multiple years, but reduced yields may be observed in the early years (Triplett et al., 1996). Generally, no-till cotton has been found to produce comparable yields and higher overall profits compared to conventionally and conservationally tilled acres (Buman et al., 2005; Keeling et al., 1989; Triplett et al., 1996).

A European meta-analysis of 174 studies reported by Skaalsveen et al. (2019) discussed the various benefits of no-till in relation to soil structure and water dynamics. Particularly, they concluded that no-till practices reduce erosion loss, albeit at the expense of greater bulk-density at the soil surface compared to a field that has recently been worked up. Surface residue left in no-till systems is integral for increasing soil aggregate stability because they allow the fungal hyphae networks to persist undisturbed and maintain aggregate structures (Soil Quality Institute, 1996).

Maintaining soil structure and keeping residue on the surface through no-till ultimately support microbial communities by leaving them undisturbed. Evidence suggests in many situations, no-till can be neutral or positive for agronomic systems. It generally takes several

years to see differences in soil properties in response to no-till practices (Blanco-Canqui & Ruis, 2018), especially in the fertile mollisols of the north central US that are resilient to change (Crespo et al., 2024). Nonetheless, there are still some risks associated with the first years of adopting no-till that will be discussed in the next section. It is ultimately up to producers and other land managers to determine if the risks of no-till are worth the benefits; or rather, if the risks of no-till are preferable or not to those of conventional systems.

Documented risks of no-till

No-till practices effectively cease the mixing operations on the surface that would normally occur under conventional tillage. Without turning the soil, there is concern about nutrient stratification and soil compaction. Some evidence suggests that disking, while intended to relieve the system of stratification, is actually associated with enhanced nutrient stratification at the surface (Smith et al., 2017). However, the lack of mixing in no-till has also been associated with lower rates of litter decomposition, and the compaction from no-till was correlated with reduced biodiversity (Domínguez et al., 2010). Other risks of soil compaction under no-till were evident in the form of corn (*Zea mays*) grain yield losses of around 17% in trials out of Pennsylvania (Sidhu & Duiker, 2006). Deep tillage alleviated some of this compaction and reduced yield losses while shallow tillage did not (Sidhu & Duiker, 2006). A single tillage event does not necessarily negatively impact soil properties (Blanco-Canqui & Ruis, 2018). Therefore, it could be that occasional tillage may temporarily relieve some of the negative outcomes of no-till.

No-till may be combined with companion practices for soil and water conservation, which could potentially enhance the benefits of no-till and relieve some of the potential negative effects on soil physical properties and crop performance (Blanco-Canqui & Ruis, 2018). In a

long-term cover crop and tillage study in Denmark, the investigators reported evidence of reduced porosity at 12- and 16-cm depths in response to no-till and harrowing tillage practices, but the presence of cover crops in these tillage regimens alleviated the compaction effect of no-till (Abdollahi et al., 2014). Additionally, it has been reported that tap-rooted cover crop species can relieve some of the soil compaction resulting from long-term no-till (Chen & Weil, 2010). Another challenge with no-till is weed management because no-till systems inherently rely on chemical weed control to keep fields clean. Repeated use of chemical herbicides is linked to the development of herbicide resistant weeds. According to a 2023 review, herbicides threaten native biodiversity and food security, especially with the rise in herbicide resistant weed species and the risks that herbicides present to non-target organisms (Ofosu et al., 2023). However, developing individualized integrated weed management strategies in no-till systems could be useful for combating herbicide resistance. The biomass and allelopathic control offered by cover crops could help reduce weeds in agroecosystems (Mirsky et al., 2013), but herbicides may still be required to terminate cover crops, not necessarily reducing inputs. Smart-technology that uses machine learning to identify weeds in the field and specifically target individuals are in development (López-Correa et al., 2023). Reducing herbicides alone may not be enough because reduced inputs could lead to increased weeds, even in an integrated approach using companion crops and occasional tillage (Summers et al., 2021). Spot treatment of weeds could be the next generation of integrated weed management in no-till systems when combined with intensified and diversified cropping systems that interrupt weed cycles.

Cropping system intensification

Evidence suggests that intensifying and diversifying cropping systems can improve overall system productivity and efficiency (Cassman & Grassini, 2020). In a recent meta-analysis

looking at 30 long-term experiments across Europe and Africa, it was concluded that ecological intensification practices, including increasing crop diversity, generally increased cash crop yields (MacLaren et al., 2022). In Oklahoma, Patrignani et al. (2019) found that intensification of wheat-fallow systems with double-crop sorghum or soybean [*Glycine max* (L) Merr.] in addition to a full-season corn, soybean, or sorghum crop utilized 37% more of the total precipitation and increased system water use efficiency. A 1997 study from Texas reported that taking advantage of summer rainfall by replacing fallow in wheat systems with sorghum increased whole-system crop yields compared to wheat-fallow (Jones & Popham, 1997).

Cropping system intensification may also improve soil health indicators. The global meta-analysis by Prairie et al. (2023) reported that cropping system intensification increased SOC by 12.4% in the form of POC linked to plant residue. This affirmed the findings of Jones & Popham (1997) that indicated the replacement of the summer fallow after wheat harvest was key to improving cropping systems. Nunes et al. (2018) reported improved soil health markers in a 12-year corn silage monoculture that was interrupted for 6 years to plant grass compared to a 24-year continuous corn silage monoculture. The legacy effects of this small change were observable 12 years after returning to an intensive monoculture, indicating that even minor system diversification can be beneficial in the long run (Nunes et al., 2018)

System intensity can also be increased with an additional harvestable crop planted after the harvest of another to effectively shorten the following fallow period. Two crops planted in a single year is referred to as double cropping (Andrews & Kassam, 1976). Double-crop soybeans after wheat harvest in July has been practiced in Kansas, Missouri, and Oklahoma. A long-term study from southeastern Kansas reported that rotations that included double-crop soybeans after wheat had higher economic returns than 2-year systems by \$10-25 per acre (Kelley, 2003).

Systems can be adapted to the shortened field season of double-crop soybeans by using early maturing cultivars of both winter wheat and soybeans, maximizing system productivity and net returns (Kyei-Boahen & Zhang, 2006). A systematic review by Santos Hansel et al. (2019) analyzed 40 years of yield data from double-crop soybeans and the preceding wheat crop and reported that wheat yields affected system yield outcomes more than environmental conditions. A recent study by Yeager et al. (2025) supported the profitability of double-crop soybeans after winter wheat and before sorghum, especially at an optimum nitrogen fertilizer application rate of 90 kg ha⁻¹ in the sorghum phase of the wheat- double-crop soybean -sorghum-soybean rotation.

Cover crops and no-till for soil health

Cover crops, by definition, are unharvested and used for soil cover between cash crops (SSSA, 2025). Cover crops have the potential to improve soil health parameters and provide a variety of ecosystem services. When precipitation is sufficient to replenish soil moisture, cover crop residue can enhance soil water storage during the cash crop growing season (Basche et al., 2016; Chalise et al., 2019; Fageria et al., 2005). Cover crops and their residue also reduce sediment losses in runoff (Carver et al., 2022). High-biomass residue physically covers the soil while root systems stabilize the soil surface, protecting soil aggregates.

In addition to protecting soil aggregates, cover crops may improve soil aggregation over time, which ultimately improves soil structure and soil carbon storage (Acharya et al., 2024; Dai et al., 2024; Prairie et al., 2023; Zhu et al., 2024). Soil aggregation could vary based on cover crop species selection, but different species within cover crop mixtures may work synchronously to improve soil structure (Blanco-Canqui, 2023a).

Cover crop monocultures and multi-species mixes are of interest to farmers for species-specific ecosystem services and the potential for synchronized benefits from multiple species.

When moisture is sufficient and temperatures are consistently high enough, legume cover crops have shown potential to fix atmospheric nitrogen that could potentially be used by the next crop and reduce fertilizer inputs (Mahama et al., 2016; Quemada & Cabrera, 1997). High biomass-producing grass cover crops such as cereal rye (*Secale cereale*) are useful as part of an integrated weed management plan, reducing weed emergence via allelopathy and competition (Mirsky et al., 2013). Diverse mixes also exhibit weed suppression capabilities (St Aime et al., 2023) in addition to potential for both nitrogen scavenging and fixation via different functional species (Finney et al., 2016; Rannels & Waggoner, 1997).

Similar to no-till, cover crops also have potential drawbacks in practice. A study out of Iowa reported that the combination of no-till and cover crops before corn impacted ear number and overall grain yields, especially after the high biomass cereal rye cover crop (Acharya et al., 2020). High-biomass grass cover crops like cereal rye also function as a green bridge for corn seedling diseases. Increased severity of radicle and seminal root rot have been observed in corn seedlings following a cereal rye cover crop compared to those following no cover crop (Acharya et al., 2022; Almeida et al., 2024; Kurtz et al., 2021). A cereal rye cover crop also decreased corn stands and decreased final grain yields compared to no-till without covers (Kurtz et al., 2021). Cover crops could be managed to reduce some of these risks, specifically to corn. Planting into a living cover crop results in a higher risk for the green-bridge effect and negatively impacted yields due to moisture issues and increased instances of *Pythium* infestation (Acharya et al., 2022; Almeida et al., 2024). Delaying termination results in increased cover crop biomass (Acharya et al., 2022; Almeida et al., 2024; Clark et al., 1994), so early termination could leave the system with less biomass residue and perhaps decrease soil coverage, which is what provides the physical mat of protection for the soil.

Overall cover crop adoption in the Midwest has increased in recent years from 3.6% of cropland recorded in 2017 to 7.2% in 2022, likely due to the increase in federal and state conservation incentive programs (Zhou et al., 2022) and a growing interest in participating in regenerative agriculture (SARE, 2025). Many farmers are interested in planting cover crops, but some non-users have expressed concerns such as economic returns, planning farm operations, and specific management issues such as water use or new weed problems (SARE, 2023).

Alternative cover crop strategies and uses

Although there are potential barriers in terms of equipment and site-specific challenges, there are alternative management strategies and goals that can be achieved with cover crops. For instance, cover crops do not necessarily need to be planted during fallow periods. Rather, if one has access to an aerial seeding method or drilled cover crops early enough in the season, cover crops could be interseeded into cash crops. An example of this is a study out of North Dakota that investigated interseeded cover crops drilled into early season corn. They reported no statistical difference in soil water content or corn yields in two on-farm sites (Goettl et al., 2024).

Another way to utilize cover crops is grazing cattle on the biomass. Dual-purpose cover crops for animal forage have the potential to provide soil health benefits while simultaneously reducing other feed inputs. Although infrastructure for hosting cattle on cropland and other barriers exist to the practice, incorporating cattle into the cropping systems can add economic value to production. When grazing cover crops, an additional \$100 to \$260 ha⁻¹ could be generated from the system (Blanco-Canqui et al., 2023b). Additionally, some evidence suggests that livestock integration could offset yield losses observed in the early years of cover crop adoption. An experiment reported by Kelly et al. (2021) observed grazed cover crops in 10 sites in semi-arid dryland systems. Treatments where cover crops were grazed were not statistically

different in terms of stable aggregates compared to ungrazed cover crops, which is supported in other reports (Obour et al., 2023), but grazed cover crop treatments did have significantly greater bulk density than the ungrazed. However, the bulk density under grazed cover crops was not different from fallow no-till (Kelly et al., 2021). Additionally, they did not see statistically different grain yields in grazed versus ungrazed systems. In the review by Blanco-Canqui (2023b), it was concluded that grazing covers did not generally decrease crop yields, but high stocking rates and wet soil conditions could potentially lead to compaction and subsequent yield losses in the cash crop.

The potential for enhanced nutrient cycling from grazing also makes it a potential piece of a “regenerative” agricultural system. In a report from Kansas, grazing cover crops resulted in a statistically significant 0.7% increase in SOC after 2 years of the practice (Obour et al., 2023). Perhaps this is due to the relatively high amounts of biomass that could be left behind by the cattle. Simon et al. (2024) reported an average of 60% of total cover crop biomass was left on the soil surface as residue. They also reported no significant effect of grazing on soil pH, nitrates, or phosphorus. There is a gap in the literature regarding stocking rate and cover crops because most cover crop grazing studies maintain a single stocking rate for grazing treatments (Blanco-Canqui, 2023b). Soil texture in specific fields also influences compaction because clayey soils can hold more water and are more susceptible to compaction from livestock, and therefore most reports of increased penetrative resistance and other compaction indicators are small despite sometimes being statistically greater than ungrazed control treatments (Rakkar & Blanco-Canqui, 2018).

Often, soil health practices are combined altogether to synergistically benefit from no-till, cover crops, and grazing. The meta-analysis by Prairie et al. (2023) observed 157 studies on regenerative agricultural practices looking at the effects of no-till, cropping system intensity, and

livestock integration on SOC, mineral associated organic carbon (MAOC), and particulate organic carbon (POC). While experimental duration, diversity, and specific intensification strategy moderated the effects of management, they generally found that integrating these practices in the long run is key to seeing increases in organic carbon because the studies longer than 12 years trended toward more SOC, MAOC, and POC than shorter studies (Prairie et al., 2023).

When considering cover crops for ecosystem services, there are variety of management options depending on producer goals. Cover crops can be used to support pollinators and beneficial insects so long as they are able to flower (SARE, 2015). There are some studies on the use of cover for beneficial insects in the context of controlling agricultural pests. Le Gall et al. (2022) reported enhanced bottom-up control of slugs when cover crop termination was delayed, meaning slugs were preferably eating the cover crop biomass instead of the cash crop. However, this bottom-up control came at the cost of reduced grain yields due to other factors when planting into a live cover crop. Another pest study by Rowen et al. (2020) reported that no-till alone is sufficient to support predatory insects that can feed on problematic pests, and additional residue is not necessarily more beneficial in this regard. Insects are not the only organisms feeding on cover crops. Deer and other wildlife use the cover crop biomass as forage or habitat (SARE, 2018). Planting cover crops in a nearby location during the cash crop growing season could lure deer and other herbivores away from the cash crop. Alternatively, cover crops could be integrated into the cropping system to entice wildlife to enter to the field during what would otherwise be a fallow period. Attracting such wildlife could be ecologically beneficial and offer some opportunity to rent hunting ground or otherwise feed the various populations. It has also

been reported that cover crops could offer spring habitat to migratory and residential birds, especially when termination is delayed (Wilcoxon et al., 2018).

Conclusion

There are many reasons a producer may want to plant cover crops, and cover crop management will be based entirely on the producer's goals. Many studies on cover crops come from the eastern US where rainfall is less limited, and there is a need for researchers in the western US to identify opportunities in their local cropping systems to incorporate cover crops in a way that is economical and mindful of producer goals. Site specifics can be as precise as the sub-field level, so it is important to continue building on the existing literature and bring cover crops research into localized context.

Research Rationale

The goal of this research is to ultimately inform farmers in northeast Kansas and locations with similar edaphoclimatic conditions about the potential outcomes of different cover crop or fallow replacement management strategies before corn. Private and federal incentives could encourage farmers to plant more cover crop acres, and it is our job to provide them with the information they need to empower their decisions and meet their goals.

Cover crop management is based on producer goals and site-specific needs. Additional research is still needed to understand nutrient dynamics, agronomic outcomes, and ecosystem services of cover crops in more locations and within a location. In Kansas, double-crop soybeans and cereal rye are common fallow replacement strategies. However, brassicas, legumes, other grasses, and broadleaves may provide unique soil health benefits

The goals of chapter 2 were to i) identify agronomically optimal fallow replacement strategies ii) assess nitrogen dynamics in the fallow replacement before and nitrogen treatments in corn, and iii) evaluate system legacy effects of using different fallow replacement strategies.

The goals of chapter 3 were to assess the effects of delayed cereal rye termination on i) corn growth and development and grain yield, ii) weed biomass, and iii) insect activity.

The goal of chapter 4 was to explore the relationship between nitrogen fertilizer management and inherent soil properties. The chapter begins with a separate literature review on the topic.

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Chapter 2 - Yield and nitrogen dynamics after different fallow replacement strategies in a wheat-corn-soybean rotation in northeast Kansas

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Abbreviations:

CC, crimson clover monoculture; CF, chemical fallow; CR, cereal rye monoculture; DBI1, double-crop soybeans after winter wheat followed by winter cover crop; DBI2, double-crop soybeans after winter wheat followed by winter cover crop and a summer cover crop after grain sorghum; DSB, double-crop soybeans; FTC, diverse multispecies mix; NDVI, normalized difference vegetation index; R/C, crimson clover and cereal rye mix; SCC, summer cover crop after winter wheat; SCCI, summer and winter cover crop after grain sorghum

Plain Language Summary

Adding more crops into a rotation can improve the outputs of the whole system while also improving soil health by reducing the fallow period. Producers can do this by including more cash crops, or they may opt for a cover crop – which is not harvested but rather used to protect the soil and offer other ecosystem benefits. In this study, we investigated how different additional crops and nitrogen fertilizer rates affected yield outcomes in a no-till wheat-corn-soybean rotation in northeast Kansas. We monitored crop yields from each phase, soil fertility, and corn development throughout the growing season after these fallow alternatives. An additional soybean crop planted after wheat harvest performed most similar to the fallow check, as nitrogen and moisture use appeared to limit the corn crop after cover crops.

Abstract

Reducing fallow periods in cropping systems via additional cash or cover crops can improve overall system productivity. Cover crop use in the central Great Plains region is low due to economic concerns regarding potential yield losses due to moisture and nitrogen use. We sought to fill research gaps on the effects of nitrogen fertilization and fallow replacement strategy in drier regions. The study took place from 2020-2025 within a long-term experiment in northeast Kansas. The fallow-replacement treatments included a chemical fallow check (CF), cover crops (legume, grass, legume/grass mix, a diverse mix), and double-crop soybeans (DSB, [*Glycine max* (L.) Merr.]) planted after wheat (*Triticum aestivum* L.) and before corn (*Zea mays*) in a no-till wheat-corn-soybean rotation. Five nitrogen fertilizer rates (0, 45, 90, 180, and 270 kg ha⁻¹) were applied to the corn within each treatment. Corn development was monitored via scouting, normalized difference vegetation index, days to silking, and SPAD chlorophyll meter readings. Soil nitrogen was analyzed before planting and after terminating cover crops, and after corn harvest. There was a significant interaction effect ($P < 0.001$) of fallow replacement and nitrogen rate for most response variables. System yields were generally highest after the CF and DSB treatments, driven by corn yields. Additional nitrogen may overcome corn yield drag following some cover crops, but moisture use by cover crops is still a concern. Including the cover crop in a different period of the rotation and using a DSB to intensify the system between wheat and corn may be preferable.

Introduction

Intensifying and diversifying cropping systems have been shown to improve overall system productivity and efficiency (Cassman & Grassini, 2020). In a recent meta-analysis looking at 30 long-term experiments across Europe and Africa, it was concluded that ecological

intensification practices including increasing crop diversity positively affected cash crop yields (MacLaren et al., 2022). In the southern Great Plains region, Patrignani et al. (2019) found that intensification of wheat (*Triticum aestivum* L.) -fallow systems by replacing the fallow periods in with a double crop sorghum (*Sorghum bicolor*) or soybean [*Glycine max* (L) Merr.] plus a full-season corn (*Zea mays*), soybean, or sorghum utilized 37% more of the total precipitation, increasing overall system water use efficiency. Another study from Texas in 1997 found that taking advantage of summer rainfalls by replacing fallow in wheat systems with sorghum increased whole-system crop yields compared to wheat-fallow (Jones & Popham, 1997). Aside from productivity and water use efficiency, cropping system intensification may also have its own soil health benefits. A global systemic meta-analysis by Prairie et al. (2023) concluded that cropping system intensification increased soil organic carbon by 12.4%, specifically in the form of particulate organic carbon linked to plant residue. This affirmed the sentiment of Jones & Popham (1997) that replacing the summer fallow the year after wheat harvest was key to improving cropping systems, except in this case the improvements were in particulate organic matter (Prairie et al., 2023).

In some cases, an additional harvestable crop can be planted following harvest of another to shorten the fallow period and increase system intensity. When two crops are planted in one year it is referred to as double cropping (Andrews & Kassam, 1976). Double-crop soybeans (DSB) following wheat has been practiced in KS, MO, and OK. A long-term study in southeastern KS determined that rotations with DSB after wheat resulted in higher economic returns than 2-year systems by \$10-25 per acre (Kelley, 2003). The impacts of a shortened field season in DSB can be mitigated by using early maturing cultivars of both wheat and soybeans, maximizing system productivity and net returns (Kyei-Boahen & Zhang, 2006). A systematic

review by Santos Hansel et al. (2019) analyzed 40 years of yield data from DSB and the preceding wheat crop, and they determined that wheat yields inversely drove DSB yields and affected yield outcomes more than environmental conditions or planting date. A recent study by Yeager et al. (2025) confirmed the profitability of DSB after wheat, specifically at an optimum nitrogen fertilizer application rate of 90 kg ha⁻¹ in the sorghum phase of the wheat-DSB-sorghum-soybean rotation.

An alternative to double-cropping is the addition of cover crops, which by definition are unharvested and used for soil cover and other benefits between cash crops (SSSA, 2025). Cover crops may offer a variety of ecosystem services when integrated into cropping systems. When precipitation is sufficient to replenish soil moisture, cover crops can enhance soil water storage during the growing season via reduced evaporation with residue coverage (Basche et al., 2016; Chalise et al., 2019; Fageria et al., 2005). Cover crops also reduce sediment losses in runoff by physically covering soil with residue and introducing roots to stabilize the soil surface and protect aggregates (Carver et al., 2022). Incorporating cover crops in a rotation also has the potential to build soil aggregation over time, which improves soil structure and soil carbon storage (Acharya et al., 2024; Dai et al., 2024; Prairie et al., 2023; Zhu et al., 2024). Soil aggregation may vary depending on cover crop species selection, but the different species within cover crop mixtures may work synchronously to improve soil structure (Blanco-Canqui, 2023).

Both monocultures and multispecies mixes of cover crops are of interest for their potential in reducing agrochemical inputs and reducing nutrient losses in agroecosystems. In appropriate moisture and temperature conditions, leguminous cover crops have shown potential to mineralize nitrogen *in situ*, potentially mineralizing nitrogen for the next crop to use and reducing fertilizer needs (Mahama et al., 2016; Quemada & Cabrera, 1997). High biomass-

producing grass cover crops such as cereal rye (*Secale cereale*) have exhibited usefulness as an integrated weed management tool, reducing the emergence of weed species via allelopathy and competition (Mirsky et al., 2013). Diverse mixes are of interest as well for their weed suppression capabilities (St Aime et al., 2023) and potential for enhanced nitrogen scavenging by different functional species (Finney et al., 2016; Rannels & Waggoner, 1997).

Integrating cover crops and conservation tillage or no-till practices can lead to inadvertent consequences on the cash crops. In Iowa, Acharya et al. (2020) determined that the combination of no-till and cover crops before corn may impact ear number and ultimately grain yields, especially after cereal rye compared to camelina (*Camelina sativa* [L.] Crantz). Additionally, grass cover crops like cereal rye may act as a green bridge for seedling diseases in corn. Increased severity of radicle and seminal rot have been observed in corn seedlings following a cereal rye cover crop compared to those following no cover crop in Iowa (Kurtz et al., 2021). The same study observed decreased corn stands and decreased final grain yields after cereal rye compared to no-till without covers.

Despite the potential for yield losses, cover crop residue provides physical cover to prevent erosive soil loss. Although no-till practices are popular in Kansas, with almost 12 million acres in no-till in 2022 compared to the approximately 4 million acres under conventional or intensive tillage (US Census Bureau, 2022), cover crop adoption has not gained the same traction in the state. Only about 768,000 acres were managed with cover crops in 2022 (US Census Bureau, 2022). Farmer hesitation may be due to moisture limitations, increased operation costs, minimal crop insurance incentives, potential yield reductions, and a general lack of cover crop research within the region (Irvine et al., 2024; Yeager et al., 2025).

Overall cover crop adoption in the Midwest has increased in recent years from 3.6% of cropland recorded in 2017 to 7.2% in 2022, likely due to the increase in federal and state conservation incentive programs (Zhou et al., 2022) and a growing interest in participating in regenerative agriculture (SARE, 2025). Many farmers are interested in planting cover crops, but some non-users have expressed concerns such as economic returns, planning farm operations, and specific management issues such as water use or new weed problems (SARE, 2023).

This study seeks to close some of the research losses in the central Great Plains region regarding cropping system intensification and add to the growing body of knowledge about the potential benefits and consequences of cover crops in warmer, drier climates. We investigated the effects of nitrogen fertilizer application rate and preceding fallow-replacement strategy on corn growth and development, nitrogen dynamics, and total system productivity in a no-till wheat-cover crops-corn-soybean rotation in northeast Kansas.

Materials and Methods

Site Description and Experimental Design

The experimental site was established in 2007 at the Ashland Bottoms Research Farm managed by Kansas State University. This study observed the fifth cycle of the rotation described by Preza-Fontes et al. (2017), located 8 km south of Manhattan, KS (39°11' N lat, 96°35' W long). The study site has been mapped as a Wymore silty clay loam (fine, smectitic, mesic Aquertic Argiudoll), and the region is classified as having a hot humid continental climate (Köppen Climate Classification System: Dfa).

This study primarily examined the corn phase, but all three phases of the wheat-corn-soybean rotation were present every year. Wheat was managed according to Preza-Fontes et al. (2017) and received nitrogen and phosphorus fertilizer at planting plus an additional mid-season

nitrogen application (Table 2.1). The corn phase was previously sorghum but changed in 2020 to accommodate this experiment.

A full system cycle was observed starting with cover crop planting in late summer 2020 and ending with the final wheat harvest in summer 2025. Cover crop treatments initiated in September 2020 were crimson clover (*Trifolium incarnatum*) monoculture (CC) at a seeding rate of 34 kg ha⁻¹, cereal rye monoculture (CR) at 67 kg ha⁻¹, a mix of crimson clover and cereal rye (R/C) at 14 and 34 kg ha⁻¹, respectively, and a diverse “Fall-T-Cropper” mix (Sharp Bros. Seed Co.) consisting of 65% triticale ($\times$ *Triticosecale*), 20% forage peas (*Pisum sativum*), 5% sorghum sudangrass (*Sorghum bicolor* $\times$ *S. bicolor* var. *Sudanese*), 4% canola forage, (*Brassica napus* L.), 4% daikon radish (*Raphanus sativus* L.), and 2% forage turnips (*Brassica rapa*) (FTC) planted at a total rate of 75 kg ha⁻¹. The chemical fallow (CF) and DSB treatments were consistent with Preza et al. (2017), and the experiment was a randomized complete block design with four replications and split-split plot treatment structure. Whole plots were crop phase (corn, soybean, wheat) of the rotation, split plots were the fallow replacement treatments, and split-split plots were the nitrogen rates applied to the corn phase. In the fourth cycle of the study, the fallow replacement treatments were CF, DSB after wheat, DSB after wheat plus a winter cover crop (DBI1), summer and winter cover crop after sorghum (SCCI), DSB after wheat plus a winter cover crop and a winter cover crop after sorghum (DBI2), and a summer cover crop after wheat (SCC). In 2019, all fallow replacement strips were managed with DSB after wheat except the CF treatment, which was consistent. When planting fallow replacement treatments after wheat in 2020, the new cover crop treatments replaced existing treatments with similar functions; CF and DSB were the same, CC replaced DBI1, CR replaced SCCI, R/C replaced DBI2, and FTC replaced SCC. In each year of the rotation, the corn phase plots were in a new location following

the previous wheat phase in the rotation with a different randomization for crop phase, cover crop, and nitrogen fertilizer rate. Fertilizer nitrogen rates were changed from 0, 45, 90, 135, and 180 kg ha⁻¹ nitrogen for sorghum to 0, 45, 90, 180, and 270 kg ha⁻¹ for corn, only changing with an increase in the upper two rates.

Cover Crop and Wheat Management

The wheat crop in the rotation was harvested on June 26, 2020; June 22, 2021; and June 30, 2022. Weeds were chemically managed throughout the entire cycle to maintain clean plots. Cover crops were planted with a John Deere 1590 no-tillage drill set to 19-cm row spacing (Deere & Co., Moline, IL) on September 2, 2020; September 9, 2021; and August 24, 2022. They were terminated on April 14, 2021 using a mixture of glyphosate, dichloro-phenoxyacetic acid (2,4-D), and dicamba; on April 26, 2022 with a mixture of glyphosate and 2,4-D; and on April 14, 2023 using a mixture of glyphosate, 2,4-D, and dicamba. Prior to termination, cover crop and weed biomass was harvested from each plot using a 0.5-m² quadrat and manually clipped to soil surface on April 13, 2021; April 25, 2022; and April 13, 2023. Total carbon, nitrogen, and ash weights were determined after samples were oven dried at 60°C using a LECO TruSpec CN combustion analyzer (LECO Corporation, St. Joseph, MI).

Table 2.1 Summary of field operations for each full cropping system cycle from 2020-2025 starting with the first double-crop soybean planting in 2020 and ending with final wheat harvest in 2025.

Operation	2020-2023	2021-2024	2022-2025
Double-Crop Soybeans			
Planting	July 2, 2020	July 9, 2021	July 9, 2022
Variety	Pioneer P38A49L	Pioneer P38A49L	Pioneer P39T61SE
Seeding Rate (seeds ha ⁻¹)	445000	445000	445000
Harvest	Nov. 2, 2020	Nov. 5, 2021	Oct. 10, 2022
Yield (kg ha ⁻¹)	1560	1667	1768
Cover Crops			
Planting	Sept. 2, 2020	Sept. 9, 2021	Aug. 24, 2022

Termination	Apr. 14, 2021	Apr. 26, 2022	Apr. 14, 2023
Corn			
Planting	Apr. 30, 2021	May 11, 2022	Apr. 24, 2023
Variety	Pioneer P0977AM	Pioneer 0995AM	Pioneer 0995AM
Population (seeds ha ⁻¹)	69000	67000	69000
V5 Fertilization	June 3, 2021	June 15, 2022	May 30, 2023
Harvest	Sept. 17, 2021	Oct. 4, 2022	Sept. 19, 2023
Soybeans			
Planting	May 12, 2022	Apr. 24, 2023	May 23, 2024
Variety	Pioneer P39T61SE	Pioneer P38A54E	Pioneer P37A18E
Seeding Rate (seeds ha ⁻¹)	395000	395000	395000
Harvest	Oct. 10, 2022	Oct. 10, 2023	Oct. 10, 2024
Wheat			
Planting	Oct. 15, 2022	Oct. 11, 2023	Oct. 26, 2024
Variety	KS Hatchett	KS Hatchett	KS Providence
Seeding Rate (kg ha ⁻¹)	135	135	135
Fertilizer	24-62-0	24-62-0	24-62-0
N-P ₂ O ₅ -K ₂ O (kg ha ⁻¹)	24-62-0	24-62-0	24-62-0
Topdress	91-0-0	91-0-0	91-0-0
N-P ₂ O ₅ -K ₂ O (kg ha ⁻¹)	91-0-0	91-0-0	91-0-0
Harvest	June 28, 2023	June 27, 2024	June 28, 2025

Crop Management

Corn was planted in late April or early May each year of the cycle (Table 2.1). Nitrogen fertilizer was applied using a flat-coulter fertilizer applicator at rates of 0, 45, 90, 180, and 270 kg ha⁻¹ applied as 28% urea ammonium nitrate. At planting, nitrogen was applied at 45 kg ha⁻¹ to all plots except 0 kg ha⁻¹ nitrogen checks, and the balance was applied at V5. No phosphorus or potassium fertilizers were applied during the corn phase.

Flowering notes were taken at R1 in each plot (Abendroth et al., 2011). Chlorophyll readings were done in each plot at V5 in 2021, V11 in 2022, and at R1 in 2022 and 2023 using a Soil Plant Analysis Development (SPAD, Minolta Camera Co., Osaka, Japan) chlorophyll meter. Readings from 15 randomly selected plants in the center two rows of each plot were taken from the base of the first leaf above the developing ear and averaged for the plot. Normalized

difference vegetation index (NDVI) readings were captured from an entire length of row in each plot during V5 in 2021 and 2022 using a Green Seeker® crop sensor (Trimble Navigation Ltd., Sunnyvale, CA) configured for manual data collection to assess nitrogen uptake and biomass production in the early season corn (Shaver et al., 2011).

Corn was harvested in September or early October using a Gleaner EIII combine, modified for small plot harvest. Two of the center four rows were identified for harvest and stand counts, and notes on lodging were collected prior to combine harvest. Grain moisture was determined using a moisture meter (Model GAC 2000, DICKEY-John Corp., Springfield, IL). For yield calculations, moisture was normalized to 15%, 13%, and 13.5% for corn, soybean, and wheat grains, respectively. The next years' soybeans were planted in late April or early May with no additional fertilizer inputs (Table 2.1). The following wheat phase was planted in October following soybean harvest and fertilized with nitrogen and phosphorus (Table 1). Total system yield (Mg ha^{-1}) was determined by summing corn, soybean, wheat, and DSB yields for each full cycle replicate.

Soil Sampling and Analyses

Soil profile samples down to 60-cm depth were collected before cover crop planting in August and after corn harvest in March using a tractor-mounted hydraulic probe (Model GSRTS, Giddings Machine Company, Inc., Windsor, CO) with a 5-cm push tube attachment, oven dried at 60 °C, and ground to pass through a 2-mm mesh. Samples were analyzed for total nitrogen using the LECO TruSpec CN combustion analyzer (LECO Corporation, St. Joseph, MI). After cover crop termination, 10 soil samples were collected down to 30-cm depth using a PN139 JMC 42-inch Dakota Probe (JMC Soil Samplers, Newton, IA) in the 90 kg ha^{-1} nitrogen rate plots, and

these samples were air dried, ground to pass through a 2-mm mesh, and analyzed for inorganic nitrogen via potassium chloride extraction (Mulvaney, 1996).

Bulk density samples were collected using two different methods for the 0-15 cm and 15-60 cm depths. The 15-30 cm and 30-60 cm depths were collected using the aforementioned hydraulic probe method and drying the partitioned samples at 105 °C until a constant weight was achieved. Bulk density of surface samples from 0-15 cm was determined using the ring sampling method described by Blake and Hartge (2018). Metal rings were pushed into the soil using a slide hammer, then the soil was placed into an oven at 105 °C to dry to constant weight. The resulting dry weights were used to calculate bulk density (Equation 2.1).

Equation 2.1

$$\text{Bulk density (g cm}^{-3}\text{)} = \frac{\text{Mass of dry soil (g)}}{\text{Soil core volume (cm}^3\text{)}}$$

Nitrogen Balance in the Corn Phase

Total nitrogen in each layer of soil was calculated using the bulk density and total nitrogen by depth (Equation 2.2). Profile nitrogen was calculated as a summation of each layer divided by a factor of 10 to account for total nitrogen per hectare down to 60-cm depth and converted to kilograms (Equation 2.3).

Equation 2.2

$$\begin{aligned} \text{Total Nitrogen (mg cm}^{-3}\text{)} \\ = \text{nitrogen concentration (mg kg}^{-1}\text{)} \times \text{Bulk Density (kg cm}^{-3}\text{)} \end{aligned}$$

Equation 2.3

$$\text{Profile Nitrogen (kg ha}^{-1}\text{)} = \frac{\sum \text{Total nitrogen per volume (mg cm}^{-3}\text{)}}{10 \text{ ha mg cm}^{-2} \text{ Mg}^{-1}} * \frac{1000 \text{ kg}}{1 \text{ Mg}}$$

Nitrogen balance for the system was calculated by subtracting outputs and changes in stored profile nitrogen (Eq. 2.4) as described by Sainju (2017).

Equation 2.4

$$\begin{aligned} \text{Nitrogen balance (kg ha}^{-1}\text{)} \\ = \text{N inputs (kg ha}^{-1}\text{)} - \text{N outputs (kg ha}^{-1}\text{)} \\ - \text{changes in soil total N (kg ha}^{-1}\text{)} \end{aligned}$$

Nitrogen inputs for our study included inorganic fertilizer nitrogen and cover crop nitrogen content. Inputs from seeds would have been consistent for the entire system given a uniform seeding rate, and the intricacies of nitrogen fixation by soil microbes were not captured in our analyses. Nitrogen return from the cover crop was estimated using the values described by Sainju (2017) (Equation 2.5). For R/C treatments and treatments with significant weeds presence, system nitrogen uptake/return was calculated using the totals of nitrogen in the different biomass components (Equation 2.6).

Equation 2.5

$$\begin{aligned} \text{Biological N fixation (kg ha}^{-1}\text{)} = \\ 0.7 \times 1.33 \times \text{total aboveground biomass N (kg ha}^{-1}\text{)} \end{aligned}$$

Equation 2.6

$$\begin{aligned} \text{Total aboveground biomass N (kg ha}^{-1}\text{)} = \\ \sum \text{fraction component (\%)} \times \text{component biomass (kg ha}^{-1}\text{)} \times \text{component nitrogen (\%)} \end{aligned}$$

Nitrogen outputs for our study include that removed in corn grain at harvest and denitrification losses from fertilizer inputs. Nitrogen removal from corn harvest was estimated using the relationships between grain N, yield, and nitrogen fertilization (Cerrato & Blackmer, 1990; Liang et al., 1996). The equation from Liang et al. (1996) was used to solve for grain nitrogen (Equation 2.7). The relationship between corn yield and grain nitrogen is linear, and the nitrogen rates in this study do not exceed those used by Liang et al. (1996) to develop this equation. Values were converted from Mg ha⁻¹ to kg ha⁻¹ before including in the nitrogen balance calculations.

Equation 2.7

$$\text{Grain N removed (Mg ha}^{-1}\text{)} = \text{Grain yield (Mg ha}^{-1}\text{)} + \frac{11.5}{1.43}$$

Fertilizer losses from direct and indirect gas emissions were estimated at 2% according to IPCC reports (IPCC, 2014) and align with calculations based on NO_x emissions reported by Preza-Fontes et al. in the same field under different cover crop treatments (Preza-Fontes et al., 2020) in the hot-humid continental climate.

A positive nitrogen balance value indicates that nitrogen remains in the field and was not removed by the grain. A negative nitrogen balance indicates a net nitrogen removal in the system by grain.

Statistical Analysis

Prior to analysis of variance (ANOVA), all data were tested for normal distribution and equal variances using the Shapiro-Wilk test ($P < 0.001$). Yield data from each phase, total system yield, corn development parameters, and nitrogen balance were analyzed using a randomized complete block design with split plot structure, with the fallow replacement treatment as the whole plot and the nitrogen fertilizer application rates as the split plots. We tested the main effects of and interactions between fallow replacement and nitrogen rate ($\alpha = 0.05$).

Two different ANOVAs were done for data with three complete years using SAS® software (SAS Institute Inc, Cary, NC) PROC GLIMMIX function, with year as a fixed and as a random variable. The plots were in a new location every year in the cycle, so year could be considered random, but variation in weather each year could significantly affect response variable outcomes. When considered as a fixed effect, year significantly accounted for the variation via interactions with nitrogen rate and fallow replacement treatment for all measured variables. However, there was no three-way interaction between year, fallow replacement, and nitrogen rate for any of the results. Additionally, the PROC CORR procedure was used to determine if there was a linear relationship between blooming date and grain yield.

Results and Discussion

Total System Yields

Total system yields had significant interaction effects of year by fallow replacement ($p = 0.0023$), year by nitrogen rate ($p < 0.0001$), and fallow replacement by nitrogen treatment ($p < 0.0001$). There was not a significant three-way interaction of the main effects ($p = 0.5029$).

Yields from the soybean and wheat phases, however, had a significant main effect of year only ($p > 0.0001$ and $p = 0.0023$, respectively). The DSB yields had no significant main effects of nitrogen rate ($p = 0.6588$) or year ($p = 0.0531$), although the year main effect was close to the $\alpha = 0.05$ used for the study. The corn yields had the same significant main effects and interactions as the total system yields ($p > 0.0001$), also without a three-way interaction of the main effects.

Year consistently influenced yield outcomes, but otherwise, the corn phase appeared to drive the entire system yield. For all three rotations, the yields for soybeans, wheat, and DSB remained relatively uniform, while corn response changed significantly dependent on nitrogen rate and fallow replacement (Figure 2.1). In general, the highest system yields resulted from CF and DSB treatments.

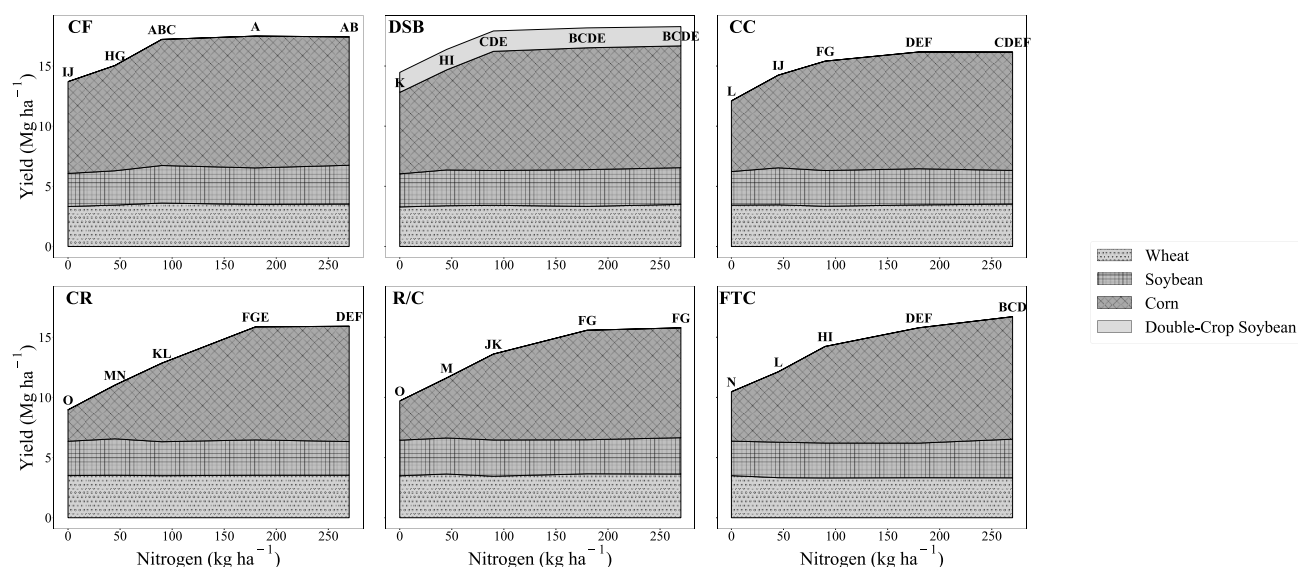


Figure 2.1 Cumulative yield response to nitrogen rate by fallow replacement treatment.

Double-crop soybean, wheat, and soybean yields were consistent in each treatment, but corn response varied significantly. Different letters indicate significantly different mean corn yield values across all treatments and years. CF – chemical fallow, DSB – double-crop soybean, CC – crimson clover monocrop, CR – cereal rye monocrop, R/C – rye/clover mixture, FTC – fall-t-cropper diverse mix.

Annual Weather Conditions

Variation in weather conditions throughout the cycle may explain the significant main effect of year, as well as the year interactions with fallow replacement and nitrogen rate in the corn and total yield response. When assessing the corn phases alone, the departures from normal differed throughout the fallow replacement (pre-corn) period to harvest over the three crop cycles (Table 2.2).

Table 2.2 Cumulative precipitation, average temperatures, and departures from normal compared to the 30-year average for different periods in the corn phase from post-wheat harvest through corn harvest.

Period	30-year average	2020 - 2021	Departure	2021- 2022	Departure	2022- 2023	Departure
June 1- Aug. 31	50.5	43.0	-7.5	21.7	-28.9	34.7	-15.8
Sept. 1 – Dec. 31	19.0	16.6	-2.3	19.9	0.9	18.5	-0.4

Precipitation (cm)	Jan. 1 – Apr. 30	16.7	17.6	0.9	8.9	-7.8	12.6	-4.0
	May 1 – June 30	24.1	17.7	-6.4	4.5	-19.5	16.7	-7.4
	July 1 – Sept 30	28.8	28.1	-0.7	23.3	-5.5	15.7	-13.1
Temperature (°C)	June 1– Aug. 31	19.3	25.3	6.0	25.5	6.2	25.3	6.0
	Sept. 1 – Dec. 31	10.0	10.2	0.2	12.8	2.8	10.1	0.1
	Jan 1 – Apr. 30	4.9	4.7	-0.2	4.2	-0.6	5.2	0.3
	May 1 – June 30	14.5	20.9	6.4	21.7	7.2	22.1	7.6
	July 1 – Sept. 30	17.3	24.8	7.5	24.4	7.1	25.7	8.4

In the June 1 – August 31 period in 2021-2022 and 2022-2023 seasons, precipitation departures from normal were -28.9 and -15.8 cm, respectively. These are greater departures than that observed during the same period in 2020-2021, which was only -7.5 cm. These greater departures from normal precipitation indicate that the corn crop in 2021-2022 and 2022-2023 started with considerably less moisture than normal, and this lack of moisture in the early season could explain annual differences in yield observed after the fallow replacement treatments versus the CF control.

Corn Yield Response

The interaction effect of year in the corn yield response explained the variation in fallow replacement effects over the three corn seasons. While there was no three-way interaction, nitrogen rate and fallow replacement combinations affected yield differently each year, although general trends were quite similar. Within fallow replacement treatments, yield increased as nitrogen rate increased (Figure 2.2). Yields across fallow replacement treatments were similar at the highest nitrogen rates. The CR and R/C treatments at 0 kg ha⁻¹ nitrogen consistently resulted

in the lowest yields, but the yield loss was remedied at 240 kg ha⁻¹ in 2021. The cover crop fallow replacement treatments, especially those with a grass component (cereal rye in CR and R/C, and both triticale and sorghum sudan in FTC) had significantly lower yields when 90 kg ha⁻¹ nitrogen or less was applied compared to CF or DSB treatments.

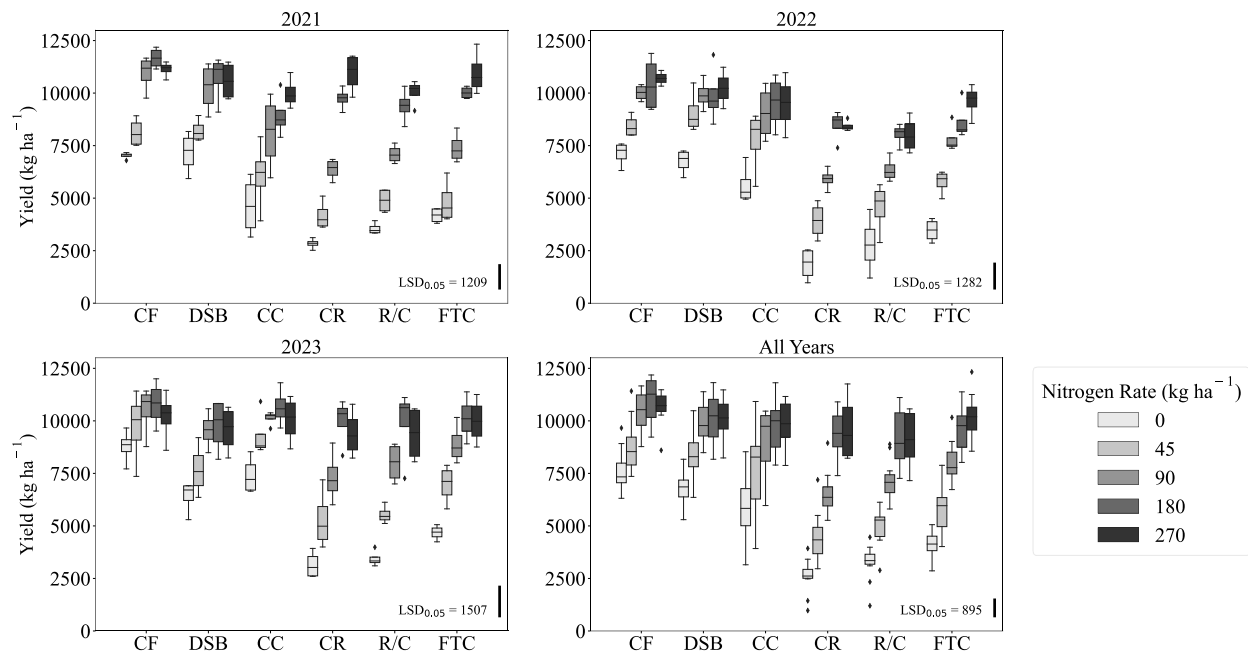


Figure 2.2 Yield response to nitrogen rate and fallow replacement treatment by year and results across years.

CF – Chemical Fallow, DSB- double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix. Least significant differences are noted as LSD at the bottom right of each graph at $\alpha = 0.05$. Black lines to the right of LSD represent the LSD value to scale.

Similar to our observations, yield decreases have been previously observed in corn following cover crops, particularly grass species, perhaps due their nitrogen scavenging nature (Kramberger et al., 2014; Salmerón et al., 2010; Vyn et al., 2000). The high C:N ratio of grass cover crop residue results in the need for additional nitrogen input to for tissue to decompose, resulting in slower breakdown and net nitrogen immobilization during the early decomposition phase compared to a legume (Sievers & Cook, 2018). Salmerón et al. (2010) found corn yield

decreases following two different grass cover crop species despite adequate water input via irrigation and high nitrogen inputs throughout the season. Similar results have been observed across the United States corn belt, where cover crops before corn resulted in, an estimated 5.5% yield losses, especially in regions with lower amounts of spring precipitation and high maximum temperatures during July, coinciding with approximate flowering dates (Deines et al., 2022).

The differences between years may be due to the differences in precipitation deviations from normal, especially during various critical periods in the corn phase. In the 2021-2022 corn phase, there was a high departure from normal for precipitation during the early growing season (May 1 – June 30). The departure from normal in this growing season was consistently negative for all periods except Sept 1 – Dec 31, where there was 0.9 cm more precipitation than normal (Table 2). There were also precipitation departures from normal throughout the 2022-2023 season. However, these departures were generally less than those in the 2021-2022 season. Cumulative precipitation was actually less in 2023 (60.8 cm) than in 2022 (73.4 cm) or 2021 (71.3 cm). The timing of the departures from normal in 2022, especially during the fallow before cover crop planting (June 1 – August 31) and during the early corn growing season leading up to R1 (May 1 – June 30), may have been the driver for significant annual differences in corn grain yield. These departures during the fallow period resulted in a lack of soil moisture that was never replenished throughout this season of the corn phase. High temperatures during the reproductive flowering period in conjunction with ongoing limited precipitation may explain yield reductions associated with all cover crops at low nitrogen rates. Overall, the presence of any cover crop resulted in a yield decrease across nitrogen rates. This could be a result of nitrogen immobilization by cover crops, which has been previously linked to subsequent corn yield decrease (White et al., 2016) and will be further discussed with nitrogen balance.

The general trend across years was that at the higher nitrogen rates of 180 and 270 kg ha⁻¹, yields plateaued regardless of fallow replacement treatment, with the exception of FTC which may have required higher nitrogen inputs to build the yield curve (Figure 2.3). This plateau response for most treatments indicated that nitrogen was no longer the limited resource in the system. Corn year 2022 was particularly dry (Table 2.1), and the corn yield response after the high biomass CR and R/C treatments was exaggerated compared to corn year 2021 (Figure 2.2).

Water use by the highly productive cover crops possibly reduced total stored soil water at corn planting, resulting in the observed yield losses. However, this contradicts some of the current literature regarding soil water dynamics after cover crops, which indicate improvements over time and limited impacts on grain yields (Basche et al., 2016; Chalise et al., 2019; Wang et al., 2021). Much of the current literature on soil-moisture dynamics following cover crops come from regions with different edaphoclimatic factors than Kansas, particularly the south and mid-Atlantic regions of the US.

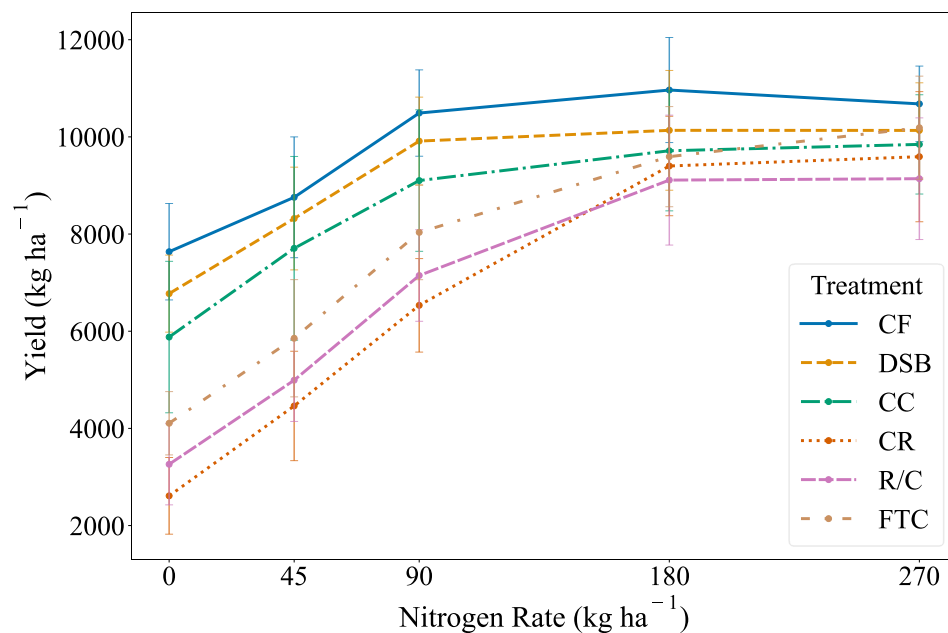


Figure 2.3 Corn yield response to nitrogen rate and fallow replacement treatment with year as a random effect.

Vertical lines on each datapoint represent standard error. CF – Chemical Fallow, DSB- double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix.

Generally, cover crops have been found to improve soil water dynamics in soils over time due to improved soil physical properties (Basche et al., 2016; Chalise et al., 2019). In a meta-analysis by Wang et al. (2021), it was similarly concluded that cover crop residue improved soil-water dynamics and did not impact the following crop yields or crop water use efficiency in general. This study gave big picture results from over 99 studies in both humid and semiarid regions, but it is not surprising that we are seeing conflicting results after cover crops in a single 3-year cycle within a long-term study. Perhaps, in normal precipitation years or after more than one crop cycle, we would see overall less of an impact of cover crops on corn yield. The annual precipitation in Riley County, KS is around 885 mm annually (Kansas State University Research and Extension, 2024), and there were varying degrees of limited precipitation every year of our

study (Table 1). An earlier meta-analysis by Marcillo and Miguez (2017) also found that cover crops did not result in reduced corn yields under proper management. It may also be that management changes such as earlier termination (timed with cover crop growth and development) may mitigate the negative impacts associated with cover crops on resulting corn yields. Perhaps a different placement of the cover crops in the rotation would be preferable in this wheat-corn-soybean rotation from a nitrogen management and yield perspective. It could be that planting grass-dominant cover crops after corn and before soybeans in our rotation would remove excess nitrogen that is otherwise left in the field and susceptible to nitrification, volatilization, or leaching. A recent study in Oklahoma determined that cover crops before soybeans had minimal yield impacts on grain yield (Rice et al., 2024). Planting cover crops before soybeans could be an improved option to intensify the system with lower risks related to nitrogen, although it is possible that moisture concerns would still persist in this situation.

Nitrogen Balance

Following the trend of the yield data, there was no significant three-way interaction between the effects of year, fallow replacement treatment, and nitrogen rate for nitrogen balance ($p = 0.4138$). Significant two-way interactions were observed between year, fallow replacement treatment, and nitrogen rate ($p < 0.0001$ for each of the three interaction terms), although trends were similar each year. The nitrogen balance following each treatment results in a similar pattern to that observed in the yield data, where nitrogen balance increases with increased nitrogen fertilizer inputs (Figure 2.4).

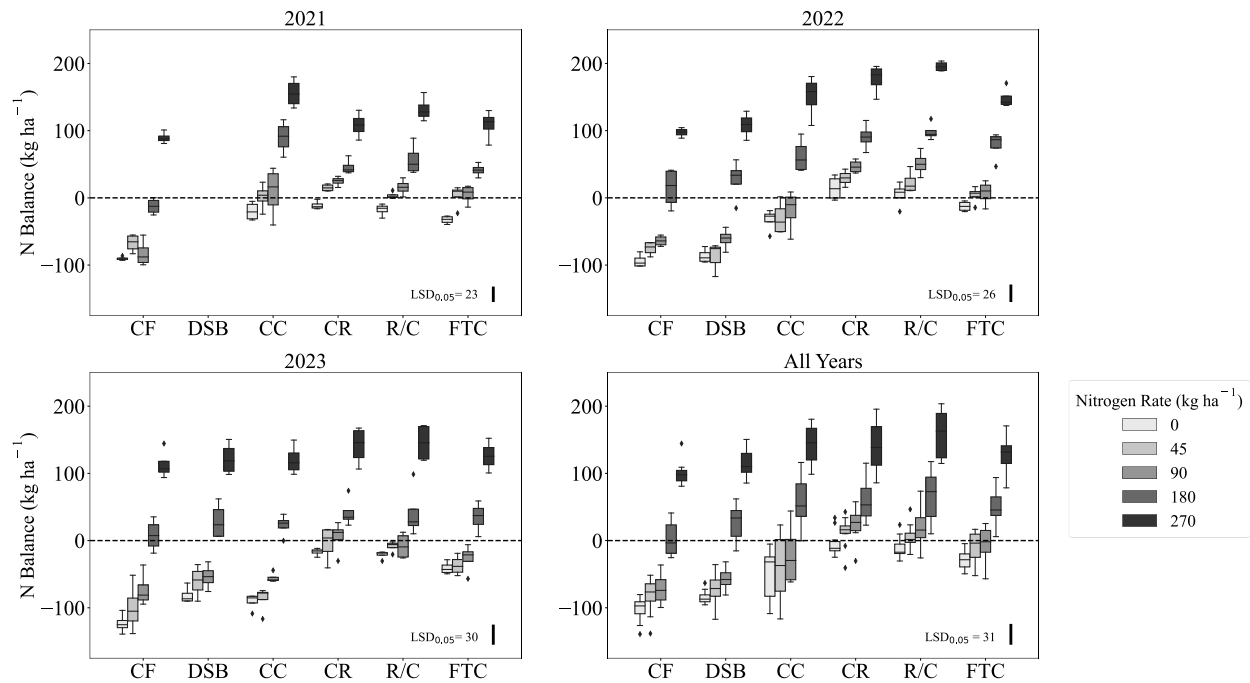


Figure 2.4 Nitrogen balance after corn and fallow replacement treatments each year and across years.

A dashed line at 0 represents a balanced system where inputs are equal to outputs. CF- Chemical Fallow, DSB – double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix. Least significant differences are noted as LSD at the bottom right of each graph at $\alpha = 0.05$, and accompanying black vertical lines visually represent LSD values. Samples were not taken in fall of 2020 for DSB.

Nitrogen balance calculations were mostly driven by nitrogen removal in the grain and nitrogen additions from the cover crop biomass, given that the other parameters such as volatilization estimates and nitrogen fertilizer were constant values within treatments. The CF, DSB, and CC (in 2022 and 2023) treatments with no fertilizer inputs resulted in negative nitrogen balance indicating that there was a net loss of nitrogen in the system after corn harvest. These treatments did not result in a positive nitrogen balance until 180 kg ha⁻¹ nitrogen was added. Alternatively, the other cover crop treatments had 0 or greater nitrogen balances without the addition of fertilizer, indicating those systems are balanced or leaving some amount of nitrogen in the field from the cover crop biomass. For all treatments, the nitrogen fertilizer rate of

270 kg ha⁻¹ resulted in high nitrogen balances, indicating that the corn crop did not remove the excess fertilizer via yields. This further supports the hypothesis that water may be the additional limited resource here.

Inorganic Soil Nitrogen

After DSB harvest and cover crop termination in the spring, inorganic nitrogen (NH₄⁺ and NO₃⁻) was highest in the CF treatment in both the 0-15-cm and 15-30-cm depths (Figure 2.5). All other treatments had significantly lower amounts of inorganic nitrogen prior to corn planting, including the DSB treatment. This supports the hypothesis that there was a nitrogen deficit in the fallow replacement treatments due to cover crop and DSB nitrogen uptake compared to CF. The corn in these plots started at a disadvantage compared to CF, and more nitrogen was needed to bring the soil back up to baseline CF nitrogen levels.

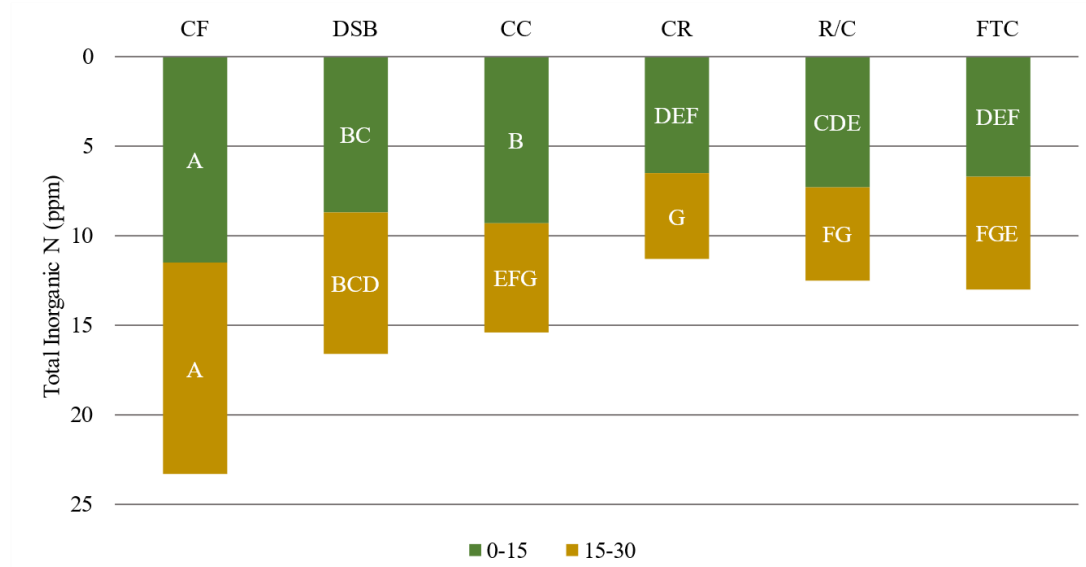


Figure 2.5 Inorganic soil nitrogen (ammonium and nitrate) after cover crop termination in the spring before corn planting from 0-15 and 15-30 cm depths.

CF- Chemical Fallow, DSB – double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix. Bar sections with the same letter are not significantly different at $\alpha = 0.05$.

Corn Growth and Development

Although water appears to be the most limited resource according to the corn yield curves and nitrogen balance data, evidence from the study suggested that nitrogen was limited in cover crop treatments during corn development. Flowering date, NDVI, and SPAD readings were affected by fallow replacement treatment and nitrogen rates.

There was a significant interaction between cover crop selection and nitrogen rate for days to bloom ($p < 0.0001$). Year was a significant main effect ($p < 0.0001$) and had significant interactions with both fallow replacement treatment ($p < 0.0001$) and nitrogen rate ($p < 0.0001$). However, there was not a significant 3-way interaction between year, fallow replacement treatment, and nitrogen rate. Trends were generally the same within years and across years, and differences in year were likely due to climatic variation across years. Chemical fallow generally resulted in earlier flowering dates than cover crop treatments, while high biomass cover crop treatments like CR and R/C had later flowering dates than low biomass treatments like CF and CC.

It was previously observed that high nitrogen rates are linked to delayed flowering time in rice (Zhang et al., 2021) and low nitrogen rates are linked to delayed flowering in sorghum (Roozeboom et al., 2023). In our study, corn that received lower nitrogen rates generally took longer to bloom than high rates across cover crop treatments. Our results are supported by previous evidence that low nitrogen application rates in corn results in longer anthesis-silking intervals, ultimately delaying flowering (Boomsma et al., 2009). Furthermore, there was no observed significant correlation between days to flowering and corn grain yield ($R^2 = 0.2$). The

trends of flowering date response to fallow replacement treatment and nitrogen rate were similar across years, but days to bloom were generally fewer in most treatments in 2022 compared to other years. Increased temperatures have been shown to shorten the period between sowing to silking in corn (Allison & Daynard, 1979), and the combination of drought stress and higher-than-normal temperatures in 2022 may be related to the quicker blooming that year.

While we did not measure tissue nitrogen in the growing corn crop, SPAD and NDVI data provide some insight into the nitrogen status of the crop because they are linearly correlated with crop nitrogen content (Rhezali & Aissaoui, 2021). At V5 in 2021, there was no nitrogen rate main effect or interaction for SPAD readings, but there was a significant main effect of fallow replacement treatment (Figure 2.6). The CR and R/C treatments had the highest SPAD readings at V5 of 44.6 and 44.4, respectively. All other treatments were significantly lower but not different from each other with readings of 41.9 for CF and 40.7 for both CC and FTC. The high C:N ratio of the ryegrass cover crop would typically decompose slower than the lower C:N legume monoculture (Jensen, 1997), and we would expect less nitrogen to be available in the CR and R/C treatments. Rather than being driven by nitrogen, it is possible that these results were driven by moisture. The physical coverage of the rye biomass may have resulted in reduced soil temperatures (Vieira et al., 2021; Yang et al., 2021), preserving soil moisture which made more favorable early-season growing conditions for the developing corn (Fortin & Edwards, 1994) which resulted in higher SPAD values at V5 after CR and R/C treatments. Nitrogen side-dress was applied at V5 around the time of NDVI, so only 40 kg ha⁻¹ was applied at planting to all but the 0 kg ha⁻¹ treatments at this reading. However, there is no nitrogen treatment effect at all, and perhaps the timing of this reading was too early to see any differences from nitrogen rate.

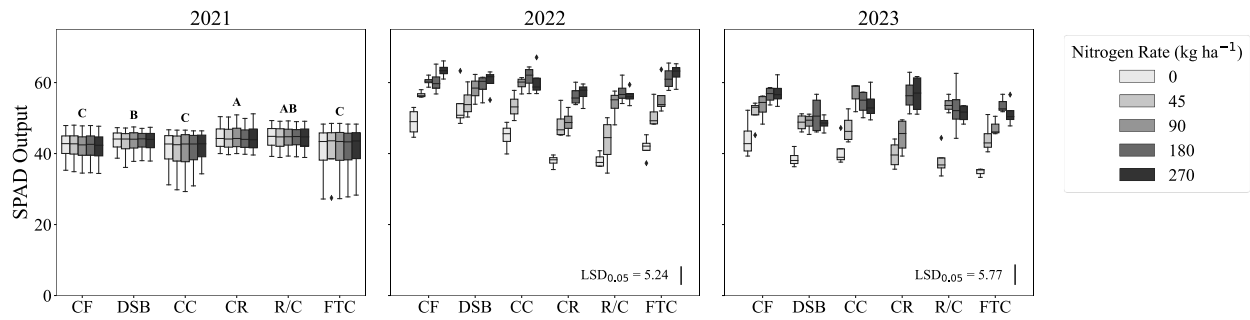


Figure 2.6 SPAD readings for 2021, 2022, and 2023.

Readings were done at V5 in 2021 when corn was vegetative and only the initial 40 kg ha⁻¹ was applied to all but the 0 kg ha⁻¹ treatments at this time. Fallow replacement treatments with the same letters are not statistically different in 2021, as there was only a main effect of fallow replacement treatment. There was no effect interaction of fallow replacement and nitrogen treatments in 2021. Readings were done at R1 in 2022 and 2023 when corn was flowering and side-dress balance nitrogen had been applied. The least significant differences are represented as LSD with a black vertical line as a visual representation of these values for 2022 and 2023. CF – Chemical Fallow, DSB – double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix.

At R1 in 2022 and 2023, there was a significant interaction between nitrogen rate and fallow replacement treatment. The response to nitrogen ramping in each treatment is very similar to what we see in the grain yield data, which is unsurprising as SPAD data can be used to predict yield outcomes (Rhezali & Aissaoui, 2021). These interactions were different each year, but generally CF and CC had the highest SPAD readings of both years across all nitrogen rates (Figure 6). Higher SPAD values in the CF and low biomass CC treatments support the hypothesis that higher biomass grass cover crops may indeed be scavenging nitrogen in the field (Fageria et al., 2005; Rannells & Waggar, 1997; Williams et al., 2018) but not releasing it in time for the subsequent cash crop to use. Additionally, the SPAD readings appear to plateau around 180 kg ha⁻¹ nitrogen as yield did, indicating that nitrogen may not be the only limitation. Corn years 2022 and 2023 had 5.5 and 13.1 cm precipitation departures from normal respectively

(Table 2), and these moisture trends can be seen in the SPAD data as overall decreased values in 2023 (Figure 6).

Similar to the SPAD data, the NDVI response from 2021 had a significant interaction effect of fallow replacement treatment and nitrogen rate ($p < 0.0001$). In 2022, there were only significant main effects of fallow replacement treatment and nitrogen rate ($p < 0.0001$ for both) and no interaction effect ($p = 0.1045$). Similar nitrogen response curves are observed in NDVI data as SPAD and yield (Figure 2.7).

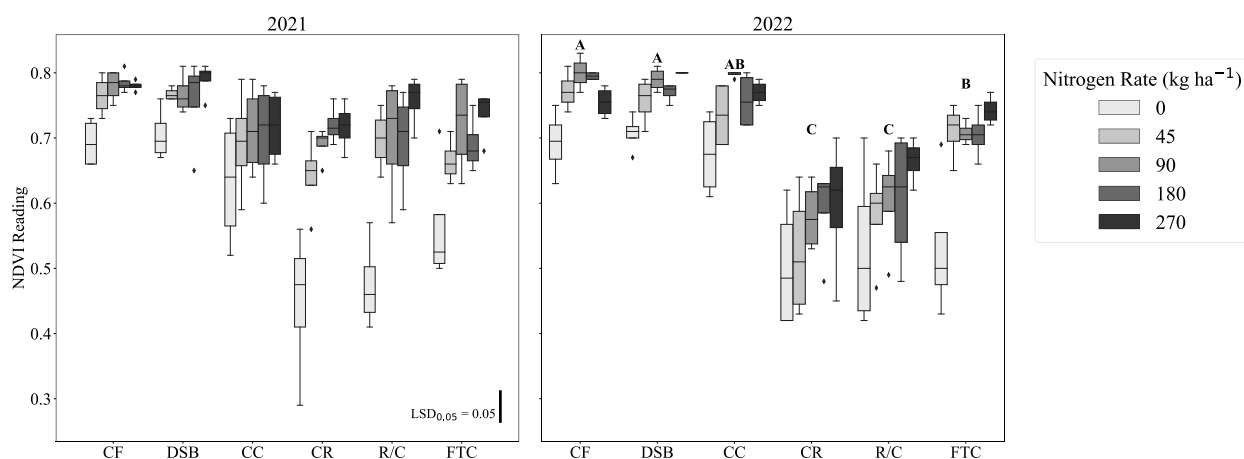


Figure 2.7 NDVI readings for 2021 and 2022.

Readings were done at R1 in 2021 and 2022. The least significant difference (LSD) for 2021 at $\alpha = 0.05$ was 0.05, and the black vertical line next to the LSD on the graph represents this value to scale. Fallow replacement treatments in 2022 with the same t-grouping letter are not significantly different. CF- Chemical Fallow, DSB – double-crop soybean, CC – Crimson Clover, CR – Cereal Rye, R/C – Rye/Clover Mix, FTC – diverse multispecies mix.

In 2021, the high biomass treatments (CR, R/C, and FTC) have significantly lower NDVI readings at the 0 kg ha⁻¹ nitrogen check. As nitrogen was added in these treatments, they started to more closely compare with the CF, DSB, and CC values (Figure 7). In 2022, NDVI response to nitrogen rate increased up to 90 kg ha⁻¹ and plateaued at rates above. The CF, DSB, and CC treatments had the highest NDVI readings, FTC readings were not different from CC, and the

two treatments with cereal rye had the lowest readings (Figure 2.7). Field measurements from NDVI are directly correlated to canopy cover (Tenreiro et al., 2021), so we could presume in our data that the NDVI response to applied nitrogen parallels an increase in corn canopy coverage with increased fertilizer nitrogen across fallow replacement treatments. Canopy coverage has been shown to be positively correlated with corn grain yield (García-Martínez et al., 2020), and limited differences were observed in daily evaporation in dryland corn with and without straw residue when the crop canopy was present (Todd et al., 1991). The decreased corn canopy coverage after high biomass CR, R/C, and FTC cover crop treatments could explain some of the yield losses observed in these treatments, but there is a gap in the literature on soil-water dynamics in regions prone to drought or precipitation deficits that raises more questions about the use of stored soil moisture by cover crops prior to corn planting. Even if another nutrient is ultimately the limitation, evapotranspiration cannot occur without sufficient moisture, and the limitation of water would ultimately lead to limitation in other nutrients available in the soil (Allen, 2000).

For all the SPAD and NDVI data, it is important to note that each of these results only covers one year of data, limiting the robustness of each dataset. While there is not enough information in a single year to make a highly confident claim on the effects of nitrogen application rate and fallow replacement treatments on these variables, the outcomes support the hypothesis that nitrogen may be immobilized in the cover crop treatments and not released in time for the corn to use, limiting their nitrogen status throughout the growing season.

Conclusion

Cycle 5 of the long-term cover crop study in Ashland Bottoms was analyzed looking at the nitrogen and fallow replacement treatment legacy effects on following crop yields. Only the

corn crop immediately following the fallow replacement treatment was affected by fallow replacement strategy and in-season nitrogen application rate. The following yields of the soybean and wheat phases in the rotation were unaffected by these treatments, and all variation for those yields was attributed to annual weather. Although corn yields also varied by year, the general trend observed was that high biomass grass cover crops limited nitrogen the most in the system, resulting in a need for increased fertilizer rates. Low biomass cover crops and the DSB economic alternative performed similarly and often comparably to the CF treatment. Nitrogen status of the growing corn plants was evidently impacted by an interaction effect of the fallow replacement strategy and nitrogen fertilizer application rate. However, nitrogen does not appear to be the only limiting resource in our study, as plateaus in yield response to nitrogen rate after cover crop fallow replacement treatments suggest that most treatments reached their maximum yield potential within the ramped nitrogen rates. If nitrogen were the main limitation, the yield response curves would continuously increase rather than reach a plateau. Where the seasonal precipitation was much lower than the 30-year normal in some stages, it is possible this other limiting resource was moisture. The fallow replacement treatments were likely missing out on some of the stored soil moisture that persisted in the CF treatments during periods of precipitation deviations lower than normal which ultimately affected corn yield outcomes.

Planting a cover crop before corn in rainfed systems where precipitation can be variable and quite limited may not always be ideal in terms of nitrogen, and probably also water, dynamics. Due to the nitrogen scavenging nature of grass cover crops, their high C:N ratio limit the nitrogen released in time to benefit a subsequent corn crop. Drier conditions observed within our study would not favor rapid cover crop decomposition and nitrogen mineralization. Moisture use concerns around cover crops may be valid, as they are using water that may otherwise be

stored during a fallow period. Nonetheless, incorporating a fallow replacement strategy may improve water use efficiency in the overall system, as other studies have shown in the region. Furthermore, moisture and nitrogen immobilization concerns could be mitigated by earlier termination of cover crops before corn. Future directions of our studies in the drier regions of the US should be looking for alternative periods in our crop rotations to add cover crops that will not present such a yield risk or increase nitrogen fertilizer application needs in cash crops.

As a cash crop alternative to intensify the rotation, DSB treatments often resulted in comparable grain and overall yields to the CF treatment. Further study on this cycle would look into the economics of DSB in the rotation, but from an agronomic perspective the evidence suggests that there was little effect on the corn crop following DSB most years. Of course, the DSB still used moisture during the otherwise summer fallow period, which could result in reduced yields in the following crop if precipitation is not replenishing the soil sufficiently. However, of the intensification strategies presented to replace fallow periods before corn, DSB was ultimately the best choice for yield outcomes. The concern with selecting DSB instead of a cover crop is the lack of winter coverage after DSB harvest. Part of the benefit of intensification is keeping roots in the soil and biomass above to prevent erosion and improve water infiltration. With DSB harvest in November in Kansas, the soil is left exposed (perhaps more than CF due to increased disturbance with DSB operations) until corn planting in late spring.

Shortening fallow periods in crop rotations is generally considered a good strategy to improve soil health indicators, prevent erosion, increase water use efficiency, and improve rotation yields. However, farmers in Kansas may need to take a dynamic approach to their strategies, having flexibility between years to plan according to weather conditions and economics of nitrogen fertilizers. Years with greater early season moisture could be intensified

with a DSB after wheat that would intensify the system and use that moisture to produce a profitable soybean yield. In drier years, it may be better to plant a summer cover crop after wheat that is terminated early, like the late-maturing soybean presented by Preza-Fontes et al. (2017), which would be planted in July and terminated in October. The late maturing soybeans in this study resulted in statistically similar yields to those from the CF treatment. Farmers interested in using grass cover crops for soil coverage and intensification may consider placing them in an alternative part of the rotation, perhaps between corn and soybeans. Future economic analysis of this cycle will give more insight into the cost of these fallow replacement options and help farmers decide which strategy will work best for their operation and how they can plan by year to incorporate different strategies to optimize their system yields while protecting their soil.

Data Availability Statement

Data from this study is available in appendix A. Select data is available in the USDA Ag Commons.

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Chapter 3 - Agronomic and ecological effects of delayed termination of a cereal rye cover crop before corn in northeast Kansas

Abstract

Several sustainability goals may be achieved by planting cover crops, for instance, cover crops promote soil health by keeping live roots in the soil and providing a physical mat of protection against geophysical forces that contribute to erosion. Although cover crops in Kansas are typically terminated 2-4 weeks prior to cash crop planting, there may be situations where late-burndown or planting into a living cover crop may be necessary or even beneficial. This experiment investigated the effect of cereal rye (*Secale cereale*) cover crop termination date on corn development and grain yield, weed dynamics, and the presence of beneficial and problematic insects. Three different termination dates were tested – 4 weeks prior to planting (early), 3 days prior to planting (late), and at planting (green), as well as a check treatment with no cover crop planted. Insect assessments did not indicate a significant effect of termination timing on beneficial insects. There were significant yield losses observed in cover crop treatments some years, especially where corn was planted green. Cover crop biomass in 2022 was 64% lower than what was observed in 2021, and cover crop biomass in 2023 was 84% lower than in 2021. The control and early termination treatments resulted in significantly higher yields than the late and green treatments in 2022, but only the green treatment resulted in significantly reduced grain yields in 2021. The late termination and planting green treatments resulted in a 1.38 and 3.75 Mg ha yield penalty in 2021 and 2022, respectively. In 2023, corn grain yields were not statistically different between treatments, and the average yield in 2023 was 32% lower than the highest yields in 2021. Overall cereal rye biomass was lowest in 2023, which may

explain the lack of treatment effect. Corn root biomass was significantly affected by cereal rye termination timing, with the lowest values in planting green plots. Yield losses after planting green may be attributed to increased seedling disease, immobilization of soil nitrogen, and stored soil water uptake by the living cereal rye cover crop. Despite observed yield losses, the late terminated cover crops did significantly decrease weed biomass in the system. Weed biomass was 50% and 75% less than the no cover control in the late terminated and planting green plots, respectively. Delaying cereal rye termination before corn has some usefulness for integrated weed management, but the herbicide cost offset for weed control would need to be economically advantageous to make the practice worth the potential yield losses.

Introduction

Cover crops continue to be used and studied for the role they play in building climate-resilient agricultural systems. Cropping systems in the Midwest with cover crops incorporated into the rotation have been reported as more resistant against losses due to extreme weather events (Aglasan et al., 2022). Evidence continues to support that cover crops offer a variety of soil health benefits that result in these more resilient systems. For example, cover crop residue has been found to increase soil organic carbon, improve water storage, and occasionally increase yields (Chalise et al., 2019; Fageria et al., 2005). However, cover crops can take up more soil moisture during their growing season, resulting in dryer soils compared to no-till fallow (Kelly et al., 2021). Generally, cover crops are beneficial for improving soil biological health indicators, reducing soil erosion, and reducing soil bulk density, contributing to better functioning soils in the long run (Koudahe et al., 2022).

In addition to their reputation for building soil health, cover crops can also be a part of integrated weed management strategies. Cereal rye (*Secale cereale*), for example, is both a high-

biomass cover crop that competes with weeds (Fernando & Shrestha, 2023) and exhibits allelopathic effects to inhibit weed seedling emergence. Allelopathic chemicals from cereal rye and barley (*Hordeum vulgare*) were reported to suppress the emergence of yellow foxtail (*Setaria pumila*) by up to 90% (Creamer et al., 1996). The high-biomass output of cereal rye has been reported to significantly outcompete weed species in agroecosystems (Mirsky et al., 2013; Saini et al., 2006). A meta-analysis by Dong and Zeng (2024) report that cover crop mixtures perform better in regards to weed suppression than monocultures. These results are contrary to those reported by Baraibar et al. (2017), which indicate there is no significant difference between mixtures so long as they contained cereal rye. Including a prolific grass species in a mix, even at a lower seeding rate, can provide sufficient biomass to outcompete weed seedlings (Baraibar et al., 2017).

General recommendations for cover crop termination are based on normal precipitation and local soil conditions (USDA-NRCS, 2019). If desired, increased cover crop biomass can be achieved by delaying termination (Acharya et al., 2022; Almeida et al., 2024; Clark et al., 1994), although in some conditions this may not be the case (Wayman et al., 2014). Delaying termination with the goal of increased biomass has the aforementioned weed suppression benefits. However, sufficient biomass could be grazed to economically offset the cost of growing cover crops. Grazing cover crops generally does not affect cash crop yields (Blanco-Canqui, 2023) and can be a synergistic component of building resilient agricultural systems over time (Prairie et al., 2023).

As opposed to intentional delay of cover crop termination, there could also be situations where delayed termination is necessary, such as in a wet year when field operations are not feasible and could cause serious damage. Whatever the reason for delayed termination, there are

documented risks and hypothesized benefits to this management decision. Planting green, or planting into a living cover crop, has some of the greatest risks. Studies from the Midwest report increased instances of seedling diseases when planting corn (*Zea mays*) into a living cereal rye cover crop, especially *Pythium* (Acharya et al., 2022; Almeida et al., 2024). Additionally, higher residue cover is linked to decreased soil surface temperatures (Shen et al., 2018; Yang et al., 2021), so while cover crops may shade out potential weed competitors, they may also be limiting the emerging cash crop. There is a risk for yield loss in planting green treatments, due to either water restrictions, nitrogen immobilization, or seedling disease (Acharya et al., 2022; Almeida et al., 2024; Correira et al., 2023).

Alternatively, there are some ecological considerations for planting green. For example, Le Gall et al. (2022) found that delayed cereal rye termination resulted in increased biomass that served as a food source for slugs, ultimately deterring them from feeding on and damaging young corn plants. However, the cover crop biomass does not necessarily provide more habitat for beneficial insects, as undisturbed no-till is sufficient for supporting predatory insects that should feed on some agricultural pests (Rowen & Tooker, 2021).

Cover crop management is extremely site-specific, and there is a need for more research on the outcomes of delayed termination of cover crops in different climate and soil conditions. The goal of this research was to assess the risks and potential ecological benefits of planting corn into a late terminated cereal rye cover crop. Specifically, we wanted to address corn growth and development, grain yields, weed suppression, and both beneficial and problematic insect activity after different cereal rye cover crop termination timings before corn in a corn-soybean rotation in northeast Kansas.

Materials and Methods

Site description

This experiment took place just outside of Junction City, Kansas in a corn-soybean (*Glycine max*) rotation. Specifically, the plots were located at 39° 3'N, -96° 41'W in 2021 and 2023 and at 39° 1'N, -96° 41'W in 2022. Both sites were managed under no-till for the duration of the experiment. The site change in 2022 was to follow the corn phase of the rotation, which cycled back to the original site in 2023. The plots were on a Reading silt loam (Fine-silty, mixed, superactive, mesic Pachic Agiudoll) in 2021 and 2023 and on a Kahola silt loam (Fine-silty, mixed, superactive, mesic Cumulic Hapludoll) in 2022.

Cereal rye and corn management

The cereal rye cover crop was drilled corn at a seeding rate of 67 kg ha⁻¹ with a John Deere 1590 no-tillage drill set to 15-cm row spacing (Deere & Co., Moline, IL) in mid or late October each year after soybeans and prior to. Termination timing treatments included early termination (~2 weeks before planting corn), late termination (~1 week before planting corn), and planting green (cover crop terminated at or shortly after corn planting), and a check treatment with no cover crop (Table 3.1). Cereal rye was terminated with glyphosate. Treatments were replicated four times and arranged in a randomized complete block design. Each plot was 12 by 15 m in dimension, enough to fit 16 corn rows or four planter passes with 76-cm (30-in) row spacing. Replicates were separated with 4.5-m alleys.

Table 3.1 Summary of field operations from 2020-2025 starting with the first cereal rye cover crop planting in 2020 and ending with final corn harvest in 2023

Operation	2020-2021	2021-2022	2022-2023
Cereal Rye			
Variety	Ryman	Dillon	Dillon
Planting date	Oct. 18, 2020	Oct. 21, 2021	Oct. 26, 2022

Early termination	Apr. 15, 2021	Apr. 14, 2022	Apr. 14, 2023
Late termination	Apr. 24, 2021	Apr. 24, 2022	Apr. 21, 2023
Planting green termination	May 6, 2021	May 5, 2022	Apr. 27, 2023
Corn			
Hybrid	P1548YHR	NK1103-3111A	NK1103-3111A
Seeding rate (seeds ha ⁻¹)	69000	67000	69000
Planting date	May 1, 2021	Apr. 22, 2022	Apr. 24, 2023
Harvest date	Sept. 11, 2021	Sept. 30, 2022	Sept. 8, 2023

Just before cereal rye termination, above-ground biomass was sampled from four randomly placed 0.25-m quadrats in each plot. Samples were dried to a constant weight at 60 °C and weighed for dry biomass. In 2022 and 2023, biomass samples were analyzed for carbon and nitrogen using a LECO TruSpec CN combustion analyzer (LECO Corporation, St. Joseph, MI) (Appendix D).

Corn was planted in late April or early May each year (Table 3.1), and nitrogen fertilizer was applied at planting as 28% urea ammonium nitrate applied with a flat-coulter fertilizer applicator at a rate of 157 kg ha⁻¹. Note that the corn seed planted in this experiment was treated only with a fungicide seed coating. No insecticides were used for this study.

Corn stands and vigor were manually monitored around the V3 stage. When 50% of the plants in the check plots reached V3, stand counts were taken from a 5-m center section of three random rows in each plot. The number of plants at least one growth stage behind was also noted. Also, at V3, five seedlings from the centers of rows 5 and 12 were completely excavated and brought to the lab to determine shoot height from each plant. Seedlings were then separated into shoots and roots and dried to constant weight at 60 °C. Roots and shoots were composited by plot and row and weighed. At V5, aboveground weed biomass was collected from four randomly placed 0.25-m quadrats in rows 1 through 4.

Mature plants were manually monitored for stalk rot at R6. Three consecutive plants in rows 5 and 12 were cut at the ear level to remove the ear and above stover. The remaining stalks were cut down the middle to the crown. Total counts of nodes and internodes were taken, as well as number of nodes and internodes colored brown indicating stalk rot. A stalk rot index was determined by dividing the number of rotted nodes and internodes by the total number of nodes and internodes.

Grain yield was determined via hand harvest of 5-m sections of center two rows in each plot, which each are representative of one planter pass. Grain moisture was determined using a moisture meter (Model GAC 2000, DICKEY-John Corp., Springfield, IL), and moisture was normalized to 15% for yield calculations.

Insect activity

Early season insect activity was determined at V3 alongside the stand and vigor assessments and again at V5. An insect damage index was calculated by dividing the number of damaged plants by the total number of plants in a given 5-m section that was used for corn stand. Results are presented for 2022 and 2023. Insect damage was identified to be from stink bugs (*Halyomorpha halys*), armyworms (*Spodoptera frugiperda*), or black cutworms (*Agrotis ipsilon*).

Sentinel prey assays were done at three different corn development stages (when 50% of the plants in check plots reached V3, V5, and R1) according to the procedure described by Rowen and Tooker (2021). Waxworms (*Galleria mellonella*) were pinned to freshly molded 2.5-cm diameter clay balls for deployment into the plots. At 20:30 the first day, one pinned worm was deployed and covered with a mammal exclusion cage at 4.5, 7.5, and 10.5 m from the edges of rows 6 and 11 of each plot. At 8:30 the next morning, each deployed set-up was monitored for

evidence of predation, either a partial or missing worm. Without removing or replacing any deployment set-up, the worms were monitored again at 20:30 and all set-ups were removed from the field. Results presented are reflective of predation through the entire day.

Statistical analyses

Prior to analysis of variance (ANOVA), all data were tested for normal distribution and equal variances using the Shapiro-Wilk test ($P < 0.001$). For each ANOVA, we tested the main and interaction effects of termination treatment and year ($\alpha = 0.05$) using SAS® software (SAS Institute Inc, Cary, NC) PROC GLIMMIX function. Because the plots cycled back to the original site in the third year, and there was considerable variation in the annual weather, it was decided to consider year a fixed effect.

Results and Discussion

Annual temperatures and precipitation

Daily temperature and precipitation varied throughout the three growing seasons of this study (Figure 3.1). Cumulative precipitation during the cereal rye growing season, from October

to April, was 276.32, 198.07, and 268.23 mm for the 2020-2021, 2021-2022, and 2022-2023 seasons respectively.

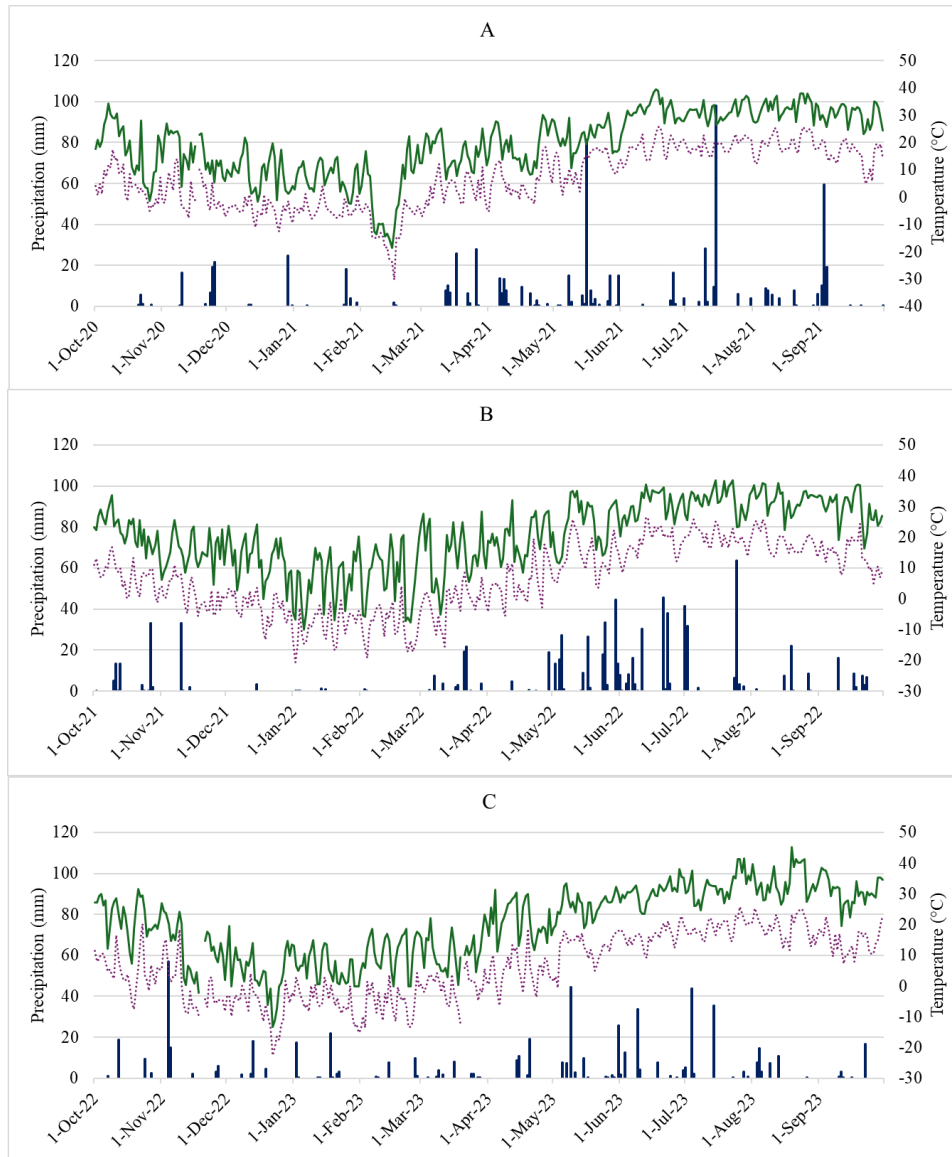


Figure 3.1 Daily precipitation and maximum and minimum temperatures from October through the following September in 2020-2021 (A), 2021-2022 (B), and 2022-2023 (C).

The 30-year normal total precipitation for the cereal rye growing season (October to April) and the corn growing season (April to August) were 290 and 541 mm respectively. During the cereal rye growing season, the cumulative precipitation was 247 mm (-43 mm from normal),

200 mm (-90 mm from normal), and 247 mm (-43 mm from normal) for 2021, 2022, and 2023, respectively. During the corn growing season the cumulative precipitation was 431 mm (-110 mm from normal), 578 mm (+37 mm from normal), and 364 mm (-177 mm from normal) mm for 2021, 2022, and 2023 respectively. The 30-year normal average temperature for the cereal rye growing season and the corn growing season were 5.6 °C and 21.4 °C, respectively. Average temperatures for the cereal rye growing seasons were 5.9 °C (+0.3 °C from normal), 6.6 °C (+1.0 °C from normal), and 5.8 °C (+0.2 °C from normal) for 2021, 2022, and 2023 respectively. Average temperatures for the corn growing seasons were 21.6 °C (+0.2 °C from normal), 21.9 °C (+0.5 °C from normal), and 22.2 °C (+0.8 °C from normal). The limited precipitation during the cover crop season in 2021 and during the corn season in 2023 could explain the observed significant main effect of year on several response variables.

Cover crop and weed biomass

Cover crop biomass was not normally distributed, so values were log transformed to normalize the data. The treatment by year interaction effect was significant ($p = 0.0040$), so results will be further discussed by year. Generally, cereal rye biomass was the greatest in 2021 and increased with delayed termination in all three years (Figure 3.2).

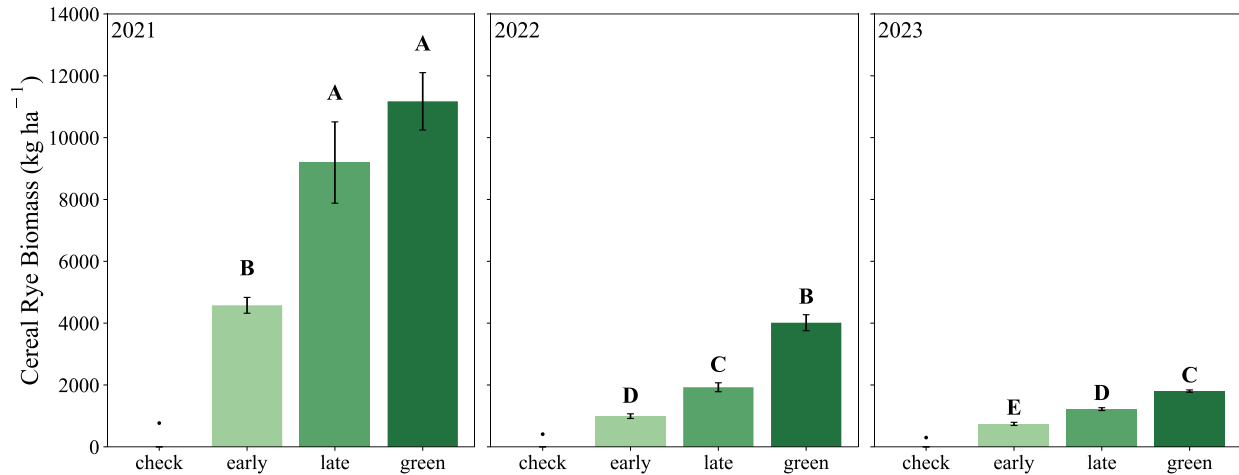


Figure 3.2 Cereal rye biomass by termination timing in 2021, 2022, and 2023.

Different letters above bars indicate significantly different mean values across all years. Termination timing treatments were check – no cover crop; early – 2 weeks before planting; late – 1 week before planting; green – at planting.

With more time to grow, cereal rye biomass was significantly higher in treatments with delayed termination. This is consistent with previous termination timing studies. Almeida et al. (2024) found that delayed termination in cereal rye in eastern Nebraska resulted in greater biomass production dependent on year. Other cover crop termination timing studies present similar results to support that delayed termination results in significantly more cover crop biomass (Acharya et al., 2022; Clark et al., 1994).

In 2023, cereal rye biomass was generally lower than in 2021 and 2022, with the planting green treatment averaging only 1800 kg ha⁻¹ biomass compared to 4100 and 11,170 kg ha⁻¹ biomass in the same treatment in 2022 and 2021, respectively. This is likely due to the aforementioned differences in precipitation during the cereal rye growing season each year and the closer termination timings in 2023 compared to other years.

For weed biomass at V5, only termination timing treatment was a significant main effect ($p = 0.0167$). Year was not a significant main effect ($p = 0.0859$), and the year by treatment

interaction was not significant ($p = 0.8215$). Therefore, the results for weed biomass were assessed across years. On average, weed biomass was greatest in the check and early termination treatments, the late termination was not different from the early or planting green treatments, and the planting green treatment had the lowest average weed biomass (Figure 3.3).

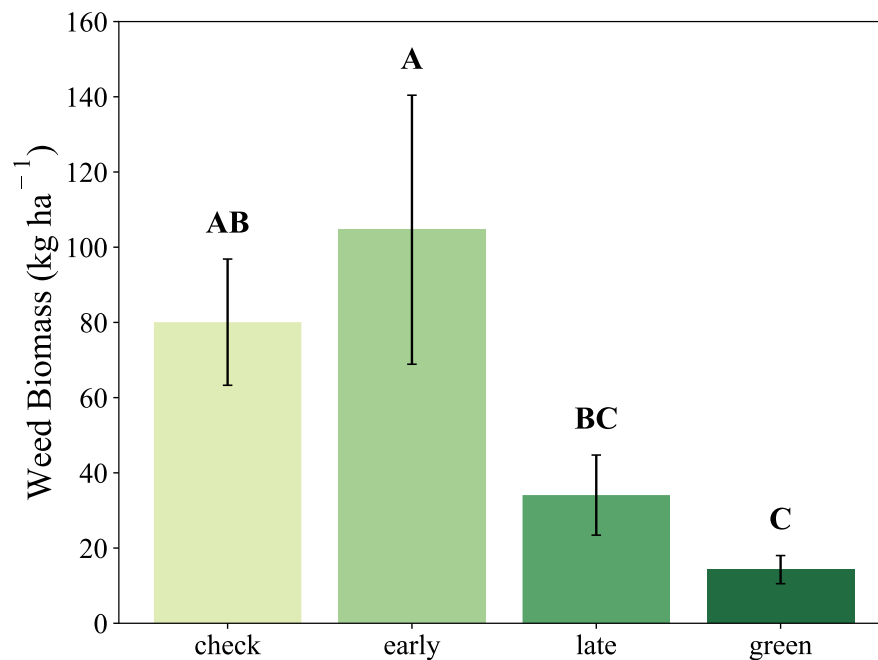


Figure 3.3 Average weed biomass in each cereal rye termination timing treatment.

Different letters indicate statistically different average weed biomass values. Termination timing treatments were check – no cover crop; early – 2 weeks before planting; late – 1 week before planting; green – at planting.

As cover crop termination timing was delayed and cereal rye biomass increased, there was enhanced weed suppression. Generally, cover crops have been found to provide early season weed suppression comparable to that of mechanical and chemical control options (Osipitan et al., 2018). Cereal rye, specifically, has been shown to inhibit weed emergence by more than 75% when biomass exceeded 8000 kg ha⁻¹ (Mirsky et al., 2013). This level of biomass was achieved in late termination and planting green treatments in 2021 in the current study (Figure 3.2), and in general the additional biomass coverage in later terminated cover crop treatments enhanced weed

suppression. Interestingly, the early terminated cereal rye treatment was not significantly different in terms of weed suppression than the no cover check (Figure 3.3). Perhaps in this case, biomass was not sufficient to shade or outcompete weeds in this treatment, as the biomass in 2021 was just over 4000 kg ha⁻¹ and was less than that in 2022 and 2023. Cereal rye was planted in October each year following soybeans, which is within the timeframe specified by NRCS code 340 for cool-season cover crop planting. However, cereal rye can be broadcasted into soybeans pre-harvest to give more time for the cover crop to grow before winter dormancy. A study from South Dakota concluded that while pre-harvest broadcast or post-harvest drilling of cover crops in/after corn did not result in differences in spring biomass, there was greater cover crop biomass observed when covers were broadcasted over soybeans compared to post-harvest drilling (Klopp et al., 2024).

Corn development and yield

Cereal rye termination timing treatment did not significantly affect corn seedling stands at V3 ($p = 0.2063$). Only year was a significant main effect ($p < 0.0001$), with significantly different stand counts every year. The greatest stands were in 2021 with 69 plants per 1/1000 ha, followed by 2023 with 56 plants per 1/1000 ha, and the lowest stands in 2022 with 52 plants per 1/1000 ha. Year was also the only significant main effect on seedling vigor, with a greater proportion of seedlings at least one growth stage behind V3 in 2021 and 2022 compared to 2023 (22%, 19%, and 11% for 2021, 2022, and 2023 respectively). In a similar termination timing study in Nebraska, they found that corn seedlings in delayed cereal rye termination treatments were developmentally ahead of other treatments in the first year but developmentally behind in the subsequent year (Almeida et al., 2024). Similarly, Acharya et al. (2022) found a significant effect of cereal rye termination timing on seedling vigor in one year of their two-year study,

where the control and early termination treatments had more developed plants than the delayed termination treatments. The annual differences in vigor could be linked to the differences in soil temperature. Corn emergence and vigor is influenced by soil temperature, where seedlings grown at higher temperatures emerge faster (Egli & Rucker, 2012). Drilled cereal rye cover crops in no-till systems have previously shown to reduce soil temperatures during the spring season compared to no-till soil with chopped barley (*Hordeum vulgare*) residue only (Goettl et al., 2025). The overall greater cereal rye biomass in 2021 and 2022 compared to 2023 (Figure 3.2) may have resulted in reduced soil temperatures in the cover crop treatments resulting in decreased vigor in those years, as more cover crop residue can decrease shallow soil temperatures by 0.24 °C for every Mg ha⁻¹ biomass (Yang et al., 2021). However, there was no effect of treatment on seedling vigor that would suggest surface soil temperature differences between treatments. Alternatively, the main effect of year on vigor may have resulted from annual weather differences. Although we did not take soil moisture measurements in this study, it could be inferred that the different treatments did not result in soil moisture differences, similar to what was reported by Goettl et al. (2025).

There was a significant year by termination treatment interaction ($p < 0.0001$) for the V3 seedling shoot height. In 2021, the check plot had the tallest seedlings, but in 2022 and 2023 corn growing in early terminated cereal rye was not significantly shorter than that grown into no-till without a cover crop (Figure 3.4). In 2022 and 2023, planting into green cereal rye significantly reduced seedling shoot height (Figure 3.4).

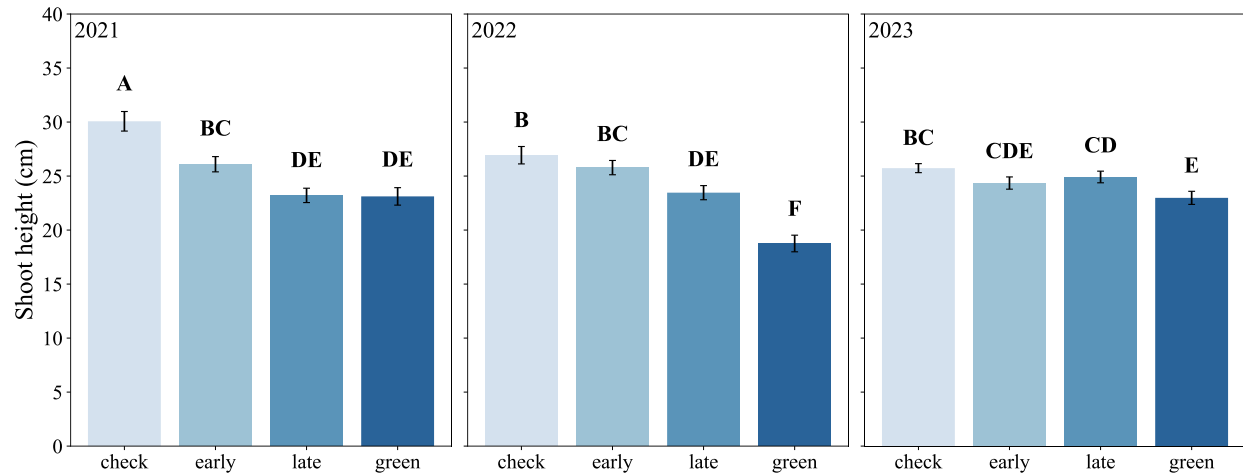


Figure 3.4 Corn seedling shoot heights at V3 following different cereal rye cover crop termination timings in 2021, 2022, and 2023.

Different letters above bars indicate significantly different mean values across all years. Termination timing treatments were check – no cover crop; early – 2 weeks before planting; late – 1 week before planting; green – at planting.

This is contrary to what has been presented by Acharya et al. (2022), where they found an increase in seedling height when cereal rye was terminated 6 or 12 days after planting compared to corn seedlings planted in cereal rye residue that was terminated 17 days before planting.

There was also a significant interaction effect of year and termination timing on both root ($p = 0.0216$) and shoot ($p < 0.0001$) biomass. There was a general pattern of shoot biomass decreasing after cereal rye in 2021 and 2022 and an observed decrease in root biomass after any cereal rye cover crop in 2021, and only after planting green in 2022 (Figure 3.5).

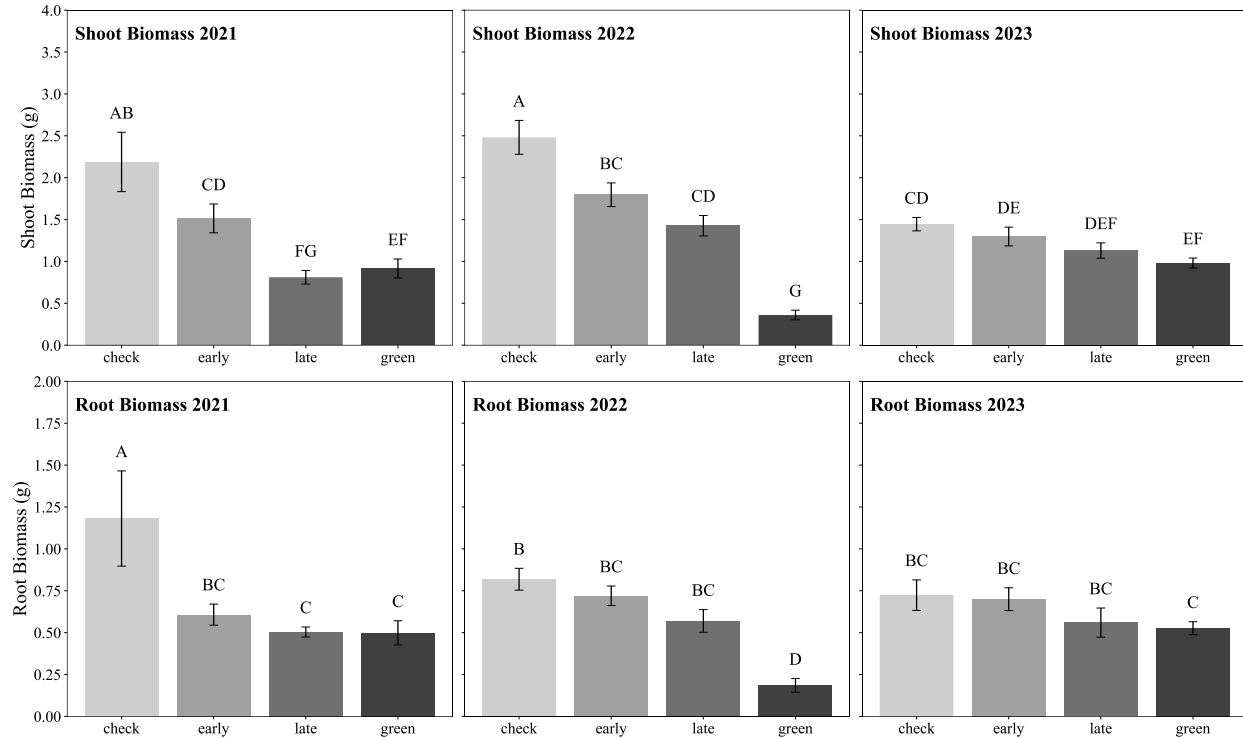


Figure 3.5 Root and shoot biomass at V3 after different cereal rye cover crop termination timings.

Different letters above bars indicate significantly different mean values across all years. Termination timing treatments were check – no cover crop; early – 2 weeks before planting; late – 1 week before planting; green – at planting

The observed decrease in shoot height and biomass associated with delayed cereal rye termination in our study could be a result of increased seedling disease, specifically *Pythium* populations that cause radical root rot. Increased *Pythium* populations have been associated with terminating cover crops closer to planting (Acharya et al., 2022). Increases in radical root rot following delayed cover crop termination has also been reported and would also explain the decrease in root biomass when planting green (Acharya et al., 2022; Almeida et al., 2024). The green-bridge effect of planting a grass crop into a living grass cover crop combined with potential annual moisture limitations and decreased soil temperatures could explain the differences in seedling height observed in this study.

There was a significant year by termination treatment interaction effect ($p = 0.0447$) on corn grain yields. Grain yields were significantly greater in 2021 than 2022, with a 43% yield decrease in the check plots from one year to the next (Figure 3.6).

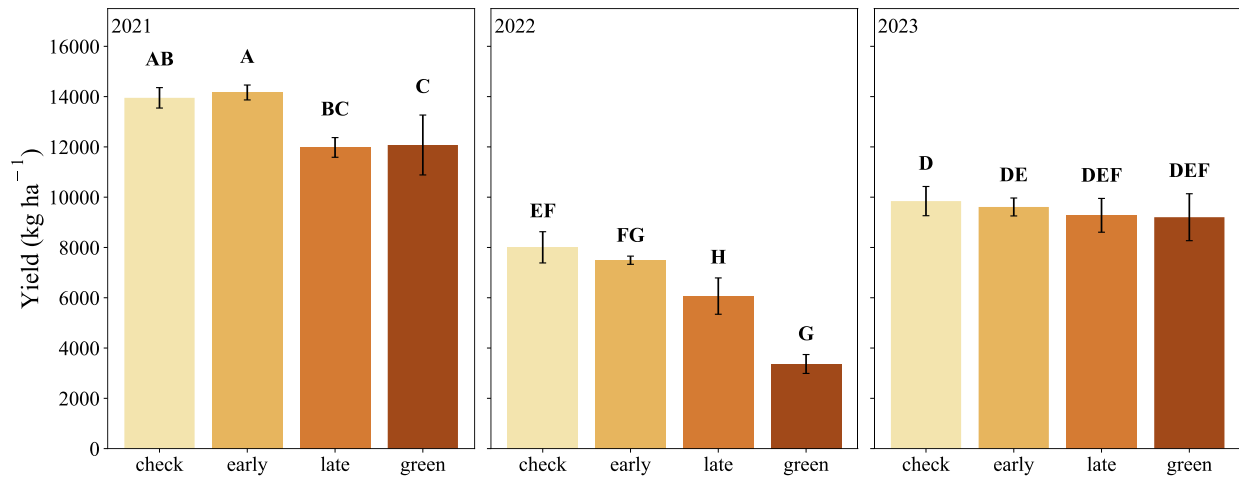


Figure 3.6 Corn grain yield after different cereal rye cover crop termination timings in 2021, 2022, and 2023.

Different letters above bars indicate significantly different mean values across all years. Termination timing treatments were check – no cover crop; early – 2 weeks before planting; late – 1 week before planting; green – at planting

In 2021, an early terminated cover crop did not significantly affect yield compared to the no-cover check, and delaying cover crop termination or planting green decreased yields by 15%. In 2022, there was a 24% yield decrease when delaying cover crop termination and a 58% yield decrease when planting green compared to early termination – which was not statistically different from the no cover check. In 2023, there was no significant difference in grain yields between treatments, but yields were approximately 32% lower compared to the highest yields in 2021.

Delayed termination in 2021 was associated with reduced corn grain yields, and this could potentially be due to the decreased seedling biomass in the late termination and planting

green treatments. In the study by Acharya et al. (2018) in Iowa, they had similar results in which delayed termination of cover crops was linked with decreased corn grain yield possibly due to increased cereal rye biomass and the subsequent impact it had on corn seedling disease (Acharya et al., 2022). In 2022, the presence of cereal rye significantly affected grain yields, and delayed termination resulted in further yield loss (Figure 3. 6). As mentioned before, there was less precipitation during the cover crop growing season before corn planting in 2022. It is possible that the precipitation received during the corn season, while being greater in 2022 than other years, was not sufficient to replenish that used by the cereal rye.

The trend of decreased yield with delayed termination in 2021 and 2022 also could potentially be explained by nitrogen immobilization by the cereal rye. In an irrigated study near the Mediterranean, they found that nitrogen immobilization by a winter grass (barley) cover crop resulted in reduced corn yields due to poor synchronization of uptake and release (Salmerón et al., 2011). Even in warmer humid conditions with additional water from irrigation, they saw nitrogen immobilization from the cover crop. Contrarily, a cover crop termination timing study observing 12 site-years from the northeastern US concluded that total nitrogen application rate was more influential on corn grain yields than cereal rye biomass or nitrogen application timing (Huddell et al., 2025). Perhaps in our rainfed study, both nitrogen immobilization and moisture availability were impacting yields.

In addition to moisture and nitrogen availability, yield losses from planting green may also be due to an increase in radical root rot (or *Pythium* populations) which was not explicitly analyzed in our study but could correlated with the decreased root and shoot biomass in the cereal rye treatments (Figure 3.5). Almeida et al. (2024) and Acharya et al. (2022) presented correlations

between increased incidence of root rot and decreased corn grain yield, especially after planting green.

Insect Dynamics

There were no statistically significant differences in waxworm predation from the sentinel prey assays between treatments ($p = 0.3951$), years ($p = 0.1690$), or growth stage ($p = 0.5035$). There also were no significant interaction effects. The main effect of treatment ($p < 0.0001$) and the interaction effect of growth stage and year ($p = 0.0016$) were significant for ratio of plants damaged by insects. Therefore, results will be discussed by year with focus on the main effects of growth stage and treatment, which were significant both years, while the interaction effect was not ($p = 0.2660$ in 2022 and $p = 0.0587$ in 2023). In 2022 and 2023, the overall insect damage indices were higher at V3 than V5 ($p < 0.001$). In 2022, the late termination and planting green treatments had higher insect damage indices (0.82 and 0.83 for late termination and green, respectively) than the early termination treatment and no cereal rye check (0.70 and 0.67 for early and check, respectively). In 2023, all cereal rye treatments had greater insect damage indices than the check treatment (0.17, 0.24, 0.26, and 0.3 for check, early, late, and green, respectively).

The results from our sentinel prey assays were consistent with the existing literature. The presence of cover crops does not affect invertebrate predation, and no-till conditions maintaining soil structure and surface residue is sufficient for hosting active populations of ground predators in agroecosystems (Rowen & Tooker, 2020). High-predation in sentinel prey assays was also observed in no-till corn in the absence of a cover crop and in delayed and early terminated cereal rye (Le Gall et al., 2022). Despite the overall high activity observed by predators via the sentinel prey assays, there was a considerable proportion of plants with insect damage at V3 in our study,

more so in 2022 than 2023. The insect damage at V3 would not severely impact corn development yet, as the growth point is still below the surface. It could be that the insect damage had less impact on corn grain yields than the increased risk for radical root rot when delaying cover crop termination. Although not presented here, most damage ratings were rather low, indicating that invertebrate damage was present but not severe. No extreme insect damage was noted during sampling and scouting.

Conclusions

Delaying cereal rye termination before corn is sometimes necessary in practice due to annual weather patterns and field logistics, but doing so presents various risks to the corn crop. While early termination of cereal rye did not impact subsequent corn yields, any delay resulted in significant yield losses. These yield losses may be due to nitrogen immobilization and/or stored soil moisture usage by the cereal rye cover crop or by increased instances of *Pythium* and radical root rot in corn seedlings. In terms of enhancing ecosystem services like beneficial invertebrate habitat, no significant difference was observed between termination timing treatments. From our observations in this three-year rainfed study in Kansas, the only advantage to delaying termination of cereal rye before corn was to control early season weeds. Greater biomass in the late termination and planting green treatments successfully suppressed weeds in terms of total weed biomass. It is not clear whether this difference would be the most economical or save one a post-emergence spray pass, but the yield losses in treatments with delayed cover crop termination would be cause for concern. However, if financial incentives, offsets, or market premiums were offered, then delaying cereal rye termination could be economical. A cereal rye cover crop in general could be a part of a well-developed integrated pest management strategy. Delaying cereal rye cover crop termination could be a dynamic practice saved for years where

precipitation and soil moisture are sufficient to support both cover crops and cash crops in their respective seasons.

Acknowledgements

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Chapter 4 - Effects of Farming on Pedogenesis in the Southern Great Plains – a Case Study of the Magruder Plots

Abstract

Soil mineralogy is historically thought to be an inherited soil quality originally derived from parent materials. However, recent studies suggest that soil acidification from agricultural land use may be altering soil minerals in shorter time scales, challenging the view that mineralogical changes only occur at the deep time scale. The objectives of this research were to stress the importance of basic soil mineralogy knowledge for agronomists and to address whether long-term soil fertility management increases the proportion of highly-weathered clay minerals. Soil samples were pulled from the historic Magruder plots in Stillwater, Oklahoma at Oklahoma State University. The plots were moved in 1947 and consistently managed since then. There are six fertility treatments applied to continuous wheat plots. Soil cores were pulled from each plot to a depth of one meter. Samples were prepared for clay mineralogical assessments and x-rayed using the Jackson (1975) method. In the surface samples, organic carbon was highest in the manure plot, base saturation was highest in the manure plot and NPK with lime amendment plot, and pH was lowest in NP and NPK plots. Mineralogical differences were not observed in the XRD patterns or in soil thin section, but chemical analyses indicate increased weathering in NP and NPK plots.

Introduction

The weathering and erosion of minerals is a crucial step in soil development heavily influenced by the soil forming factors described by Jenny (1941) including climate, topography, parent material, and biota. Several years earlier, Hugh Hammond Bennett was trying to caution

American farmers that erosion was threatening cropland soil due to tillage practices across the country (Bennett & Chapline, 1928). Whether the focus is formation or destruction, weathering and erosion are highly influential on soils, and humans have become a part of this process. The focus of this literature review and the following experiment is to explore the relationships between agriculture and soil weathering processes, specifically the relationship between soil minerals and land management.

Review of relevant literature

Where do mineral soils come from?

The parent material of a soil, whether alluvial, aeolian, or residual, contains clues about its history that can be further explored through mineralogical and other soil characteristic analyses. Fresh rocks once they are exposed are susceptible to weathering, and Goldich (1938) described the susceptibility of primary minerals to erosion in an order based on crystallinity. Primary minerals that form in high temperatures like olivine and Ca-feldspar will weather more readily than cool-temperature crystallizing minerals like quartz and muscovite.

A review by Wilson (2004) described several of these primary mineral weathering sequences. Organic acids and other root exudate materials in soil environments play a role in the dissolution and transformation of olivine, feldspars, and micas into Fe oxides, phyllosilicate clay minerals, and free ions in solution. It is unlikely to find the more easily weathered minerals in soils unless they are near an igneous source or protected within a reaction rim or coating of illite or other secondary minerals (Wilson, 2004).

“Clay minerals” describes both a particle size class and a class of secondary minerals. Clay particles are defined as smaller than 0.002 mm in diameter, and their mineral composition can be indicative of their degree of weathering and soil environment. Fe oxides, hydroxides, and

oxyhydroxides are considered secondary minerals and precipitate as coatings in areas of alternating wet periods. Fe depletions can be seen as grey areas of loss in saturated soils (USDA-NRCS, 2024). Clay films accumulate on soil pedes through argillic accumulation down the soil profile (Schoeneberger et al., 2012). Kaolinite is the simplest phyllosilicate clay mineral (Wilson, 2004) and its prevalence in a soil is indicative of a highly weathered soil (Soil Survey Staff, 1999, Dixon et al., 1989).

Clay mineral properties

Clay mineral properties and their surface chemistry were well defined by Dixon et al. (1989). The first major clay mineral group to be discussed is layer silicates, or phyllosilicates. There are two general types of phyllosilicate minerals; 2:1 and 1:1. All phyllosilicates contain tetrahedral and octahedral silicate layers, and how these layers are arrayed is influenced by their chemical composition.

The 1:1 layer structure contains one tetrahedral sheet and one octahedral sheet (Dixon et al., 1989). The most common 1:1 phyllosilicate is kaolinite, and it generally has very little isomorphic substitution and therefore rarely has permanent surface charges. It is the most simple phyllosilicate mineral ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$), and it forms in soil as a secondary mineral by the ultimate weathering product of other minerals like feldspars and micas.

The 2:1 phyllosilicate structure contains one octahedral sheet with a tetrahedral sheet on both sides sandwiching the octahedral sheet (Dixon et al., 1989). The 2:1-layer silicates have more spatial and charge availability for isomorphic substitutions, creating a vast array of how atoms are arranged and ordered in these types of minerals and resulting in more diversity among 2:1 phyllosilicates (dioctahedral and trioctahedral arrangements). Isomorphic substitutions or vacancies in phyllosilicates result in permanent surface charges, and these surface charges vary

in strength depending on the chemical composition and crystal lattice structure. For example, muscovite and montmorillonite are both 2:1 dioctahedral phyllosilicate minerals, but muscovite has greater structural charge because its substitutions result in structural charges in both the tetrahedral and octahedral sheets, whereas montmorillonite only has substitution-related charges in its octahedral sheet. The charges on 2:1-layer silicates attract water or cations into their interlayer spaces and expand, resulting in the shrink-swell action observed in minerals such as smectite and bentonite, although not all 2:1 minerals are expansive, such as chlorite.

Iron minerals are extremely common, and they are present in most soils. Irons released from other mineral weathering precipitate into iron oxides like hematite (Fe_2O_3) and oxyhydroxides like goethite (FeOOH), which remain relatively stable in unsaturated soils and result in the red (hematite) and yellow (goethite) colors observed in soils (Dixon et al., 1989).

Clay mineral interactions in the soil environment

Due to their surface charges and interactions in the soil environment, clay minerals have been studied for many years to understand how they influence inherent soil fertility and other soil properties. The decomposition of minerals is responsible for the availability of micronutrients such as Mg, Ca, and K in soils (Manning, 2022). Clay mineral interactions in the soil related to K, for example, are well documented such as in a recent review by Sattar (2019). They determined that 90-98% of K in soils is fixed and unavailable to plants without microbial interactions in the rhizosphere that break down the soil minerals to which the K is bound. A study in North Dakota by Breker et al. (2019) found that soil test K thresholds should consider clay mineralogy to better predict crop response to K additions. They found that the smectite/illite ratio changed the K critical level for K fertilization because a higher proportion of smectite

requires increasing the critical K level due to potential increased fixation of the K ions in the smectite interlayers.

In addition to inorganic fertility markers, organic matter and its interactions in soil may be impacted by mineral composition. Mineral-associated organic matter is a source of interest for carbon sequestration, despite its lower responsiveness to inputs over time (Rocci et al., 2021). The interaction between clay minerals and organic matter is also important for the formation of stable soil aggregates, and this interaction is significantly impacted by soil mineral composition (Denef et al., 2002). Minerals can adsorb organic matter on their surfaces and can act as catalysts or redox partners for organic reactions (Kleber, 2021). Denef et al. (2002) investigated the short-term effects of organic inputs and wetting/drying cycles on aggregate formation in different clay soils (2:1 dominant, 1:1 dominant, and mixed mineralogy). With organic amendments, lower aggregation was observed in 1:1 dominant soils compared to 2:1 dominant soils because of the lower amount of mineral surface charges. However, they observed greater aggregation in the 1:1 dominant soils in the low or zero organic matter amendments compared to the other soils, perhaps due to the mineral-mineral interactions of these clays.

Goethite and hematite are the most common iron oxyhydroxide and oxide in the soil environment (Dixon et al., 1989), and they are also the most stable (Lindsay, 1979). These iron compounds contribute to yellow and red coloration in soils, especially in more oxidizing (dry) environments, and an abundance of these iron minerals are indicative of highly weathered soil often associated with high amounts of kaolinite clays (Dixon et al., 1989). In reducing or saturated environments, Fe^{3+} may be reduced to Fe^{2+} by anaerobic microbes resulting in gleying often observed in hydric soils (USDA NRCS, 2024).

Equilibrium of soil minerals, nitrates, and ammonium

Most of the nitrogen in soils is fixed in organic matter and unavailable to plants unless transformed into soluble nitrogen compounds via microbial activity (Lindsay, 1979). Common nitrogen sources in agricultural fields are ammonium (NH_4^+) and nitrate (NO_3^-). The microbially facilitated denitrification reaction results in a net release of H^+ (Equation 4.1, adapted from Lindsay, 1979). This net release of H^+ can result in lower pH over time, as observed in long-term fertility studies (Schlegel et al., 2017; Aula et al., 2016; Barak et al., 1997; Biederbeck et al., 1996; Bouman et al., 1995).

Equation 4.1 $\text{NH}_4^+ + 3 \text{H}_2\text{O} \leftrightarrow \text{NO}_3^- + 10 \text{H}^+$ $\log k = -119.07$

The conversion of NH_4^+ to NO_3^- is energetically favored ($\log k -119.07$), and at equilibrium with atmospheric N and O, NO_3^- is much more stable and generally the dominant form of nitrogen in soils, whereas NH_4^+ is only stable in trace amounts (Lindsay, 1979). In soils, NH_4^+ may be fixed onto 2:1 clay minerals such as beidellite (similar to bentonite), vermiculite, and montmorillonite (Bajwa, 1982).

Equilibrium of soil minerals and carbonates

Soils are continually reacting with carbonates in the atmosphere – CO_2 is released via microbial respiration, and minerals like calcite (CaCO_3) precipitate within soil profiles. The equilibrium of carbonates in soil is heavily pH dependent, as lower pH levels favor H_2CO_3 , neutral pH levels favor HCO_3^- , and high pH levels favor CO_3^{2-} (Lindsay, 1979). Increases in atmospheric CO_2 shifts the activity of these carbonates species, resulting in possible precipitation of carbonate minerals due to decreased activity in solution.

Equilibrium of soil minerals and iron

Aqueous Fe^{3+} and also Fe^{2+} are quite stable in the soil environment under common redox conditions (Lindsay, 1979). Soil conditions such as pH do not have a significant impact on iron

activity, meaning iron minerals will persist in soils under normal conditions. As previously mentioned, accumulation of iron oxide minerals is indicative of highly weathered soils. Because iron is so prevalent in soils, it is unlikely that its solubility is influenced by the presence of iron minerals. However, iron is much more abundant than other divalent cations (like Zn) and may have more influence on their solubility. Preferential sorption of phosphates and other microbial metabolites onto iron oxide minerals has previously been explored, finding that the interaction sorption of organic matter on iron oxides reduces their sorption of microbial metabolites, resulting in greater availability for uptake by microorganisms (Swenson et al., 2015). Irons are common in soils, and their interactions with organics may be important for understanding a soil's inherent fertility status.

Impacts of nitrogen fertilizer application on soil properties

As previously mentioned, several studies have found that long-term application of nitrogen fertilizers resulted in decreased soil pH (Schlegel et al., 2017; Aula et al., 2016; Barak et al., 1997; Biederbeck et al., 1996; Bouman et al., 1995) likely due to the increase in NH_4^+ availability for the nitrification reaction (Zhang et al., 2012). The application of nitrogen fertilizers can affect soil mineralogy as well, specifically increasing the amount of NH_4^+ fixed by 2:1 minerals and even in a relatively short timescale (Matocha et al., 2016; Bajwa, 1982). Particularly high nitrogen rates, especially above the agronomic optimums, results in increased soil organic carbon (Aula et al., 2016; Raun et al., 1998). The introduced nitrogen may provide nutrients for soil microbes to process high C:N residues.

The legacy effects of nitrogen fertilizer inputs are very site specific and continue to be studied in a variety of cropland environments (Poffenbarger et al., 2018; Schlegel et al., 2017; Davis et al., 2006). Nitrate leaching, ammonium fixation, and atmospheric leaching of nitrous

oxide are among the concerns for N loss in agricultural systems. Poffenbarger et al. (2018) determined that historical N application rate has little effect on losses, but, rather, in-season over application result in N losses, consistent with a nitrous oxide emission study by Preza-Fontes et al. (2019).

Crop production may be contributing to soil changes beyond gradual acidification. Liebig et al. (2024) observed site-specific changes to soil pH, organic carbon, and even texture in response to dryland agriculture by analyzing and comparing archives to modern soils. In geological time, 71 years may be just a drop in the bucket. However, their experiment provided evidence that humans are influencing agricultural soils in ways otherwise unexpected in the span of less than 100 years.

Research rationale

Evidence suggests that agricultural activity and inputs are changing soil properties that were previously understood to be inherent, like mineralogy and soil texture. Long-term experiments and soil archives provide unique opportunities to assess how soils change over time in response to land management. Observed changes in soils are also continuously attributed to site specifics; not all soils respond equally to land management. Differences in soil mineralogy affect a soil's inherent fertility and how it responds to a history of agricultural inputs. Soil mineralogy also influences the nutrient needs for crops, as some soil minerals have a higher affinity for fixing cations like NH_4^+ or K^+ .

One long-term fertility experiment in the Great Plains region is the Magruder plots outside of Stillwater, OK. After more than a century of cultivating continuous wheat, they are still able to harvest grain from the zero-input check plot (Fornah et al., 2020). The inherent fertility of these soils is amazing, and how these soils have changed over time can provide

valuable insight into anthropogenic impacts on rich cultivated soils in the central U.S. and potentially inform farmers on nutrient management decisions. Anthropogenic impact on inherent soil properties has recently been explored in long-term experiments around the world, and researchers are finding differences in timeframes that were otherwise understood to be too short in terms of the geological timescale.

Many soil and agronomic assessments have been done on the Magruder plots since their original establishment in 1892. They were moved in 1947, relocating the top 40.6 cm of soil 1.6 km west of their original location (Girma et al., 2007). The transported material in the surface was hypothesized to be different than the deeper subsoil in terms of mineralogy, although differences by depth in floodplain soils would not be surprising anyway. The biological activity from the continuous wheat operations would keep carbon cycling, even in the zero-input check plots. Uniformity of the topsoil was not of concern because these soils were annually deep tilled and therefore homogenized regularly. These plots are iconic for the region as one of the oldest long-term experiments and the oldest continuous wheat trial in the country. However, there are no published mineralogical assessments on the plots to investigate potential changes driven by continuous tillage and nutrient amendments. There is a unique and interesting opportunity in these plots to develop a whole-picture understanding of the relationship between soil minerals and agricultural management in the Red Rolling Prairies region of the Great Plains. It was hypothesized that the treatments managed with nitrogen fertilizer, but not managed for pH, would exhibit greater evidence of secondary mineral weathering than check treatments and the treatment with lime incorporation as needed.

Methods

Site description

The Magruder Plots are located in Stillwater, Oklahoma (36° 7'11.02"N, 97° 5'19.36"W) and are mapped as a Kirkland silt loam (Fine, mixed, superactive, thermic Udertic Paleustolls). They were originally established in 1892 as wheat demonstration plots. In 1947, the demonstration plots were excavated and moved to their current home at the Oklahoma State University Agronomy Farm. Since their 1947 move, fertility management has been consistent. There are 6 total treatments including a 0-input check, annual phosphorus fertilization (P; 14.6 kg P ha⁻¹); annual nitrogen and phosphorus fertilization (NP; 67 kg N ha⁻¹ and 14.6 kg P ha⁻¹); annual nitrogen, phosphorus, and potassium fertilization (NPK; 67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹); and lime applied when soil pH < 5.5 (NPK + Lime); and manure applied every 4 years at 270 kg ha⁻¹ nitrogen (Manure). These are unreplicated demonstration plots, and therefore no statistical analyses were done for this study.

Soil sampling

Sampling occurred in August 2023 prior to the quadrennial addition of manure to the respective treatment. Three soil cores down to 90-cm depth were pulled from the center of each plot using a Giddings exploration probe with a 5-cm diameter push tube. One core was described in the field. Another core was sampled for the 0-10 cm and 70-80 cm depths, and these samples were air dried, and ground to 2-mm mesh for further analyses. The third core was used to make soil thin sections. Soil thin sections are not described in this chapter.

General soil chemical properties

Soil total and organic carbon was analyzed using a LECO TruSpec CN combustion analyzer (LECO Corporation, St. Joseph, MI). For pH, 1:1 soil-water and 1:2 soil-calcium

chloride slurries were prepared for each sample, allowed to equilibrate for 30 minutes. Then, samples were measured for pH using a dual electrode robotic pH analyzer (Skalar SP50, Baford, GA & Breda, Netherlands) equipped with glass pH electrodes.

Quantification of iron oxides

Iron oxide content was quantified from the freeze-dried clay fractions (see Soil Mineralogy section below for clay fractionation) using the method described by Mehra and Jackson (1960). 1.0-g weighed clay fraction followed by 45 mL sodium citrate bicarbonate solution were added to the tube. The test tubes were placed in an 80 °C water bath, and once the solution is at temperature, 1.0 g sodium dithionite is added to the sample and thoroughly mixed. After 10 minutes, a second 1.0 g dose of sodium dithionite is added and mixed again. After allowing the reaction to complete and occasionally mixing for 10 minutes, the tubes were removed from the bath and centrifuged to separate the clay from the supernatant. The supernatant was added to a 250 mL volumetric flask. Another 45 mL of the sodium citrate bicarbonate solution was added to the tube, and the solution was heated again to 80 °C in a water bath. Once the solution reached temperature, a third 1.0 g dose of sodium dithionite was added, and the solution was stirred and allowed to react for 10 minutes. The tube was centrifuged again and decanted into the 250 mL volumetric flask. A final 45 mL of the sodium citrate bicarbonate solution was added to the tubes, and the tube was placed in the water bath to reach 80 °C. Once at temperature, the clays were mixed and allowed to react for 5 minutes. A final centrifuge and decanting were done and the solution in the 250 mL volumetric flask was brought to volume using deionized water.

Solutions were diluted 1:20 by aliquoting 5 mL of the decant solution into a 100 mL volumetric flask and bringing to volume with deionized water. Iron standards were prepared at 0, 5, 10, and 20 $\mu\text{g ml}^{-1}$ and used to build a standard curve for atomic absorption spectroscopy.

Exchangeable cations

Extractable Acidity

Exchangeable cations were determined using the barium chloride buffer with triethanolamine leaching method (Soil Survey Staff, 2014). To prepare the leaching assembly, 60 mL syringes were connected via rubber tubing, with the plunger of the extracting syringe fully pressed and no plunger in the reservoir syringe. Both syringes were arranged in a mechanical vacuum extractor with the reservoir on top and extractor syringe on the bottom. An approximately 5-cm strip of fiberglass pulp was placed and compressed into the bottom of the reservoir syringe to serve as a filter to prevent soil particles from going into the extracting syringe. A weighed 2.5-g sample of the ground soil was added to the reservoir syringe for each soil sample, and soils were run in duplicate. Four blanks were run as well with each extraction. Into the reservoir syringe, 20 mL of buffer solution (0.5 *N* BaCl₂, 0.2 *N* Triethanolamine (TEA)) was added and left to stand for 30 minutes. After 30 minutes, the extractor was set to a 30-minute extraction rate and samples were extracted until solution in reservoir was only 0.5 to 1 cm above the soil. At this point, 20 mL of the replacement solution (0.5 *N* BaCl₂) was added to the reservoir. Another extraction at the 30-minute extraction rate was run until the solution was 0.5 to 1 cm above the soil. A final 20 mL of replacement solution was added at this stage, and the extraction was run to completion at the 30-minute rate.

Solutions were added to Erlenmeyer flasks and titrated with a standardized 0.13 *N* hydrochloric acid solution to pH 4.6. Extractable acidity could then be solved for (Equation 4.2)

Equation 4.2 Extractable acidity (meq 100 g⁻¹) = {(B-T)xNxR/C} x 100

B = Average reagent blank titer (mL)

T = sample titer (mL)

N = Normality of HCl

C = sample weight (g)

100 = conversion factor (100-g basis)

R = Air-dry ratio

Extractable bases

In another extraction set up as previously described, 2.5-g subsamples were added to the tubes followed by 20 mL of a 1 N ammonium acetate extraction solution. After standing for 20 minutes, the extractor was run at the 0.5 position until the solution was just above the soil sample surface. An additional 30 mL dose of the extraction solution was added, and the extraction was left to run for 12 hours.

The resulting solutions were added to 100 mL volumetric flasks and brought to volume using deionized water. After inverting the flasks 30 times to ensure adequate mixing, the solutions were filtered into dilution vials and stored in the refrigerator.

The next day, the samples were analyzed using an Agilent 5800 inductively coupled plasma-optical emission spectrometer (Agilent Technologies, Santa Clara, Ca). Extractable base data was inconclusive and not included in this work. Re-runs of all samples are in-process.

Soil mineralogy

Sample preparation

Soil mineralogy was analyzed for each surface and subsurface sample using the methods described by Jackson (1975). Soil samples were ground to pass through a 2-mm sieve, and 40-g subsamples were taken for mineralogy analyses. Carbonates were removed in the samples by

incrementally wetting samples with 1 M sodium acetate solution until carbonates were fully dissolved (effervescence ceased). Organic matter was removed by heating the samples in an 80°C water bath and incrementally adding 5-mL aliquots of 30% hydrogen peroxide until no further reaction occurred with the addition. Samples were centrifuged at 1500 rpm for 15 minutes, washed with 1 M sodium chloride 2-3 times, and dispersed with deionized water. Following the wash step, 30 mL of 0.25 M sodium carbonate were added to each sample. Samples were shaken by hand, then placed in a reciprocal shaker at 120 oscillations min⁻¹ and left to shake overnight.

Samples were transferred through a 300-mesh sieve to separate the clay and silt from the sand. Clay and silt mixtures were placed into 2 L acid bottles marked for 10-cm depth of sedimentation from the water surface. Samples were shaken and left to settle according to the required sedimentation time described by Jackson (1975) (Equation 4.3).

Equation 4.3 Sedimentation time

$$t = \frac{18\eta h}{g(S_p - S_l) D^2}$$

where η = viscosity in g/cm sec = 0.01005 at 20°C

h = depth of fall in cm = 10 cm

g = 980 cm/sec²

s_p = density of particles in g/cm³ = 2.65

s_l = density of water in g/cm³ = 0.998 at 20°C

D = particle diameter in cm = 0.0002

Following the appropriate sedimentation times, samples were siphoned from the 10-cm mark into another container. This siphoning process was repeated approximately 8-10 times per

sample to ensure separation of clays and silts. Separated clays were then flocculated with magnesium chloride hexahydrate crystals and the supernatant was removed.

The separated clays were moved to 250 mL Nalgene bottles and 100 mL of 0.5 M magnesium chloride was added to each sample. Samples were washed with magnesium chloride two more times, then washed with 4% ethanol solution until dispersed. Dispersed samples were sonicated at 60% power for 2 minutes using a Fisher Sonic Dismembrator. Samples were then quick-frozen in a dry ice-ethanol bath and moved to a freeze dryer.

Freeze-dried clays were homogenized for resuspension for x-ray diffraction. Samples were already magnesium saturated, so 0.15 g these samples were rehydrated with 10 mL deionized water and dispersed with the sonicator for 2 minutes. Duplicate clay sample slides were using 1 mL of the suspended magnesium saturated samples. Once dried, one set was x-rayed as is and the other set was placed in an ethylene glycol pot for at least 12 hours at 60 °C.

To make potassium saturated samples, 0.45 g of the freeze-dried magnesium saturated samples was washed with 30 mL of 1 M potassium chloride solution three times, each time being centrifuged at 1800 rpm for 5 minutes. Two additional washes with deionized water followed. These samples were then dispersed as the previous samples were with the sonicator, and 1 mL of the solution was spread on a petrographic slide. A total of 3 potassium-saturated slides were prepared for each sample. Heat treatments of 350 °C and 550 °C were done on potassium slides using a muffle furnace for 4 hours.

In the end, each clay sample was prepared for 5 separate slides:

- Mg - 25°C
- Mg - ethylene glycol (Mg - EG)
- Mg - glycerol (Mg - GLY)

- K - 25°C
- K - 350°C
- K - 550°C

X-ray diffraction

Samples were scanned using a Panalytical Empyrean x-ray diffractometer. Scans were recorded using Panalytical software. The original Mg-25 °C samples were scanned from 2 – 34 °2θ and all other treatments were scanned from 2 – 15 °2θ.

Particle size analysis

Particle size distribution was determined using the micro-pipette method (Soil Survey Staff, 2014). Performed in duplicate, 4 g of sample were added to a tared dish and oven dried at 110 °C. Once completely dry, sample is added to a glass bottle with 30 mL of deionized water, and the solution is shaken overnight. The next day, each bottle is filled to 40 mL to have a 1:10 soil-water ratio in solution. Solutions are stirred vigorously for 30 seconds, and based on the temperature of the water, a 2.5 mL aliquot is removed from a 2.5-cm depth in the solution. The aliquot was moved to a tared dish and dried at 110 °C. The residue weight, representative of a portion of the clay fraction, was weighed to the nearest 0.1 mg. The remaining sample in the glass container was then poured through a 300-mesh (0.047 mm) sieve to separate the sands. Sands were thoroughly washed to remove silt and remaining clay particles. Sand separates were dried at 110 °C then sieved through a nest of sieves in descending mesh sizes of 1.0, 0.5, 0.25, 0.1, and 0.047 mm. The contents of each sieve was weighed for sand separates. Clay (Equation 4.4) and sand (Equation 4.5) were determined, then the sum of their distribution was subtracted from 100% to quantify silt fraction (Equation 4.6).

Equation 4.4 Clay % = 100 x [(RW₂ x CF)/TW]

Clay = < 2 μm fraction

RW₂ = Residue weight (g) of < 2 μm fraction

CF = 40 mL/DV

DV = Dispensed pipette volume (2.5 mL)

TW = total weight (g) of oven dried sample

Equation 4.5 Sand % = $\sum_i (S_{wi}/TW) \times 100$

S_w = sand fraction weight

i = 1.0, 0.5, 0.25, 0.1, and 0.047-mm sand fractions

Equation 4.6 Silt % = 100 – (Clay % + Sand %)

Results and Discussion

Field description of soil

The soil as described in the field very closely matched that of its mapping as a Kirkland silt loam. Slickensides were not observed in the 2-in push tube sample described, but otherwise the field description resembles that of the Kirkland series with some slight horizon naming discrepancies. The Kirkland series is classified as fine, mixed, superactive, thermic Udertic Paleustolls. The site was approximately 300 m elevation and 0-1% slope.

The Ap horizon (0-15 cm) was described as a loam texture with 50% sand and 20% clay with weak fine subangular blocky structure and a dark reddish-brown color (7.5YR 3/2) containing 1.19% TOC. The pH from the described Ap horizon 6.1, but pH varied between treatments and cannot be generalized for these plots (table 2-3).

The AB horizon (15-33 cm) was described as a clay loam texture with 50% sand and 30% clay with moderate medium subangular blocky structure and a very dark reddish-brown color (7.5YR 2.5/3) containing 0.71% TOC.

The AB/Bt horizon (33-62 cm) was described as a clay texture with 50% sand and 40% clay. The horizon was 30% reddish brown (7.5YR 4/3) and 70% deeper reddish brown (5YR 4/4) and was 0.46% TOC. Clay films were observed at a frequency of 40% and iron-manganese nodules (N 2.5/0) were present.

The Bt horizon (62-92 cm) was described as a clay texture with 50% sand and 48% clay with moderate medium prismatic structure and a brighter reddish brown (5YR 4/6) color. Clay films were observed at a frequency of 50% and iron-manganese nodules (N 2.5/0) were present. In the check plot only, calcium carbonate nodules were observed within this depth. This horizon was 0.28% TOC.

The Btk horizon (92-95+ cm) was described as a clay texture with 50% sand and 48% clay with moderate medium prismatic structure and a brighter reddish brown (5YR 4/6) color. Clay films were observed at a frequency of 50% and iron-manganese nodules (N 2.5/0) were present. This horizon contained 12% fine to medium calcium carbonate concretions throughout and was 0.19% TOC.

Soil carbon

Soil organic carbon (SOC) in surface samples (0-10cm) was the highest in the manure plots, and carbon was generally greater in plots with regular nitrogen amendments compared to the phosphorus only and check plots (Table 4.1). Davis et al. (2002) also looked at surface organic matter levels in the Magruder plots and similarly saw the greatest levels in the manure treatments and higher SOC levels in treatments with nitrogen amendments. Similarly, Dhillon et al. (2018) continued monitoring SOC in the Magruder plots. They found that the quadrennial addition of manure maintained SOC levels, the plots with annual N fertilization had sustained SOC levels but were lower than manure, and check and P only plots had the most significant

decrease in SOC over time. However, Girma et al. (2007) reported overall loss in OM (%) since 1892 across all plots but lower losses in manure plots consistent with the aforementioned sources. Long-term N-fertilization has previously been linked to increased SOC around this region (Poffenbarger et al., 2017; Raun et al., 1998), but C concentrations generally decrease with time and management intensity (Ward et al., 2016).

Table 4.1 Total nitrogen and carbon for 0-10cm samples from the Magruder plots in 2023 determined via LECO TruSpec CN combustion.

Treatment	Total Nitrogen (%)	Total Carbon (%)	Total Organic Carbon (%)
Check	0.09	0.6	0.59
P	0.09	0.61	0.58
NP	0.1	0.86	0.91
NPK	0.11	0.92	0.88
NPK + Lime	0.11	0.95	0.89
Manure	0.13	1.17	1.19

Check – no treatment, P – annual phosphorus fertilization (14.6 kg P ha⁻¹), NP – annual nitrogen and phosphorus fertilization (67 kg N ha⁻¹ and 14.6 kg P ha⁻¹), NPK –annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹), NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen.

For the subsurface total C was greatest in the check plot (Table 4.2). Generally, the highest concentrations of organic carbon are found in the surface depths of grassland soils and changes due to management decrease with depth (Ward et al., 2016).

Table 4.2 Total carbon and nitrogen percentages for 70-80cm samples from the Magruder plots in 2023 determined via LECO TruSpec CN combustion.

Treatment	Total Nitrogen (%)	Total Carbon (%)	Total Organic Carbon (%)
Check	0.06	0.45	0.19
P	0.08	0.26	0.25
NP	0.07	0.26	0.25
NPK	0.07	0.26	0.25
NPK + Lime	0.07	0.28	0.27

Manure	0.07	0.27	0.27
Check – no treatment, P – annual phosphorus fertilization (14.6 kg P ha ⁻¹), NP – annual nitrogen and phosphorus fertilization (67 kg N ha ⁻¹ and 14.6 kg P ha ⁻¹), NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha ⁻¹ , 14.6 kg P ha ⁻¹ , and 28.8 kg K ha ⁻¹), NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha ⁻¹ , 14.6 kg P ha ⁻¹ , and 28.8 kg K ha ⁻¹) fertilization and lime applied when soil pH < 5.5, Manure – applied every 4 years at 270 kg ha ⁻¹ nitrogen.			

Soil pH

Surface soil pH was documented as lower in treatments with inorganic N fertilization compared to check, P fertilization only, and manure amendments with the exception of the treatment with lime additions (Table 4.3). Lime is added to this treatment when soil pH measures <5.5, so it is not unreasonable that this treatment would not show the same signs of acidification as its lime-free counterpart.

Table 4.3 pH measurements for 0-10cm (surface) and 70-80cm (deep) samples from each treatment in the Magruder plots in 2023.

Treatment	pH (1:1 water)		pH (1:2 CaCl ₂)	
	surface	deep	surface	deep
Check	6.4	6.6	5.3	6.6
P	6.2	7.4	5.3	5.7
NP	5.6	6.7	4.6	6.1
NPK	5.5	7.1	4.5	6.5
NPK + Lime	6.8	7.1	6.9	5.7
Manure	6.1	7.1	6.1	6.7

Check – no treatment, P – annual phosphorus fertilization (14.6 kg P ha⁻¹), NP – annual nitrogen and phosphorus fertilization (67 kg N ha⁻¹ and 14.6 kg P ha⁻¹), NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹), NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen.

Historical nitrogen fertilization is well documented as linked to decreased soil pH (Schlegel et al., 2017; Aula et al., 2016; Barak et al., 1997; Biederbeck et al., 1996; Bouman et al., 1995). Lower pH levels in plots with applied inorganic N without additional lime were expected. These pH differences were notable in the surface depths but not observed in the subsoil (Table 4.3).

Extractable Iron

Greater concentrations of extractable iron were expected in the NP and NPK treatments due to increased acidity that could ultimately release iron from feldspars and make them available for iron oxide formation. However, there was not a drastic difference in extractable irons based on treatment (Table 4.4). The clay from the NPK treatment had the highest concentration at 2.03 ppm, followed by the NP treatment at 1.91 ppm. The fact that the check treatment contained the least total Fe supports the idea that the system receiving the least acidification effects from N fertilizer would have the least mineral weathering.

Table 4.4 Extractable iron concentrations from the top 10 cm of the Magruder Plots in 2023

Treatment	Total Fe (ppm)
Check	1.65
P	1.87
NP	1.91
NPK	2.03
NPK + Lime	1.91
Manure	1.77

Check – no treatment, P – annual phosphorus fertilization (14.6 kg P ha⁻¹), NP – annual nitrogen and phosphorus fertilization (67 kg N ha⁻¹ and 14.6 kg P ha⁻¹), NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹), NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen.

The presence of iron minerals could explain how the soil maintained fertility even in the check treatment, as iron oxides can sorb K⁺ ions and organics onto their surface influencing nutrient availability to microbes and consequently to plants (Swenson et al., 2015).

Soil mineralogy

There were no differences observed between the soil mineralogy in the different Magruder plot treatments. The topsoils contain some smectite, kaolinite, muscovite, biotite, quartz, and chlorite. The major diffraction peaks of mica, kaolinite, and quartz can be observed in figure 2-1.

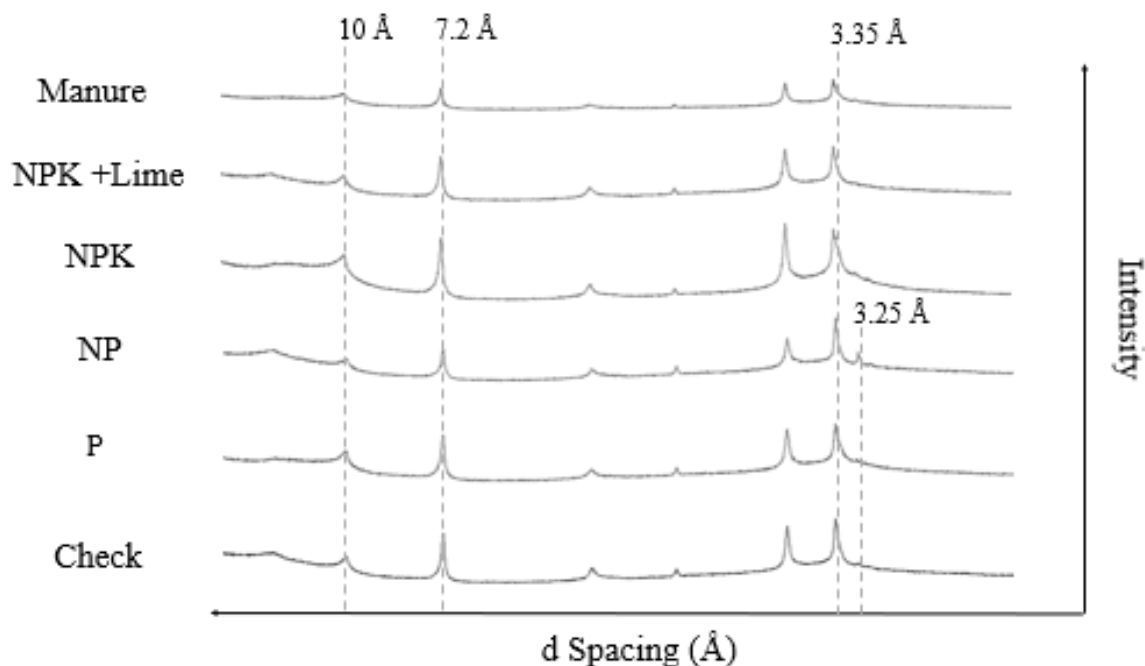


Figure 4.1 Diffraction patterns of Mg-25 clays from Magruder plots.

Each pattern shows primary peaks indicative of mica (10 Å), kaolinite (7.2 Å), and quartz (3.35 Å). Smaller peaks around 4.9 Å and 4.2 Å are secondary peaks for the detected mica (both) and quartz (4.2 Å). Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen, NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹), NP – annual nitrogen and phosphorus fertilization (67 kg N ha⁻¹ and 14.6 kg P ha⁻¹), P – annual phosphorus fertilization (14.6 kg P ha⁻¹), Check – no treatment

Although the observed peaks are not remarkably different, the area under the peaks is slightly different between treatments (Figure 4-1). Interestingly, there is a defined peak in the NP treatment at 3.25 Å that was matched as rutile. This peak is not defined in the other treatments, but it is possible that this mineral is more abundant in the NP plot. The unmarked broad peaks beyond the 10 Å may be indicative of poorly crystalline or mixtures of 2:1 clay mineral such as smectite. This broad peak is slightly more defined in the check and NPK + Lime treatments, and this peak is less defined in the NPK, P, and Manure plots. This broad, poorly defined peak is accompanied by a slight increase in the intensity of the kaolinite peak at 7.2 Å (figure 4-1). Kaolinite is often associated with highly weathered soils (Dixon et al., 1989) as they are a product from 2:1 mineral weathering. Kaolinite quantification and further analyses of the areas under the peaks in the clay x-ray diffraction spectra could provide additional insight into the degree of weathering of the topsoil in the different treatments.

Mineralogy of the deeper soil layers indicate a lithic discontinuity (Figure 4-2). This is not surprising given that the Magruder plots are located in an alluvial floodplain above Permian age shales. Deposition of new materials over a geological timescale and the argillic accumulation in Bt horizons could explain the observed differences.

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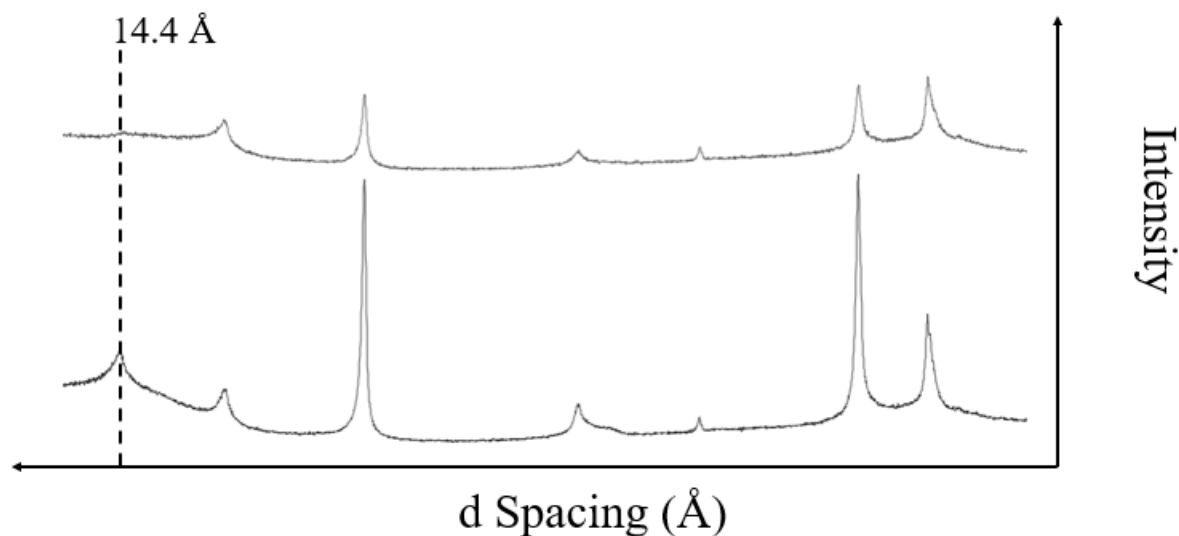


Figure 4.2 Diffraction patterns and d-spacing of Mg-25 clays from surface (upper spectra) and deep (lower spectra) samples in the P treatment of the Magruder plots.

Peak intensity increases in the subsurface samples relative to the surface samples in almost all clay minerals, especially for kaolinite, smectite, and mica. Note the peak marked at 14 Å is smectite. It is much more defined in the deep clay whereas it is barely observable in the surface clay.

The mineralogy is not significantly different down the profile, but the quantities (relative intensities) of the mineral phases present are different. Soil texture in the field at the deep sample depth was estimated to be very high in clay content (48%), and laboratory texture data can provide confirmation if this was an over-estimation due to the high quantities of the expansive and sticky smectites.

Soil texture

Soil texture did not differ much between treatments in topsoil samples and only very slightly differed in subsoil samples based on slight differences in silt percentages (Table 4.6 and Table 4.7).

Table 4.5 Particle size distribution for 0-10cm (surface) samples from each treatment in the Magruder plots in 2023.

Treatment	Series	Total Sand	Total Silt	Total Clay	Texture Class
Check	Kirkland silt loam	36.2	46.8	17.0	loam
P	Kirkland silt loam	34.1	47.8	18.1	loam
NP	Kirkland silt loam	33.3	47.1	19.6	loam
NPK	Kirkland silt loam	33.0	46.9	20.1	loam
NPK + Lime	Kirkland silt loam	33.0	49.1	17.9	loam
Manure	Kirkland silt loam	34.9	49.9	15.2	loam

Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen, NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹),), NP – annual nitrogen and phosphorus fertilization (67 kg N ha⁻¹ and 14.6 kg P ha⁻¹), , P – annual phosphorus fertilization (14.6 kg P ha⁻¹), Check – no treatment

Table 4.6 Particle size distribution for 70-80cm (subsurface) samples from each treatment in the Magruder plots in 2023.

Treatment	Series	Total Sand	Total Silt	Total Clay	Texture Class
Manure	Kirkland silt loam	17.0	44.4	38.6	silty clay loam
Check	Kirkland silt loam	14.2	51.3	34.5	silty clay loam
P	Kirkland silt loam	20.9	40.9	38.2	clay loam
NP	Kirkland silt loam	21.3	41.0	37.7	clay loam
NPK	Kirkland silt loam	22.2	39.8	38.0	clay loam
NPK + Lime	Kirkland silt loam	24.2	40.0	35.8	clay loam

Manure – applied every 4 years at 270 kg ha⁻¹ nitrogen, NPK+ Lime – annual nitrogen, phosphorus, and potassium (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹) fertilization and lime applied when soil pH < 5.5, NPK – annual nitrogen, phosphorus, and potassium fertilization (67 kg N ha⁻¹, 14.6 kg P ha⁻¹, and 28.8 kg K ha⁻¹),), NP – annual nitrogen and phosphorus

fertilization (67 kg N ha^{-1} and $14.6 \text{ kg P ha}^{-1}$), , P – annual phosphorus fertilization ($14.6 \text{ kg P ha}^{-1}$), Check – no treatment

There were very slightly higher clay contents in the NP (19.6%) and NPK (20.1%) topsoil samples compared to the check (17.0%). Particle size for the surface samples from manure plot may be influenced by transported particles brought in with the manure application. Any observed differences in texture were not sufficient to change textural class. These results are not sufficient to claim that enhanced acidity has led to weathering in the topsoil to increase clay fraction.

Similar to the surface samples, subsurface samples differed only slightly in texture, and the different texture observed in the manure and check plots compared to the other plots are due to the small differences in the ratio between sand and silt.

Conclusion and future directions

The results on mineralogical changes between treatments were inconclusive, in that there were no differences observed. Chemical data indicated slight differences in total iron and pH. The soil pH may not be low enough to lead to drastic weathering of minerals. Also, the geological placement of the plots in a floodplain could mean new material is regularly introduced and mixed into the system via annual tillage. These results, more than anything, indicate that 132 years of management is still not enough to see changes in mineralogy.

The mineralogy and chemical properties of the Magruder plot soils after over a century of management serve as a reminder as to what makes the prairie soils in the Great Plains such high-quality fertile farmland. Despite the inherent quality of these soils, they are slowly being degraded via fertilizer inputs and continuous tillage. Other soil qualities such as pH, SOC, and other nutrient pools have been recorded consistently for several decades, but this is the first known full mineralogy analysis of these specific plots. Further insight into what changes have

occurred could be gathered by assessing archived soils for mineralogy, extractable irons, and/or kaolinite quantity. Additional analysis of archived soils will complete the story of how these soils change over time. Perhaps archived prairie soils from the region (or even native prairie soils) could serve as a proxy to better understand the big picture.

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Appendix A - Chapter 2 Raw Data

System Yield Data

Year	Loc	Study	Block	Crop	Phase	CC	CCROP	N	NITROGEN	PLOT	MS T	TW	BU_A	KG_HA
2021	MAN	ASHCC	1	2	CORN	6	FTC	1	0	131	16	56	71.4	4475
2021	MAN	ASHCC	1	2	CORN	6	FTC	3	80	132	15	57	133	8330
2021	MAN	ASHCC	1	2	CORN	6	FTC	2	40	133	16	54	78.9	4947
2021	MAN	ASHCC	1	2	CORN	6	FTC	4	160	134	16	57	156	9793
2021	MAN	ASHCC	1	2	CORN	6	FTC	5	240	135	15	57	159	9979
2021	MAN	ASHCC	1	2	CORN	3	CC	3	80	136	15	57	158	9938
2021	MAN	ASHCC	1	2	CORN	3	CC	2	40	137	15	56	126	7912
2021	MAN	ASHCC	1	2	CORN	3	CC	4	160	138	15	57	165	10375
2021	MAN	ASHCC	1	2	CORN	3	CC	1	0	139	17	55	87.2	5468
2021	MAN	ASHCC	1	2	CORN	3	CC	5	240	140	16	57	160	10031
2021	MAN	ASHCC	1	2	CORN	1	CF	5	240	141	15	58	183	11472
2021	MAN	ASHCC	1	2	CORN	1	CF	3	80	142	15	58	186	11649
2021	MAN	ASHCC	1	2	CORN	1	CF	4	160	143	15	59	178	11135
2021	MAN	ASHCC	1	2	CORN	1	CF	2	40	144	16	56	135	8454
2021	MAN	ASHCC	1	2	CORN	1	CF	1	0	145	17	54	113	7062
2021	MAN	ASHCC	1	2	CORN	2	DSB	2	40	146	16	58	142	8926
2021	MAN	ASHCC	1	2	CORN	2	DSB	3	80	147	15	58	181	11374
2021	MAN	ASHCC	1	2	CORN	2	DSB	5	240	148	15	57	180	11261
2021	MAN	ASHCC	1	2	CORN	2	DSB	4	160	149	15	58	145	9089
2021	MAN	ASHCC	1	2	CORN	2	DSB	1	0	150	15	57	123	7731
2021	MAN	ASHCC	1	2	CORN	5	R/C	5	240	151	15	57	164	10289
2021	MAN	ASHCC	1	2	CORN	5	R/C	2	40	152	16	55	85.7	5374
2021	MAN	ASHCC	1	2	CORN	5	R/C	4	160	153	16	57	165	10317

202 1	MA N	ASH CC	1	2	COR N	5	R/C	1	0	154	18	54	53.5	3357
202 1	MA N	ASH CC	1	2	COR N	5	R/C	3	80	155	16	55	116	7264
202 1	MA N	ASH CC	1	2	COR N	4	CR	5	240	156	16	58	187	11746
202 1	MA N	ASH CC	1	2	COR N	4	CR	2	40	157	15	55	81.2	5095
202 1	MA N	ASH CC	1	2	COR N	4	CR	4	160	158	15	58	165	10326
202 1	MA N	ASH CC	1	2	COR N	4	CR	3	80	159	16	56	107	6695
202 1	MA N	ASH CC	1	2	COR N	4	CR	1	0	160	18	52	45.2	2832
202 1	MA N	ASH CC	2	2	COR N	3	CC	3	80	261	17	55	117	7343
202 1	MA N	ASH CC	2	2	COR N	3	CC	2	40	262	18	53	97.5	6113
202 1	MA N	ASH CC	2	2	COR N	3	CC	5	240	263	21	51	148	9272
202 1	MA N	ASH CC	2	2	COR N	3	CC	4	160	264	21	51	126	7891
202 1	MA N	ASH CC	2	2	COR N	3	CC	1	0	265	19	53	59.7	3741
202 1	MA N	ASH CC	2	2	COR N	1	CF	5	240	266	17	57	169	10618
202 1	MA N	ASH CC	2	2	COR N	1	CF	4	160	267	16	57	191	11974
202 1	MA N	ASH CC	2	2	COR N	1	CF	3	80	268	16	58	155	9750
202 1	MA N	ASH CC	2	2	COR N	1	CF	2	40	269	16	56	121	7579
202 1	MA N	ASH CC	2	2	COR N	1	CF	1	0	270	17	56	112	7047
202 1	MA N	ASH CC	2	2	COR N	6	FTC	4	160	271	17	57	163	10195
202 1	MA N	ASH CC	2	2	COR N	6	FTC	3	80	272	18	54	111	6946
202 1	MA N	ASH CC	2	2	COR N	6	FTC	1	0	273	17	55	71.6	4489
202 1	MA N	ASH CC	2	2	COR N	6	FTC	5	240	274	17	56	176	11054
202 1	MA N	ASH CC	2	2	COR N	6	FTC	2	40	275	17	54	64	4013
202 1	MA N	ASH CC	2	2	COR N	4	CR	5	240	276	16	58	186	11652
202 1	MA N	ASH CC	2	2	COR N	4	CR	4	160	277	16	57	156	9809
202 1	MA N	ASH CC	2	2	COR N	4	CR	2	40	278	16	56	67.7	4244
202 1	MA N	ASH CC	2	2	COR N	4	CR	3	80	279	16	56	109	6834
202 1	MA N	ASH CC	2	2	COR N	4	CR	1	0	280	19	52	49.7	3117

2021	MA N	ASH CC	2	2	COR N	2	DSB	3	80	281	15	58	155	9715
2021	MA N	ASH CC	2	2	COR N	2	DSB	5	240	282	16	58	183	11463
2021	MA N	ASH CC	2	2	COR N	2	DSB	1	0	283	16	56	108	6802
2021	MA N	ASH CC	2	2	COR N	2	DSB	4	160	284	16	58	181	11340
2021	MA N	ASH CC	2	2	COR N	2	DSB	2	40	285	16	56	124	7754
2021	MA N	ASH CC	2	2	COR N	5	R/C	2	40	286	15	56	68.9	4319
2021	MA N	ASH CC	2	2	COR N	5	R/C	5	240	287	15	57	162	10128
2021	MA N	ASH CC	2	2	COR N	5	R/C	3	80	288	15	56	109	6825
2021	MA N	ASH CC	2	2	COR N	5	R/C	1	0	289	18	53	53.2	3338
2021	MA N	ASH CC	2	2	COR N	5	R/C	4	160	290	16	56	149	9336
2021	MA N	ASH CC	3	2	COR N	1	CF	3	80	331	15	57	183	11470
2021	MA N	ASH CC	3	2	COR N	1	CF	5	240	332	15	58	180	11258
2021	MA N	ASH CC	3	2	COR N	1	CF	1	0	333	16	56	108	6786
2021	MA N	ASH CC	3	2	COR N	1	CF	4	160	334	16	58	194	12169
2021	MA N	ASH CC	3	2	COR N	1	CF	2	40	335	16	57	142	8908
2021	MA N	ASH CC	3	2	COR N	3	CC	2	40	336	16	55	101	6325
2021	MA N	ASH CC	3	2	COR N	3	CC	1	0	337	17	54	97.7	6125
2021	MA N	ASH CC	3	2	COR N	3	CC	4	160	338	16	55	138	8665
2021	MA N	ASH CC	3	2	COR N	3	CC	5	240	339	16	55	175	10970
2021	MA N	ASH CC	3	2	COR N	3	CC	3	80	340	16	56	147	9190
2021	MA N	ASH CC	3	2	COR N	6	FTC	4	160	341	15	57	155	9730
2021	MA N	ASH CC	3	2	COR N	6	FTC	2	40	342	16	54	98.7	6191
2021	MA N	ASH CC	3	2	COR N	6	FTC	1	0	343	17	54	62.4	3915
2021	MA N	ASH CC	3	2	COR N	6	FTC	5	240	344	16	57	196	12318
2021	MA N	ASH CC	3	2	COR N	6	FTC	3	80	345	16	56	120	7537
2021	MA N	ASH CC	3	2	COR N	2	DSB	5	240	346	15	57	157	9840
2021	MA N	ASH CC	3	2	COR N	2	DSB	2	40	347	15	58	133	8310

2021	MA N	ASH CC	3	2	COR N	2	DSB	4	160	348	15	57	184	11558
2021	MA N	ASH CC	3	2	COR N	2	DSB	3	80	349	15	58	176	11059
2021	MA N	ASH CC	3	2	COR N	2	DSB	1	0	350	15	57	130	8167
2021	MA N	ASH CC	3	2	COR N	4	CR	5	240	351	16	57	169	10587
2021	MA N	ASH CC	3	2	COR N	4	CR	4	160	352	15	57	155	9729
2021	MA N	ASH CC	3	2	COR N	4	CR	2	40	353	17	54	58.9	3695
2021	MA N	ASH CC	3	2	COR N	4	CR	1	0	354	17	53	45.7	2863
2021	MA N	ASH CC	3	2	COR N	4	CR	3	80	355	16	55	98.9	6201
2021	MA N	ASH CC	3	2	COR N	5	R/C	4	160	356	15	58	151	9482
2021	MA N	ASH CC	3	2	COR N	5	R/C	3	80	357	16	55	121	7616
2021	MA N	ASH CC	3	2	COR N	5	R/C	5	240	358	16	56	168	10537
2021	MA N	ASH CC	3	2	COR N	5	R/C	2	40	359	16	55	85.7	5371
2021	MA N	ASH CC	3	2	COR N	5	R/C	1	0	360	18	53	62.6	3927
2021	MA N	ASH CC	4	2	COR N	3	CC	4	160	461	16	56	140	8767
2021	MA N	ASH CC	4	2	COR N	3	CC	5	240	462	17	56	154	9677
2021	MA N	ASH CC	4	2	COR N	3	CC	2	40	463	17	54	62.5	3921
2021	MA N	ASH CC	4	2	COR N	3	CC	3	80	464	17	55	95.1	5962
2021	MA N	ASH CC	4	2	COR N	3	CC	1	0	465	19	52	50.2	3149
2021	MA N	ASH CC	4	2	COR N	2	DSB	4	160	466	16	58	174	10907
2021	MA N	ASH CC	4	2	COR N	2	DSB	2	40	467	16	57	125	7825
2021	MA N	ASH CC	4	2	COR N	2	DSB	1	0	468	16	56	94.5	5926
2021	MA N	ASH CC	4	2	COR N	2	DSB	5	240	469	16	57	155	9719
2021	MA N	ASH CC	4	2	COR N	2	DSB	3	80	470	15	57	141	8854
2021	MA N	ASH CC	4	2	COR N	1	CF	5	240	471	15	58	178	11145
2021	MA N	ASH CC	4	2	COR N	1	CF	3	80	472	16	57	174	10882
2021	MA N	ASH CC	4	2	COR N	1	CF	1	0	473	16	56	114	7162
2021	MA N	ASH CC	4	2	COR N	1	CF	4	160	474	15	58	181	11334

202 1	MA N	ASH CC	4	2	COR N	1	CF	2	40	475	16	56	120	7503
202 1	MA N	ASH CC	4	2	COR N	6	FTC	4	160	476	16	58	164	10314
202 1	MA N	ASH CC	4	2	COR N	6	FTC	5	240	477	16	57	166	10413
202 1	MA N	ASH CC	4	2	COR N	6	FTC	1	0	478	19	54	60.6	3797
202 1	MA N	ASH CC	4	2	COR N	6	FTC	3	80	479	16	55	107	6720
202 1	MA N	ASH CC	4	2	COR N	6	FTC	2	40	480	16	55	65.5	4106
202 1	MA N	ASH CC	4	2	COR N	5	R/C	4	160	481	16	56	134	8394
202 1	MA N	ASH CC	4	2	COR N	5	R/C	5	240	482	18	55	146	9150
202 1	MA N	ASH CC	4	2	COR N	5	R/C	2	40	483	17	54	70.5	4419
202 1	MA N	ASH CC	4	2	COR N	5	R/C	3	80	484	17	55	106	6639
202 1	MA N	ASH CC	4	2	COR N	5	R/C	1	0	485	19	52	56.7	3556
202 1	MA N	ASH CC	4	2	COR N	4	CR	4	160	486	16	58	145	9067
202 1	MA N	ASH CC	4	2	COR N	4	CR	2	40	487	17	55	57.7	3620
202 1	MA N	ASH CC	4	2	COR N	4	CR	1	0	488	21	50	40.1	2513
202 1	MA N	ASH CC	4	2	COR N	4	CR	3	80	489	17	54	91.4	5733
202 1	MA N	ASH CC	4	2	COR N	4	CR	5	240	490	16	56	156	9796
202 2	MA N	ASH CC	1	2	COR N	5	R/C	4	160	161	14	58	136	8503
202 2	MA N	ASH CC	1	2	COR N	5	R/C	1	0	162	13	56	71.1	4457
202 2	MA N	ASH CC	1	2	COR N	5	R/C	3	80	163	14	58	102	6389
202 2	MA N	ASH CC	1	2	COR N	5	R/C	5	240	164	14	58	133	8345
202 2	MA N	ASH CC	1	2	COR N	5	R/C	2	40	165	13	56	83	5208
202 2	MA N	ASH CC	1	2	COR N	6	FTC	5	240	166	14	59	158	9915
202 2	MA N	ASH CC	1	2	COR N	6	FTC	3	80	167	13	58	141	8839
202 2	MA N	ASH CC	1	2	COR N	6	FTC	4	160	168	14	60	160	10011
202 2	MA N	ASH CC	1	2	COR N	6	FTC	2	40	169	13	58	99.3	6225
202 2	MA N	ASH CC	1	2	COR N	6	FTC	1	0	170	12	56	64.2	4026
202 2	MA N	ASH CC	1	2	COR N	2	DSB	4	160	171	13	59	188	11808

202 2	MA N	ASH CC	1	2	COR N	2	DSB	2	40	172	13	58	167	10475
202 2	MA N	ASH CC	1	2	COR N	2	DSB	3	80	173	13	59	173	10832
202 2	MA N	ASH CC	1	2	COR N	2	DSB	1	0	174	13	58	114	7158
202 2	MA N	ASH CC	1	2	COR N	2	DSB	5	240	175	14	58	168	10534
202 2	MA N	ASH CC	1	2	COR N	1	CF	5	240	176	14	59	176	11068
202 2	MA N	ASH CC	1	2	COR N	1	CF	3	80	177	14	58	166	10391
202 2	MA N	ASH CC	1	2	COR N	1	CF	1	0	178	13	59	121	7566
202 2	MA N	ASH CC	1	2	COR N	1	CF	4	160	179	14	58	189	11875
202 2	MA N	ASH CC	1	2	COR N	1	CF	2	40	180	13	59	127	7993
202 2	MA N	ASH CC	1	2	COR N	4	CR	5	240	181	14	59	131	8212
202 2	MA N	ASH CC	1	2	COR N	4	CR	4	160	182	14	58	138	8629
202 2	MA N	ASH CC	1	2	COR N	4	CR	1	0	183	14	56	40.4	2535
202 2	MA N	ASH CC	1	2	COR N	4	CR	3	80	184	14	57	93.9	5890
202 2	MA N	ASH CC	1	2	COR N	4	CR	2	40	185	13	56	47.2	2959
202 2	MA N	ASH CC	1	2	COR N	3	CC	1	0	186	13	58	110	6927
202 2	MA N	ASH CC	1	2	COR N	3	CC	5	240	187	14	59	175	10960
202 2	MA N	ASH CC	1	2	COR N	3	CC	3	80	188	13	59	167	10451
202 2	MA N	ASH CC	1	2	COR N	3	CC	4	160	189	13	59	165	10344
202 2	MA N	ASH CC	1	2	COR N	3	CC	2	40	190	13	59	126	7910
202 2	MA N	ASH CC	2	2	COR N	2	DSB	2	40	201	13	58	144	9022
202 2	MA N	ASH CC	2	2	COR N	2	DSB	5	240	202	14	58	179	11221
202 2	MA N	ASH CC	2	2	COR N	2	DSB	1	0	203	13	58	115	7238
202 2	MA N	ASH CC	2	2	COR N	2	DSB	3	80	204	14	59	159	9999
202 2	MA N	ASH CC	2	2	COR N	2	DSB	4	160	205	13	59	153	9570
202 2	MA N	ASH CC	2	2	COR N	4	CR	1	0	206	14	55	15.5	972
202 2	MA N	ASH CC	2	2	COR N	4	CR	5	240	207	15	58	133	8348
202 2	MA N	ASH CC	2	2	COR N	4	CR	3	80	208	14	58	104	6508

202 2	MA N	ASH CC	2	2	COR N	4	CR	2	40	209	14	56	54.9	3444
202 2	MA N	ASH CC	2	2	COR N	4	CR	4	160	210	14	58	140	8797
202 2	MA N	ASH CC	2	2	COR N	3	CC	2	40	211	14	59	138	8631
202 2	MA N	ASH CC	2	2	COR N	3	CC	4	160	212	14	59	173	10849
202 2	MA N	ASH CC	2	2	COR N	3	CC	5	240	213	14	59	161	10071
202 2	MA N	ASH CC	2	2	COR N	3	CC	3	80	214	14	59	157	9844
202 2	MA N	ASH CC	2	2	COR N	3	CC	1	0	215	14	58	88.3	5534
202 2	MA N	ASH CC	2	2	COR N	5	R/C	1	0	216	13	51	19.1	1200
202 2	MA N	ASH CC	2	2	COR N	5	R/C	2	40	217	14	56	89.8	5629
202 2	MA N	ASH CC	2	2	COR N	5	R/C	4	160	218	14	58	129	8080
202 2	MA N	ASH CC	2	2	COR N	5	R/C	3	80	219	14	58	114	7141
202 2	MA N	ASH CC	2	2	COR N	5	R/C	5	240	220	14	58	144	9041
202 2	MA N	ASH CC	2	2	COR N	6	FTC	1	0	221	13	57	50	3133
202 2	MA N	ASH CC	2	2	COR N	6	FTC	2	40	222	13	58	97.4	6108
202 2	MA N	ASH CC	2	2	COR N	6	FTC	3	80	223	13	58	120	7540
202 2	MA N	ASH CC	2	2	COR N	6	FTC	5	240	224	14	59	166	10390
202 2	MA N	ASH CC	2	2	COR N	6	FTC	4	160	225	14	59	131	8227
202 2	MA N	ASH CC	2	2	COR N	1	CF	2	40	226	13	58	137	8601
202 2	MA N	ASH CC	2	2	COR N	1	CF	4	160	227	13	58	179	11207
202 2	MA N	ASH CC	2	2	COR N	1	CF	5	240	228	13	60	172	10809
202 2	MA N	ASH CC	2	2	COR N	1	CF	3	80	229	13	57	164	10259
202 2	MA N	ASH CC	2	2	COR N	1	CF	1	0	230	13	57	112	7048
202 2	MA N	ASH CC	3	2	COR N	3	CC	4	160	361	13	54	143	8982
202 2	MA N	ASH CC	3	2	COR N	3	CC	2	40	362	13	57	88.6	5555
202 2	MA N	ASH CC	3	2	COR N	3	CC	1	0	363	14	59	78.9	4947
202 2	MA N	ASH CC	3	2	COR N	3	CC	5	240	364	13	58	144	9022
202 2	MA N	ASH CC	3	2	COR N	3	CC	3	80	365	13	58	123	7703

202 2	MA N	ASH CC	3	2	COR N	2	DSB	3	80	366	13	59	155	9722
202 2	MA N	ASH CC	3	2	COR N	2	DSB	4	160	367	14	59	154	9654
202 2	MA N	ASH CC	3	2	COR N	2	DSB	2	40	368	13	58	132	8265
202 2	MA N	ASH CC	3	2	COR N	2	DSB	5	240	369	13	58	147	9247
202 2	MA N	ASH CC	3	2	COR N	2	DSB	1	0	370	13	57	95.2	5969
202 2	MA N	ASH CC	3	2	COR N	5	R/C	5	240	371	14	57	119	7455
202 2	MA N	ASH CC	3	2	COR N	5	R/C	4	160	372	14	56	131	8227
202 2	MA N	ASH CC	3	2	COR N	5	R/C	3	80	373	13	57	96.4	6047
202 2	MA N	ASH CC	3	2	COR N	5	R/C	2	40	374	13	54	72	4515
202 2	MA N	ASH CC	3	2	COR N	5	R/C	1	0	375	14	55	37.2	2330
202 2	MA N	ASH CC	3	2	COR N	4	CR	1	0	376	14	53	22.9	1435
202 2	MA N	ASH CC	3	2	COR N	4	CR	2	40	377	14	53	70.5	4423
202 2	MA N	ASH CC	3	2	COR N	4	CR	3	80	378	14	55	95.1	5964
202 2	MA N	ASH CC	3	2	COR N	4	CR	5	240	379	14	56	132	8308
202 2	MA N	ASH CC	3	2	COR N	4	CR	4	160	380	14	57	118	7389
202 2	MA N	ASH CC	3	2	COR N	6	FTC	1	0	381	13	57	61	3826
202 2	MA N	ASH CC	3	2	COR N	6	FTC	3	80	382	13	58	120	7503
202 2	MA N	ASH CC	3	2	COR N	6	FTC	4	160	383	14	58	132	8265
202 2	MA N	ASH CC	3	2	COR N	6	FTC	5	240	384	13	57	153	9592
202 2	MA N	ASH CC	3	2	COR N	6	FTC	2	40	385	12	57	91.4	5731
202 2	MA N	ASH CC	3	2	COR N	1	CF	4	160	386	13	59	147	9218
202 2	MA N	ASH CC	3	2	COR N	1	CF	5	240	387	13	58	168	10559
202 2	MA N	ASH CC	3	2	COR N	1	CF	1	0	388	13	58	101	6311
202 2	MA N	ASH CC	3	2	COR N	1	CF	3	80	389	13	58	156	9791
202 2	MA N	ASH CC	3	2	COR N	1	CF	2	40	390	13	60	128	8000
202 2	MA N	ASH CC	4	2	COR N	4	CR	3	80	401	14	57	83.9	5260
202 2	MA N	ASH CC	4	2	COR N	4	CR	2	40	402	14	57	77.7	4870

202 2	MA N	ASH CC	4	2	COR N	4	CR	5	240	403	14	57	140	8800
202 2	MA N	ASH CC	4	2	COR N	4	CR	4	160	404	14	58	145	9070
202 2	MA N	ASH CC	4	2	COR N	4	CR	1	0	405	13	54	39.5	2479
202 2	MA N	ASH CC	4	2	COR N	1	CF	4	160	406	13	58	149	9348
202 2	MA N	ASH CC	4	2	COR N	1	CF	5	240	407	13	60	165	10319
202 2	MA N	ASH CC	4	2	COR N	1	CF	1	0	408	13	58	120	7496
202 2	MA N	ASH CC	4	2	COR N	1	CF	3	80	409	13	59	153	9579
202 2	MA N	ASH CC	4	2	COR N	1	CF	2	40	410	13	59	145	9071
202 2	MA N	ASH CC	4	2	COR N	2	DSB	2	40	411	12	58	135	8462
202 2	MA N	ASH CC	4	2	COR N	2	DSB	1	0	412	13	57	105	6608
202 2	MA N	ASH CC	4	2	COR N	2	DSB	4	160	413	13	59	136	8518
202 2	MA N	ASH CC	4	2	COR N	2	DSB	3	80	414	13	58	145	9112
202 2	MA N	ASH CC	4	2	COR N	2	DSB	5	240	415	13	57	158	9900
202 2	MA N	ASH CC	4	2	COR N	6	FTC	1	0	416	13	56	45.6	2857
202 2	MA N	ASH CC	4	2	COR N	6	FTC	2	40	417	12	56	79.2	4966
202 2	MA N	ASH CC	4	2	COR N	6	FTC	4	160	418	14	59	128	8013
202 2	MA N	ASH CC	4	2	COR N	6	FTC	5	240	419	13	58	136	8546
202 2	MA N	ASH CC	4	2	COR N	6	FTC	3	80	420	13	58	117	7366
202 2	MA N	ASH CC	4	2	COR N	3	CC	1	0	421	12	57	80.1	5020
202 2	MA N	ASH CC	4	2	COR N	3	CC	2	40	422	13	57	142	8893
202 2	MA N	ASH CC	4	2	COR N	3	CC	5	240	423	13	57	125	7868
202 2	MA N	ASH CC	4	2	COR N	3	CC	3	80	424	13	58	131	8194
202 2	MA N	ASH CC	4	2	COR N	3	CC	4	160	425	13	58	128	8006
202 2	MA N	ASH CC	4	2	COR N	5	R/C	4	160	426	13	58	116	7285
202 2	MA N	ASH CC	4	2	COR N	5	R/C	5	240	427	13	57	114	7151
202 2	MA N	ASH CC	4	2	COR N	5	R/C	2	40	428	13	54	46	2887
202 2	MA N	ASH CC	4	2	COR N	5	R/C	1	0	429	13	56	51	3201

202 2	MA N	ASH CC	4	2	COR N	5	R/C	3	80	430	13	57	92.5	5798
202 3	MA N	ASH CC	1	2	COR N	6	FTC	4	160	101	12	57	181	11367
202 3	MA N	ASH CC	1	2	COR N	6	FTC	2	40	102	12	56	126	7875
202 3	MA N	ASH CC	1	2	COR N	6	FTC	5	240	103	12	57	179	11247
202 3	MA N	ASH CC	1	2	COR N	6	FTC	1	0	104	12	54	67.6	4239
202 3	MA N	ASH CC	1	2	COR N	6	FTC	3	80	105	12	56	144	9012
202 3	MA N	ASH CC	1	2	COR N	1	CF	3	80	106	12	57	182	11406
202 3	MA N	ASH CC	1	2	COR N	1	CF	2	40	107	12	56	167	10443
202 3	MA N	ASH CC	1	2	COR N	1	CF	4	160	108	12	57	180	11313
202 3	MA N	ASH CC	1	2	COR N	1	CF	1	0	109	12	56	154	9650
202 3	MA N	ASH CC	1	2	COR N	1	CF	5	240	110	12	57	183	11447
202 3	MA N	ASH CC	1	2	COR N	2	DSB	3	80	111	12	55	157	9817
202 3	MA N	ASH CC	1	2	COR N	2	DSB	4	160	112	12	56	172	10813
202 3	MA N	ASH CC	1	2	COR N	2	DSB	5	240	113	12	56	165	10358
202 3	MA N	ASH CC	1	2	COR N	2	DSB	2	40	114	12	56	147	9191
202 3	MA N	ASH CC	1	2	COR N	2	DSB	1	0	115	12	57	110	6901
202 3	MA N	ASH CC	1	2	COR N	5	R/C	5	240	116	12	56	168	10557
202 3	MA N	ASH CC	1	2	COR N	5	R/C	4	160	117	12	57	168	10542
202 3	MA N	ASH CC	1	2	COR N	5	R/C	3	80	118	12	57	139	8721
202 3	MA N	ASH CC	1	2	COR N	5	R/C	2	40	119	12	54	88.5	5548
202 3	MA N	ASH CC	1	2	COR N	5	R/C	1	0	120	13	51	49.4	3100
202 3	MA N	ASH CC	1	2	COR N	3	CC	3	80	121	12	57	163	10233
202 3	MA N	ASH CC	1	2	COR N	3	CC	2	40	122	12	49	141	8835
202 3	MA N	ASH CC	1	2	COR N	3	CC	1	0	123	12	51	123	7695
202 3	MA N	ASH CC	1	2	COR N	3	CC	5	240	124	12	56	171	10729
202 3	MA N	ASH CC	1	2	COR N	3	CC	4	160	125	12	54	172	10771
202 3	MA N	ASH CC	1	2	COR N	4	CR	4	160	126	13	53	167	10479

2023	MA N	ASH CC	1	2	COR N	4	CR	1	0	127	13	51	62.6	3924
2023	MA N	ASH CC	1	2	COR N	4	CR	2	40	128	13	53	71.3	4472
2023	MA N	ASH CC	1	2	COR N	4	CR	3	80	129	13	57	110	6892
2023	MA N	ASH CC	1	2	COR N	4	CR	5	240	130	12	53	156	9808
2023	MA N	ASH CC	2	2	COR N	4	CR	4	160	231	13	58	162	10183
2023	MA N	ASH CC	2	2	COR N	4	CR	3	80	232	13	58	142	8934
2023	MA N	ASH CC	2	2	COR N	4	CR	2	40	233	13	56	115	7185
2023	MA N	ASH CC	2	2	COR N	4	CR	5	240	234	13	57	172	10778
2023	MA N	ASH CC	2	2	COR N	4	CR	1	0	235	13	53	41.4	2595
2023	MA N	ASH CC	2	2	COR N	5	R/C	3	80	236	13	58	142	8880
2023	MA N	ASH CC	2	2	COR N	5	R/C	1	0	237	14	56	52.7	3302
2023	MA N	ASH CC	2	2	COR N	5	R/C	2	40	238	13	55	97.6	6121
2023	MA N	ASH CC	2	2	COR N	5	R/C	5	240	239	12	56	167	10464
2023	MA N	ASH CC	2	2	COR N	5	R/C	4	160	240	13	57	177	11099
2023	MA N	ASH CC	2	2	COR N	3	CC	3	80	241	13	57	165	10372
2023	MA N	ASH CC	2	2	COR N	3	CC	1	0	242	13	58	136	8520
2023	MA N	ASH CC	2	2	COR N	3	CC	2	40	243	13	58	174	10912
2023	MA N	ASH CC	2	2	COR N	3	CC	4	160	244	13	57	188	11799
2023	MA N	ASH CC	2	2	COR N	3	CC	5	240	245	13	57	178	11153
2023	MA N	ASH CC	2	2	COR N	1	CF	3	80	246	12	57	170	10653
2023	MA N	ASH CC	2	2	COR N	1	CF	1	0	247	12	57	142	8910
2023	MA N	ASH CC	2	2	COR N	1	CF	4	160	248	12	57	191	11988
2023	MA N	ASH CC	2	2	COR N	1	CF	5	240	249	12	56	167	10476
2023	MA N	ASH CC	2	2	COR N	1	CF	2	40	250	13	58	182	11409
2023	MA N	ASH CC	2	2	COR N	2	DSB	2	40	251	12	57	128	8055
2023	MA N	ASH CC	2	2	COR N	2	DSB	1	0	252	12	56	104	6507
2023	MA N	ASH CC	2	2	COR N	2	DSB	5	240	253	12	57	170	10636

2023	MA N	ASH CC	2	2	COR N	2	DSB	3	80	254	12	56	169	10566
2023	MA N	ASH CC	2	2	COR N	2	DSB	4	160	255	12	56	172	10815
2023	MA N	ASH CC	2	2	COR N	6	FTC	4	160	256	12	56	167	10473
2023	MA N	ASH CC	2	2	COR N	6	FTC	1	0	257	12	55	80.6	5055
2023	MA N	ASH CC	2	2	COR N	6	FTC	5	240	258	12	56	167	10503
2023	MA N	ASH CC	2	2	COR N	6	FTC	2	40	259	13	56	120	7534
2023	MA N	ASH CC	2	2	COR N	6	FTC	3	80	260	12	57	162	10152
2023	MA N	ASH CC	3	2	COR N	2	DSB	4	160	301	12	55	148	9276
2023	MA N	ASH CC	3	2	COR N	2	DSB	3	80	302	12	56	135	8480
2023	MA N	ASH CC	3	2	COR N	2	DSB	2	40	303	12	56	113	7101
2023	MA N	ASH CC	3	2	COR N	2	DSB	5	240	304	12	55	145	9066
2023	MA N	ASH CC	3	2	COR N	2	DSB	1	0	305	13	57	110	6908
2023	MA N	ASH CC	3	2	COR N	6	FTC	1	0	306	12	55	72.7	4557
2023	MA N	ASH CC	3	2	COR N	6	FTC	2	40	307	12	56	92.6	5805
2023	MA N	ASH CC	3	2	COR N	6	FTC	5	240	308	12	54	139	8746
2023	MA N	ASH CC	3	2	COR N	6	FTC	4	160	309	12	55	155	9705
2023	MA N	ASH CC	3	2	COR N	6	FTC	3	80	310	12	56	127	7993
2023	MA N	ASH CC	3	2	COR N	3	CC	5	240	311	12	56	138	8662
2023	MA N	ASH CC	3	2	COR N	3	CC	1	0	312	12	56	107	6719
2023	MA N	ASH CC	3	2	COR N	3	CC	4	160	313	12	57	154	9650
2023	MA N	ASH CC	3	2	COR N	3	CC	3	80	314	12	58	163	10245
2023	MA N	ASH CC	3	2	COR N	3	CC	2	40	315	12	57	140	8758
2023	MA N	ASH CC	3	2	COR N	4	CR	2	40	316	13	54	87.6	5496
2023	MA N	ASH CC	3	2	COR N	4	CR	1	0	317	13	52	54.4	3413
2023	MA N	ASH CC	3	2	COR N	4	CR	5	240	318	12	56	139	8741
2023	MA N	ASH CC	3	2	COR N	4	CR	4	160	319	12	57	174	10894
2023	MA N	ASH CC	3	2	COR N	4	CR	3	80	320	12	55	118	7398

2023	MA N	ASH CC	3	2	COR N	1	CF	2	40	321	12	58	154	9650
2023	MA N	ASH CC	3	2	COR N	1	CF	5	240	322	12	57	164	10268
2023	MA N	ASH CC	3	2	COR N	1	CF	3	80	323	12	58	178	11162
2023	MA N	ASH CC	3	2	COR N	1	CF	4	160	324	13	57	165	10372
2023	MA N	ASH CC	3	2	COR N	1	CF	1	0	325	12	57	140	8802
2023	MA N	ASH CC	3	2	COR N	5	R/C	5	240	326	12	56	134	8399
2023	MA N	ASH CC	3	2	COR N	5	R/C	1	0	327	13	53	63.5	3982
2023	MA N	ASH CC	3	2	COR N	5	R/C	3	80	328	12	56	118	7371
2023	MA N	ASH CC	3	2	COR N	5	R/C	4	160	329	13	56	171	10695
2023	MA N	ASH CC	3	2	COR N	5	R/C	2	40	330	13	55	81.5	5113
2023	MA N	ASH CC	4	2	COR N	3	CC	1	0	431	12	56	106	6650
2023	MA N	ASH CC	4	2	COR N	3	CC	5	240	432	12	52	153	9613
2023	MA N	ASH CC	4	2	COR N	3	CC	2	40	433	13	58	137	8621
2023	MA N	ASH CC	4	2	COR N	3	CC	4	160	434	12	56	165	10353
2023	MA N	ASH CC	4	2	COR N	3	CC	3	80	435	12	55	153	9618
2023	MA N	ASH CC	4	2	COR N	6	FTC	4	160	436	12	55	142	8900
2023	MA N	ASH CC	4	2	COR N	6	FTC	3	80	437	12	55	134	8389
2023	MA N	ASH CC	4	2	COR N	6	FTC	1	0	438	12	53	77.2	4839
2023	MA N	ASH CC	4	2	COR N	6	FTC	2	40	439	13	56	107	6693
2023	MA N	ASH CC	4	2	COR N	6	FTC	5	240	440	12	56	151	9439
2023	MA N	ASH CC	4	2	COR N	5	R/C	4	160	441	12	55	116	7259
2023	MA N	ASH CC	4	2	COR N	5	R/C	3	80	442	12	56	112	6993
2023	MA N	ASH CC	4	2	COR N	5	R/C	5	240	443	12	55	128	8047
2023	MA N	ASH CC	4	2	COR N	5	R/C	1	0	444	13	55	53.5	3352
2023	MA N	ASH CC	4	2	COR N	5	R/C	2	40	445	12	55	85.2	5340
2023	MA N	ASH CC	4	2	COR N	4	CR	2	40	446	12	54	63.7	3996
2023	MA N	ASH CC	4	2	COR N	4	CR	4	160	447	12	56	133	8337

202 3	MA N	ASH CC	4	2	COR N	4	CR	3	80	448	12	56	95.7	6001
202 3	MA N	ASH CC	4	2	COR N	4	CR	5	240	449	12	53	131	8219
202 3	MA N	ASH CC	4	2	COR N	4	CR	1	0	450	13	52	41.9	2625
202 3	MA N	ASH CC	4	2	COR N	1	CF	2	40	451	12	56	117	7353
202 3	MA N	ASH CC	4	2	COR N	1	CF	3	80	452	12	56	140	8768
202 3	MA N	ASH CC	4	2	COR N	1	CF	5	240	453	12	56	137	8589
202 3	MA N	ASH CC	4	2	COR N	1	CF	1	0	454	12	57	123	7704
202 3	MA N	ASH CC	4	2	COR N	1	CF	4	160	455	12	55	152	9504
202 3	MA N	ASH CC	4	2	COR N	2	DSB	2	40	456	12	55	101	6354
202 3	MA N	ASH CC	4	2	COR N	2	DSB	5	240	457	12	54	131	8228
202 3	MA N	ASH CC	4	2	COR N	2	DSB	1	0	458	12	54	84.4	5295
202 3	MA N	ASH CC	4	2	COR N	2	DSB	4	160	459	12	53	130	8165
202 3	MA N	ASH CC	4	2	COR N	2	DSB	3	80	460	12	54	149	9325
202 2	MA N	ASH CC	1	3	SB 6	F	TC	1	0	131	8.7	55	30.8	2072
202 2	MA N	ASH CC	1	3	SB 6	F	TC	3	80	132	8.8	56	43.9	2946
202 2	MA N	ASH CC	1	3	SB 6	F	TC	2	40	133	8.8	56	33.3	2240
202 2	MA N	ASH CC	1	3	SB 6	F	TC	4	160	134	8.8	57	33.3	2240
202 2	MA N	ASH CC	1	3	SB 6	F	TC	5	240	135	8.7	57	39.6	2657
202 2	MA N	ASH CC	1	3	SB 3	C	C	3	80	136	9	56	48.8	3280
202 2	MA N	ASH CC	1	3	SB 3	C	C	2	40	137	9	56	43	2891
202 2	MA N	ASH CC	1	3	SB 3	C	C	4	160	138	8.9	57	28.6	1922
202 2	MA N	ASH CC	1	3	SB 3	C	C	1	0	139	9	56	34.7	2332
202 2	MA N	ASH CC	1	3	SB 3	C	C	5	240	140	9.1	56	32.5	2184
202 2	MA N	ASH CC	1	3	SB 1	C	F	5	240	141	9.5	54	48.6	3262
202 2	MA N	ASH CC	1	3	SB 1	C	F	3	80	142	9.3	56	44	2954
202 2	MA N	ASH CC	1	3	SB 1	C	F	4	160	143	9.1	56	34.7	2330
202 2	MA N	ASH CC	1	3	SB 1	C	F	2	40	144	9	56	32.9	2211

202 2	MA N	ASH CC	1	3	SB 1	C	F	1	0	145	8.8	56	29.7	1997
202 2	MA N	ASH CC	1	3	SB 2	D	SB	2	40	146	9.2	56	46.2	3103
202 2	MA N	ASH CC	1	3	SB 2	D	SB	3	80	147	9.3	56	45.4	3051
202 2	MA N	ASH CC	1	3	SB 2	D	SB	5	240	148	9.2	56	38.6	2594
202 2	MA N	ASH CC	1	3	SB 2	D	SB	4	160	149	9.1	56	31.4	2111
202 2	MA N	ASH CC	1	3	SB 2	D	SB	1	0	150	9.2	56	38.6	2594
202 2	MA N	ASH CC	1	3	SB 5	R	/C	5	240	151	9.9	54	43.3	2911
202 2	MA N	ASH CC	1	3	SB 5	R	/C	2	40	152	9.8	55	40.1	2697
202 2	MA N	ASH CC	1	3	SB 5	R	/C	4	160	153	9.6	55	37.7	2534
202 2	MA N	ASH CC	1	3	SB 5	R	/C	1	0	154	9.4	55	31.7	2129
202 2	MA N	ASH CC	1	3	SB 5	R	/C	3	80	155	9.3	54	40	2688
202 2	MA N	ASH CC	1	3	SB 4	C	R	5	240	156	10	53	30.7	2060
202 2	MA N	ASH CC	1	3	SB 4	C	R	2	40	157	9.8	54	44.8	3010
202 2	MA N	ASH CC	1	3	SB 4	C	R	4	160	158	9.9	54	40.1	2694
202 2	MA N	ASH CC	1	3	SB 4	C	R	3	80	159	9.6	54	41.3	2776
202 2	MA N	ASH CC	1	3	SB 4	C	R	1	0	160	9.5	55	28.1	1885
202 2	MA N	ASH CC	2	3	SB 3	C	C	3	80	261	9.2	56	32.1	2158
202 2	MA N	ASH CC	2	3	SB 3	C	C	2	40	262	9.1	56	47.3	3179
202 2	MA N	ASH CC	2	3	SB 3	C	C	5	240	263	9.1	56	29.3	1966
202 2	MA N	ASH CC	2	3	SB 3	C	C	4	160	264	9	56	39.1	2624
202 2	MA N	ASH CC	2	3	SB 3	C	C	1	0	265	8.9	56	37.3	2505
202 2	MA N	ASH CC	2	3	SB 1	C	F	5	240	266	9.1	56	36.5	2451
202 2	MA N	ASH CC	2	3	SB 1	C	F	4	160	267	9.3	56	46.1	3100
202 2	MA N	ASH CC	2	3	SB 1	C	F	3	80	268	9.2	56	37.2	2497
202 2	MA N	ASH CC	2	3	SB 1	C	F	2	40	269	9	56	33.6	2260
202 2	MA N	ASH CC	2	3	SB 1	C	F	1	0	270	9.3	56	27	1816
202 2	MA N	ASH CC	2	3	SB 6	F	TC	4	160	271	9.1	55	36.8	2476

202 2	MA N	ASH CC	2	3	SB 6	F	TC	3	80	272	9.1	55	30.7	2063
202 2	MA N	ASH CC	2	3	SB 6	F	TC	1	0	273	9.2	56	36.1	2424
202 2	MA N	ASH CC	2	3	SB 6	F	TC	5	240	274	9.1	56	46.6	3131
202 2	MA N	ASH CC	2	3	SB 6	F	TC	2	40	275	9.2	56	34.6	2327
202 2	MA N	ASH CC	2	3	SB 4	C	R	5	240	276	9.1	56	33.2	2233
202 2	MA N	ASH CC	2	3	SB 4	C	R	4	160	277	9.1	55	43.4	2912
202 2	MA N	ASH CC	2	3	SB 4	C	R	2	40	278	9.3	55	31	2083
202 2	MA N	ASH CC	2	3	SB 4	C	R	3	80	279	9.1	55	38.3	2573
202 2	MA N	ASH CC	2	3	SB 4	C	R	1	0	280	9.1	56	36.8	2476
202 2	MA N	ASH CC	2	3	SB 2	D	SB	3	80	281	9.3	55	25.6	1719
202 2	MA N	ASH CC	2	3	SB 2	D	SB	5	240	282	9.3	56	35	2349
202 2	MA N	ASH CC	2	3	SB 2	D	SB	1	0	283	9.3	55	34.2	2301
202 2	MA N	ASH CC	2	3	SB 2	D	SB	4	160	284	9.3	55	41.1	2761
202 2	MA N	ASH CC	2	3	SB 2	D	SB	2	40	285	9.1	55	36.5	2451
202 2	MA N	ASH CC	2	3	SB 5	R	/C	2	40	286	9.4	54	27.7	1863
202 2	MA N	ASH CC	2	3	SB 5	R	/C	5	240	287	9.4	54	42.8	2879
202 2	MA N	ASH CC	2	3	SB 5	R	/C	3	80	288	9.4	55	37.4	2516
202 2	MA N	ASH CC	2	3	SB 5	R	/C	1	0	289	9.5	55	39.6	2658
202 2	MA N	ASH CC	2	3	SB 5	R	/C	4	160	290	9.6	54	27.7	1858
202 2	MA N	ASH CC	3	3	SB 1	C	F	3	80	331	9.2	52	41.1	2764
202 2	MA N	ASH CC	3	3	SB 1	C	F	5	240	332	9.1	54	45.5	3058
202 2	MA N	ASH CC	3	3	SB 1	C	F	1	0	333	9.1	54	36.8	2476
202 2	MA N	ASH CC	3	3	SB 1	C	F	4	160	334	9.3	56	39.3	2640
202 2	MA N	ASH CC	3	3	SB 1	C	F	2	40	335	8.9	54	46	3089
202 2	MA N	ASH CC	3	3	SB 3	C	C	2	40	336	9	55	30.4	2041
202 2	MA N	ASH CC	3	3	SB 3	C	C	1	0	337	9.2	54	35.4	2376
202 2	MA N	ASH CC	3	3	SB 3	C	C	4	160	338	9.1	54	53.8	3616

202 2	MA N	ASH CC	3	3	SB 3	C	C	5	240	339	9.3	55	43.3	2906
202 2	MA N	ASH CC	3	3	SB 3	C	C	3	80	340	9.3	55	33.9	2276
202 2	MA N	ASH CC	3	3	SB 6	F	TC	4	160	341	9.3	54	33.9	2276
202 2	MA N	ASH CC	3	3	SB 6	F	TC	2	40	342	9.3	54	41.1	2761
202 2	MA N	ASH CC	3	3	SB 6	F	TC	1	0	343	9.3	54	37.8	2543
202 2	MA N	ASH CC	3	3	SB 6	F	TC	5	240	344	9.4	53	52.9	3556
202 2	MA N	ASH CC	3	3	SB 6	F	TC	3	80	345	9.2	52	30.7	2061
202 2	MA N	ASH CC	3	3	SB 2	D	SB	5	240	346	9.1	55	31.8	2136
202 2	MA N	ASH CC	3	3	SB 2	D	SB	2	40	347	9.3	55	28.8	1937
202 2	MA N	ASH CC	3	3	SB 2	D	SB	4	160	348	9.5	55	48.9	3286
202 2	MA N	ASH CC	3	3	SB 2	D	SB	3	80	349	9.3	55	45.8	3075
202 2	MA N	ASH CC	3	3	SB 2	D	SB	1	0	350	9.4	54	24.8	1669
202 2	MA N	ASH CC	3	3	SB 4	C	R	5	240	351	9.8	54	35.8	2408
202 2	MA N	ASH CC	3	3	SB 4	C	R	4	160	352	9.5	54	26.6	1788
202 2	MA N	ASH CC	3	3	SB 4	C	R	2	40	353	9.5	55	36	2416
202 2	MA N	ASH CC	3	3	SB 4	C	R	1	0	354	9.4	54	33.8	2274
202 2	MA N	ASH CC	3	3	SB 4	C	R	3	80	355	9.4	53	30.2	2032
202 2	MA N	ASH CC	3	3	SB 5	R	/C	4	160	356	9.7	54	25.5	1712
202 2	MA N	ASH CC	3	3	SB 5	R	/C	3	80	357	9.6	54	24.1	1617
202 2	MA N	ASH CC	3	3	SB 5	R	/C	5	240	358	9.7	54	40.9	2748
202 2	MA N	ASH CC	3	3	SB 5	R	/C	2	40	359	9.7	53	38.4	2580
202 2	MA N	ASH CC	3	3	SB 5	R	/C	1	0	360	9.7	54	23	1543
202 2	MA N	ASH CC	4	3	SB 3	C	C	4	160	461	9	55	32.5	2187
202 2	MA N	ASH CC	4	3	SB 3	C	C	5	240	462	9	54	25.7	1725
202 2	MA N	ASH CC	4	3	SB 3	C	C	2	40	463	8.7	54	35.2	2365
202 2	MA N	ASH CC	4	3	SB 3	C	C	3	80	464	8.8	55	26.5	1778
202 2	MA N	ASH CC	4	3	SB 3	C	C	1	0	465	8.7	55	28.3	1901

202 2	MA N	ASH CC	4	3	SB 2	D	SB	4	160	466	9.3	55	32.8	2204
202 2	MA N	ASH CC	4	3	SB 2	D	SB	2	40	467	9.3	55	26.3	1768
202 2	MA N	ASH CC	4	3	SB 2	D	SB	1	0	468	9.2	56	30.3	2036
202 2	MA N	ASH CC	4	3	SB 2	D	SB	5	240	469	9.2	56	31.4	2109
202 2	MA N	ASH CC	4	3	SB 2	D	SB	3	80	470	9.2	56	27.8	1867
202 2	MA N	ASH CC	4	3	SB 1	C	F	5	240	471	9.5	55	39.9	2682
202 2	MA N	ASH CC	4	3	SB 1	C	F	3	80	472	9.5	55	37.4	2513
202 2	MA N	ASH CC	4	3	SB 1	C	F	1	0	473	9.4	55	29.9	2008
202 2	MA N	ASH CC	4	3	SB 1	C	F	4	160	474	9.5	55	35.2	2368
202 2	MA N	ASH CC	4	3	SB 1	C	F	2	40	475	9.1	55	25.3	1699
202 2	MA N	ASH CC	4	3	SB 6	F	TC	4	160	476	9.7	56	37.3	2507
202 2	MA N	ASH CC	4	3	SB 6	F	TC	5	240	477	9.6	55	34.8	2341
202 2	MA N	ASH CC	4	3	SB 6	F	TC	1	0	478	9.5	56	33.1	2223
202 2	MA N	ASH CC	4	3	SB 6	F	TC	3	80	479	9.5	56	35.6	2392
202 2	MA N	ASH CC	4	3	SB 6	F	TC	2	40	480	9.4	56	23.4	1572
202 2	MA N	ASH CC	4	3	SB 5	R	/C	4	160	481	10	54	21.1	1418
202 2	MA N	ASH CC	4	3	SB 5	R	/C	5	240	482	9.8	55	43	2890
202 2	MA N	ASH CC	4	3	SB 5	R	/C	2	40	483	9.7	54	28.7	1929
202 2	MA N	ASH CC	4	3	SB 5	R	/C	3	80	484	9.8	54	31.2	2095
202 2	MA N	ASH CC	4	3	SB 5	R	/C	1	0	485	9.7	55	30.5	2049
202 2	MA N	ASH CC	4	3	SB 4	C	R	4	160	486	9.7	55	31.6	2122
202 2	MA N	ASH CC	4	3	SB 4	C	R	2	40	487	9.8	55	33	2216
202 2	MA N	ASH CC	4	3	SB 4	C	R	1	0	488	9.8	54	32.3	2167
202 2	MA N	ASH CC	4	3	SB 4	C	R	3	80	489	9.8	55	27.6	1854
202 2	MA N	ASH CC	4	3	SB 4	C	R	5	240	490	9.7	55	24	1615
202 3	MA N	ASH CC	1	3	SB 5	R	/C	4	160	161	11	55	27.3	1836
202 3	MA N	ASH CC	1	3	SB 5	R	/C	1	0	162	11	54	23.7	1591

2023	MA N	ASH CC	1	3	SB 5	R	/C	3	80	163	11	55	27.7	1861
2023	MA N	ASH CC	1	3	SB 5	R	/C	5	240	164	11	55	26.8	1802
2023	MA N	ASH CC	1	3	SB 5	R	/C	2	40	165	11	55	23.7	1590
2023	MA N	ASH CC	1	3	SB 6	F	TC	5	240	166	11	55	25.4	1703
2023	MA N	ASH CC	1	3	SB 6	F	TC	3	80	167	11	55	29.7	1996
2023	MA N	ASH CC	1	3	SB 6	F	TC	4	160	168	11	55	35.8	2403
2023	MA N	ASH CC	1	3	SB 6	F	TC	2	40	169	11	55	26.6	1785
2023	MA N	ASH CC	1	3	SB 6	F	TC	1	0	170	11	53	25.7	1728
2023	MA N	ASH CC	1	3	SB 2	D	SB	4	160	171	11	56	31.1	2088
2023	MA N	ASH CC	1	3	SB 2	D	SB	2	40	172	11	55	29.7	1998
2023	MA N	ASH CC	1	3	SB 2	D	SB	3	80	173	11	55	34.1	2294
2023	MA N	ASH CC	1	3	SB 2	D	SB	1	0	174	11	55	33.6	2260
2023	MA N	ASH CC	1	3	SB 2	D	SB	5	240	175	11	55	29.6	1992
2023	MA N	ASH CC	1	3	SB 1	C	F	5	240	176	11	55	30.3	2034
2023	MA N	ASH CC	1	3	SB 1	C	F	3	80	177	10	55	33.6	2256
2023	MA N	ASH CC	1	3	SB 1	C	F	1	0	178	11	55	29.5	1981
2023	MA N	ASH CC	1	3	SB 1	C	F	4	160	179	11	55	33.4	2246
2023	MA N	ASH CC	1	3	SB 1	C	F	2	40	180	10	55	32.3	2173
2023	MA N	ASH CC	1	3	SB 4	C	R	5	240	181	11	56	30.7	2061
2023	MA N	ASH CC	1	3	SB 4	C	R	4	160	182	11	56	29.5	1981
2023	MA N	ASH CC	1	3	SB 4	C	R	1	0	183	11	55	34.3	2302
2023	MA N	ASH CC	1	3	SB 4	C	R	3	80	184	11	55	35.4	2379
2023	MA N	ASH CC	1	3	SB 4	C	R	2	40	185	11	55	33	2219
2023	MA N	ASH CC	1	3	SB 3	C	C	1	0	186	11	55	35.8	2403
2023	MA N	ASH CC	1	3	SB 3	C	C	5	240	187	11	56	33.9	2275
2023	MA N	ASH CC	1	3	SB 3	C	C	3	80	188	10	55	31.9	2146
2023	MA N	ASH CC	1	3	SB 3	C	C	4	160	189	10	55	30.8	2068

2023	MA N	ASH CC	1	3	SB 3	C	C	2	40	190	10	55	37.9	2548
2023	MA N	ASH CC	2	3	SB 2	D	SB	2	40	201	10	55	28	1878
2023	MA N	ASH CC	2	3	SB 2	D	SB	5	240	202	10	55	27.2	1824
2023	MA N	ASH CC	2	3	SB 2	D	SB	1	0	203	11	55	32.7	2195
2023	MA N	ASH CC	2	3	SB 2	D	SB	3	80	204	10	55	32.8	2204
2023	MA N	ASH CC	2	3	SB 2	D	SB	4	160	205	10	55	29.5	1983
2023	MA N	ASH CC	2	3	SB 4	C	R	1	0	206	10	56	36.3	2441
2023	MA N	ASH CC	2	3	SB 4	C	R	5	240	207	10	56	34	2285
2023	MA N	ASH CC	2	3	SB 4	C	R	3	80	208	10	55	36.7	2468
2023	MA N	ASH CC	2	3	SB 4	C	R	2	40	209	10	55	32.4	2175
2023	MA N	ASH CC	2	3	SB 4	C	R	4	160	210	10	55	28.3	1904
2023	MA N	ASH CC	2	3	SB 3	C	C	2	40	211	10	56	40.8	2739
2023	MA N	ASH CC	2	3	SB 3	C	C	4	160	212	10	55	38.3	2575
2023	MA N	ASH CC	2	3	SB 3	C	C	5	240	213	10	56	34.5	2315
2023	MA N	ASH CC	2	3	SB 3	C	C	3	80	214	10	55	31.9	2143
2023	MA N	ASH CC	2	3	SB 3	C	C	1	0	215	10	55	30	2014
2023	MA N	ASH CC	2	3	SB 5	R	/C	1	0	216	10	56	34	2285
2023	MA N	ASH CC	2	3	SB 5	R	/C	2	40	217	10	56	37.6	2524
2023	MA N	ASH CC	2	3	SB 5	R	/C	4	160	218	10	55	30.8	2068
2023	MA N	ASH CC	2	3	SB 5	R	/C	3	80	219	10	55	38	2551
2023	MA N	ASH CC	2	3	SB 5	R	/C	5	240	220	10	56	31.2	2099
2023	MA N	ASH CC	2	3	SB 6	F	TC	1	0	221	10	56	30.4	2041
2023	MA N	ASH CC	2	3	SB 6	F	TC	2	40	222	10	56	39.6	2661
2023	MA N	ASH CC	2	3	SB 6	F	TC	3	80	223	10	56	37.3	2503
2023	MA N	ASH CC	2	3	SB 6	F	TC	5	240	224	10	56	37.7	2530
2023	MA N	ASH CC	2	3	SB 6	F	TC	4	160	225	10	55	30.4	2043
2023	MA N	ASH CC	2	3	SB 1	C	F	2	40	226	10	54	29.2	1960

2023	MA N	ASH CC	2	3	SB 1	C	F	4	160	227	10	55	34	2283
2023	MA N	ASH CC	2	3	SB 1	C	F	5	240	228	10	55	38.4	2581
2023	MA N	ASH CC	2	3	SB 1	C	F	3	80	229	9.9	55	30.9	2075
2023	MA N	ASH CC	2	3	SB 1	C	F	1	0	230	10	54	36.1	2422
2023	MA N	ASH CC	3	3	SB 3	C	C	4	160	361	9.9	56	20.5	1374
2023	MA N	ASH CC	3	3	SB 3	C	C	2	40	362	9.8	56	26.5	1780
2023	MA N	ASH CC	3	3	SB 3	C	C	1	0	363	9.8	56	25.3	1699
2023	MA N	ASH CC	3	3	SB 3	C	C	5	240	364	10	56	25.2	1696
2023	MA N	ASH CC	3	3	SB 3	C	C	3	80	365	10	56	28.4	1909
2023	MA N	ASH CC	3	3	SB 2	D	SB	3	80	366	9.7	57	27.7	1863
2023	MA N	ASH CC	3	3	SB 2	D	SB	4	160	367	9.5	57	32.2	2165
2023	MA N	ASH CC	3	3	SB 2	D	SB	2	40	368	9.5	56	36.3	2436
2023	MA N	ASH CC	3	3	SB 2	D	SB	5	240	369	9.5	56	39.9	2679
2023	MA N	ASH CC	3	3	SB 2	D	SB	1	0	370	9.8	55	30.5	2050
2023	MA N	ASH CC	3	3	SB 5	R	/C	5	240	371	9.6	56	23.7	1595
2023	MA N	ASH CC	3	3	SB 5	R	/C	4	160	372	9.6	56	30.6	2054
2023	MA N	ASH CC	3	3	SB 5	R	/C	3	80	373	9.5	56	36.3	2436
2023	MA N	ASH CC	3	3	SB 5	R	/C	2	40	374	9.7	56	33	2214
2023	MA N	ASH CC	3	3	SB 5	R	/C	1	0	375	10	55	31.2	2099
2023	MA N	ASH CC	3	3	SB 4	C	R	1	0	376	9.8	56	26.5	1780
2023	MA N	ASH CC	3	3	SB 4	C	R	2	40	377	9.7	56	33.4	2241
2023	MA N	ASH CC	3	3	SB 4	C	R	3	80	378	9.7	55	32.6	2187
2023	MA N	ASH CC	3	3	SB 4	C	R	5	240	379	9.8	55	33.7	2266
2023	MA N	ASH CC	3	3	SB 4	C	R	4	160	380	9.7	55	31	2079
2023	MA N	ASH CC	3	3	SB 6	F	TC	1	0	381	9.8	55	26.9	1807
2023	MA N	ASH CC	3	3	SB 6	F	TC	3	80	382	9.7	55	35	2349
2023	MA N	ASH CC	3	3	SB 6	F	TC	4	160	383	9.5	56	32.2	2165

2023	MA N	ASH CC	3	3	SB 6	F	TC	5	240	384	9.7	56	32.2	2160
2023	MA N	ASH CC	3	3	SB 6	F	TC	2	40	385	9.7	55	26.5	1782
2023	MA N	ASH CC	3	3	SB 1	C	F	4	160	386	9.5	58	22.6	1516
2023	MA N	ASH CC	3	3	SB 1	C	F	5	240	387	9.6	54	34.2	2298
2023	MA N	ASH CC	3	3	SB 1	C	F	1	0	388	9.6	55	30.6	2054
2023	MA N	ASH CC	3	3	SB 1	C	F	3	80	389	9.5	56	37.1	2490
2023	MA N	ASH CC	3	3	SB 1	C	F	2	40	390	9.6	55	28.6	1919
2023	MA N	ASH CC	4	3	SB 4	C	R	3	80	401	9.9	54	22.9	1536
2023	MA N	ASH CC	4	3	SB 4	C	R	2	40	402	9.8	56	35.3	2374
2023	MA N	ASH CC	4	3	SB 4	C	R	5	240	403	9.8	56	28.1	1888
2023	MA N	ASH CC	4	3	SB 4	C	R	4	160	404	9.8	56	31.7	2131
2023	MA N	ASH CC	4	3	SB 4	C	R	1	0	405	9.7	55	28.9	1944
2023	MA N	ASH CC	4	3	SB 1	C	F	4	160	406	9.7	55	27.3	1836
2023	MA N	ASH CC	4	3	SB 1	C	F	5	240	407	9.9	55	28.1	1886
2023	MA N	ASH CC	4	3	SB 1	C	F	1	0	408	9.8	56	23.3	1564
2023	MA N	ASH CC	4	3	SB 1	C	F	3	80	409	9.7	56	33.4	2241
2023	MA N	ASH CC	4	3	SB 1	C	F	2	40	410	9.8	56	36.5	2455
2023	MA N	ASH CC	4	3	SB 2	D	SB	2	40	411	9.6	56	23.3	1568
2023	MA N	ASH CC	4	3	SB 2	D	SB	1	0	412	9.7	56	30.1	2025
2023	MA N	ASH CC	4	3	SB 2	D	SB	4	160	413	9.5	56	31.4	2111
2023	MA N	ASH CC	4	3	SB 2	D	SB	3	80	414	9.7	56	34.6	2322
2023	MA N	ASH CC	4	3	SB 2	D	SB	5	240	415	9.6	56	28.2	1892
2023	MA N	ASH CC	4	3	SB 6	F	TC	1	0	416	9.7	55	30.5	2052
2023	MA N	ASH CC	4	3	SB 6	F	TC	2	40	417	9.6	55	30.6	2054
2023	MA N	ASH CC	4	3	SB 6	F	TC	4	160	418	9.6	56	31.8	2136
2023	MA N	ASH CC	4	3	SB 6	F	TC	5	240	419	9.5	56	35.4	2382
2023	MA N	ASH CC	4	3	SB 6	F	TC	3	80	420	9.5	56	32.2	2165

2023	MA N	ASH CC	4	3	SB 3	C	C	1	0	421	9.5	56	26.6	1786
2023	MA N	ASH CC	4	3	SB 3	C	C	2	40	422	9.4	56	28.6	1924
2023	MA N	ASH CC	4	3	SB 3	C	C	5	240	423	9.5	55	25.8	1732
2023	MA N	ASH CC	4	3	SB 3	C	C	3	80	424	9.5	56	33.8	2273
2023	MA N	ASH CC	4	3	SB 3	C	C	4	160	425	9.5	56	31	2084
2023	MA N	ASH CC	4	3	SB 5	R	/C	4	160	426	9.5	56	24.2	1624
2023	MA N	ASH CC	4	3	SB 5	R	/C	5	240	427	9.6	56	24.9	1676
2023	MA N	ASH CC	4	3	SB 5	R	/C	2	40	428	9.5	56	35.9	2409
2023	MA N	ASH CC	4	3	SB 5	R	/C	1	0	429	9.5	56	35.9	2409
2023	MA N	ASH CC	4	3	SB 5	R	/C	3	80	430	9.5	56	29.8	2003
2024	MA N	ASH CC	1	3	SB 6	F	TC	4	160	101	7.9	57	54.2	3642
2024	MA N	ASH CC	1	3	SB 6	F	TC	2	40	102	7.9	53	54.2	3642
2024	MA N	ASH CC	1	3	SB 6	F	TC	5	240	103	7.9	57	50.6	3397
2024	MA N	ASH CC	1	3	SB 6	F	TC	1	0	104	8	56	56.6	3801
2024	MA N	ASH CC	1	3	SB 6	F	TC	3	80	105	8	57	57.4	3855
2024	MA N	ASH CC	1	3	SB 1	C	F	3	80	106	7.9	53	57	3832
2024	MA N	ASH CC	1	3	SB 1	C	F	2	40	107	7.9	53	53	3560
2024	MA N	ASH CC	1	3	SB 1	C	F	4	160	108	8	57	56.6	3801
2024	MA N	ASH CC	1	3	SB 1	C	F	1	0	109	8	57	57.4	3855
2024	MA N	ASH CC	1	3	SB 1	C	F	5	240	110	7.9	57	58.7	3941
2024	MA N	ASH CC	1	3	SB 2	D	SB	3	80	111	8	57	57	3828
2024	MA N	ASH CC	1	3	SB 2	D	SB	4	160	112	7.9	57	57	3832
2024	MA N	ASH CC	1	3	SB 2	D	SB	5	240	113	8	57	59.8	4018
2024	MA N	ASH CC	1	3	SB 2	D	SB	2	40	114	7.9	57	59.1	3968
2024	MA N	ASH CC	1	3	SB 2	D	SB	1	0	115	7.9	56	57.8	3887
2024	MA N	ASH CC	1	3	SB 5	R	/C	5	240	116	7.8	56	55.5	3728
2024	MA N	ASH CC	1	3	SB 5	R	/C	4	160	117	8.1	57	57.7	3878

202 4	MA N	ASH CC	1	3	SB 5	R	/C	3	80	118	7.9	57	60.3	4050
202 4	MA N	ASH CC	1	3	SB 5	R	/C	2	40	119	8.1	57	61	4095
202 4	MA N	ASH CC	1	3	SB 5	R	/C	1	0	120	8.1	57	61.8	4149
202 4	MA N	ASH CC	1	3	SB 3	C	C	3	80	121	8	57	59.8	4018
202 4	MA N	ASH CC	1	3	SB 3	C	C	2	40	122	8.1	57	59.7	4014
202 4	MA N	ASH CC	1	3	SB 3	C	C	1	0	123	8.1	58	61	4095
202 4	MA N	ASH CC	1	3	SB 3	C	C	5	240	124	8	57	62.2	4181
202 4	MA N	ASH CC	1	3	SB 3	C	C	4	160	125	7.9	58	61.5	4131
202 4	MA N	ASH CC	1	3	SB 4	C	R	4	160	126	8.2	56	55.2	3711
202 4	MA N	ASH CC	1	3	SB 4	C	R	1	0	127	8.2	56	55.2	3711
202 4	MA N	ASH CC	1	3	SB 4	C	R	2	40	128	8.2	56	50.8	3413
202 4	MA N	ASH CC	1	3	SB 4	C	R	3	80	129	8.1	56	54.9	3688
202 4	MA N	ASH CC	1	3	SB 4	C	R	5	240	130	8.2	57	52.4	3522
202 4	MA N	ASH CC	2	3	SB 4	C	R	4	160	231	9.2	55	75.4	5064
202 4	MA N	ASH CC	2	3	SB 4	C	R	3	80	232	9	55	51.2	3437
202 4	MA N	ASH CC	2	3	SB 4	C	R	2	40	233	9.1	55	82.6	5553
202 4	MA N	ASH CC	2	3	SB 4	C	R	5	240	234	9.1	55	59.1	3970
202 4	MA N	ASH CC	2	3	SB 4	C	R	1	0	235	8.9	56	65.6	4409
202 4	MA N	ASH CC	2	3	SB 5	R	/C	3	80	236	9.7	52	87.3	5862
202 4	MA N	ASH CC	2	3	SB 5	R	/C	1	0	237	9.4	57	76.8	5160
202 4	MA N	ASH CC	2	3	SB 5	R	/C	2	40	238	9.4	57	74.4	5000
202 4	MA N	ASH CC	2	3	SB 5	R	/C	5	240	239	9.3	56	72.1	4845
202 4	MA N	ASH CC	2	3	SB 5	R	/C	4	160	240	9.4	57	77.2	5187
202 4	MA N	ASH CC	2	3	SB 3	C	C	3	80	241	9.3	58	72.9	4898
202 4	MA N	ASH CC	2	3	SB 3	C	C	1	0	242	9.2	58	63	4234
202 4	MA N	ASH CC	2	3	SB 3	C	C	2	40	243	9.3	54	71.7	4818
202 4	MA N	ASH CC	2	3	SB 3	C	C	4	160	244	9.2	58	69.4	4662

2024	MA N	ASH CC	2	3	SB 3	C	C	5	240	245	9.3	58	66.9	4497
2024	MA N	ASH CC	2	3	SB 1	C	F	3	80	246	9	58	78.3	5263
2024	MA N	ASH CC	2	3	SB 1	C	F	1	0	247	9.2	57	72.6	4877
2024	MA N	ASH CC	2	3	SB 1	C	F	4	160	248	9.1	58	74.3	4989
2024	MA N	ASH CC	2	3	SB 1	C	F	5	240	249	9.1	57	59.5	3997
2024	MA N	ASH CC	2	3	SB 1	C	F	2	40	250	9.1	57	71.9	4828
2024	MA N	ASH CC	2	3	SB 2	D	SB	2	40	251	8.7	57	71.4	4796
2024	MA N	ASH CC	2	3	SB 2	D	SB	1	0	252	9	58	71.1	4780
2024	MA N	ASH CC	2	3	SB 2	D	SB	5	240	253	9	58	83.9	5639
2024	MA N	ASH CC	2	3	SB 2	D	SB	3	80	254	9.1	58	55.9	3755
2024	MA N	ASH CC	2	3	SB 2	D	SB	4	160	255	9.1	58	77.1	5177
2024	MA N	ASH CC	2	3	SB 6	F	TC	4	160	256	9.1	57	49.9	3353
2024	MA N	ASH CC	2	3	SB 6	F	TC	1	0	257	8.9	58	87.2	5861
2024	MA N	ASH CC	2	3	SB 6	F	TC	5	240	258	8.9	58	77.6	5215
2024	MA N	ASH CC	2	3	SB 6	F	TC	2	40	259	8.8	57	81.3	5463
2024	MA N	ASH CC	2	3	SB 6	F	TC	3	80	260	8.8	58	54.1	3633
2024	MA N	ASH CC	3	3	SB 2	D	SB	4	160	301	9.1	57	65.1	4372
2024	MA N	ASH CC	3	3	SB 2	D	SB	3	80	302	9	58	60.4	4055
2024	MA N	ASH CC	3	3	SB 2	D	SB	2	40	303	9	58	71.1	4780
2024	MA N	ASH CC	3	3	SB 2	D	SB	5	240	304	9.1	58	81.8	5499
2024	MA N	ASH CC	3	3	SB 2	D	SB	1	0	305	9.1	58	47.1	3165
2024	MA N	ASH CC	3	3	SB 6	F	TC	1	0	306	9.1	58	49.1	3299
2024	MA N	ASH CC	3	3	SB 6	F	TC	2	40	307	9	58	64	4297
2024	MA N	ASH CC	3	3	SB 6	F	TC	5	240	308	9.1	58	64.7	4346
2024	MA N	ASH CC	3	3	SB 6	F	TC	4	160	309	9.1	58	69.9	4694
2024	MA N	ASH CC	3	3	SB 6	F	TC	3	80	310	9.1	59	65.5	4399
2024	MA N	ASH CC	3	3	SB 3	C	C	5	240	311	8.9	58	54	3629

202 4	MA N	ASH CC	3	3	SB 3	C	C	1	0	312	9	58	57.6	3867
202 4	MA N	ASH CC	3	3	SB 3	C	C	4	160	313	9	58	64	4297
202 4	MA N	ASH CC	3	3	SB 3	C	C	3	80	314	8.9	58	63.6	4274
202 4	MA N	ASH CC	3	3	SB 3	C	C	2	40	315	9	58	65.6	4404
202 4	MA N	ASH CC	3	3	SB 4	C	R	2	40	316	8.4	59	57.9	3892
202 4	MA N	ASH CC	3	3	SB 4	C	R	1	0	317	8.5	59	60.7	4077
202 4	MA N	ASH CC	3	3	SB 4	C	R	5	240	318	8.4	58	64.8	4352
202 4	MA N	ASH CC	3	3	SB 4	C	R	4	160	319	8.4	59	75.6	5082
202 4	MA N	ASH CC	3	3	SB 4	C	R	3	80	320	8.4	59	66.4	4460
202 4	MA N	ASH CC	3	3	SB 1	C	F	2	40	321	8.3	59	64.8	4357
202 4	MA N	ASH CC	3	3	SB 1	C	F	5	240	322	8.5	58	72.3	4860
202 4	MA N	ASH CC	3	3	SB 1	C	F	3	80	323	8.6	59	69.5	4666
202 4	MA N	ASH CC	3	3	SB 1	C	F	4	160	324	8.5	58	64.7	4347
202 4	MA N	ASH CC	3	3	SB 1	C	F	1	0	325	8.5	58	55.5	3726
202 4	MA N	ASH CC	3	3	SB 5	R	/C	5	240	326	8.4	58	69.6	4676
202 4	MA N	ASH CC	3	3	SB 5	R	/C	1	0	327	8.5	59	73.9	4968
202 4	MA N	ASH CC	3	3	SB 5	R	/C	3	80	328	8.6	59	69.1	4639
202 4	MA N	ASH CC	3	3	SB 5	R	/C	4	160	329	8.5	59	72.7	4887
202 4	MA N	ASH CC	3	3	SB 5	R	/C	2	40	330	8.4	58	70	4703
202 4	MA N	ASH CC	4	3	SB 3	C	C	1	0	431	8.4	58	64	4298
202 4	MA N	ASH CC	4	3	SB 3	C	C	5	240	432	8.4	57	66.4	4460
202 4	MA N	ASH CC	4	3	SB 3	C	C	2	40	433	8.4	58	62.8	4217
202 4	MA N	ASH CC	4	3	SB 3	C	C	4	160	434	8.4	57	67.2	4514
202 4	MA N	ASH CC	4	3	SB 3	C	C	3	80	435	8.4	58	66.8	4487
202 4	MA N	ASH CC	4	3	SB 6	F	TC	4	160	436	8.5	58	68.3	4590
202 4	MA N	ASH CC	4	3	SB 6	F	TC	3	80	437	8.5	57	65.9	4428
202 4	MA N	ASH CC	4	3	SB 6	F	TC	1	0	438	8.4	58	68.4	4595

202 4	MA N	ASH CC	4	3	SB 6	F	TC	2	40	439	8.3	58	71.7	4817
202 4	MA N	ASH CC	4	3	SB 6	F	TC	5	240	440	8.5	58	76.4	5130
202 4	MA N	ASH CC	4	3	SB 5	R	/C	4	160	441	8.4	58	73.2	4920
202 4	MA N	ASH CC	4	3	SB 5	R	/C	3	80	442	8.3	58	56.8	3816
202 4	MA N	ASH CC	4	3	SB 5	R	/C	5	240	443	8.4	57	64.8	4352
202 4	MA N	ASH CC	4	3	SB 5	R	/C	1	0	444	8.5	58	66.3	4455
202 4	MA N	ASH CC	4	3	SB 5	R	/C	2	40	445	8.4	57	64.4	4325
202 4	MA N	ASH CC	4	3	SB 4	C	R	2	40	446	8.3	58	71.7	4817
202 4	MA N	ASH CC	4	3	SB 4	C	R	4	160	447	8.4	57	57.1	3838
202 4	MA N	ASH CC	4	3	SB 4	C	R	3	80	448	8.4	58	66.4	4460
202 4	MA N	ASH CC	4	3	SB 4	C	R	5	240	449	8.3	58	73.7	4952
202 4	MA N	ASH CC	4	3	SB 4	C	R	1	0	450	8.2	57	71.4	4795
202 4	MA N	ASH CC	4	3	SB 1	C	F	2	40	451	8.1	58	55.3	3715
202 4	MA N	ASH CC	4	3	SB 1	C	F	3	80	452	8	58	57.8	3882
202 4	MA N	ASH CC	4	3	SB 1	C	F	5	240	453	8.3	58	83.8	5629
202 4	MA N	ASH CC	4	3	SB 1	C	F	1	0	454	8.1	58	63	4231
202 4	MA N	ASH CC	4	3	SB 1	C	F	4	160	455	8.1	58	74.7	5017
202 4	MA N	ASH CC	4	3	SB 2	D	SB	2	40	456	8	57	75.2	5050
202 4	MA N	ASH CC	4	3	SB 2	D	SB	5	240	457	8	57	57.4	3855
202 4	MA N	ASH CC	4	3	SB 2	D	SB	1	0	458	8	58	59.8	4018
202 4	MA N	ASH CC	4	3	SB 2	D	SB	4	160	459	7.9	58	68	4566
202 4	MA N	ASH CC	4	3	SB 2	D	SB	3	80	460	8	58	69.5	4670
202 3	MA N	ASH CC	1	1	W- CC	6	FTC	1	0	131	10	57	49.3	3313
202 3	MA N	ASH CC	1	1	W- CC	6	FTC	3	80	132	9.9	57	43.5	2919
202 3	MA N	ASH CC	1	1	W- CC	6	FTC	2	40	133	9.9	57	40.6	2728
202 3	MA N	ASH CC	1	1	W- CC	6	FTC	4	160	134	10	57	41.8	2810
202 3	MA N	ASH CC	1	1	W- CC	6	FTC	5	240	135	9.9	58	41.2	2770

2023	MA N	ASH CC	1	1	W-CC	3	CC	3	80	136	10	58	55.9	3755
2023	MA N	ASH CC	1	1	W-CC	3	CC	2	40	137	10	58	54.9	3687
2023	MA N	ASH CC	1	1	W-CC	3	CC	4	160	138	10	59	58.2	3912
2023	MA N	ASH CC	1	1	W-CC	3	CC	1	0	139	10	59	55.3	3717
2023	MA N	ASH CC	1	1	W-CC	3	CC	5	240	140	10	59	57.9	3891
2023	MA N	ASH CC	1	1	W-CC	1	CF	5	240	141	10	59	61.1	4104
2023	MA N	ASH CC	1	1	W-CC	1	CF	3	80	142	10	59	58.2	3912
2023	MA N	ASH CC	1	1	W-CC	1	CF	4	160	143	10	59	57.3	3848
2023	MA N	ASH CC	1	1	W-CC	1	CF	2	40	144	10	60	57.7	3878
2023	MA N	ASH CC	1	1	W-CC	1	CF	1	0	145	10	60	51.5	3462
2023	MA N	ASH CC	1	1	W-CC	2	DSB	2	40	146	10	60	58.4	3920
2023	MA N	ASH CC	1	1	W-CC	2	DSB	3	80	147	10	60	59	3963
2023	MA N	ASH CC	1	1	W-CC	2	DSB	5	240	148	10	60	63.9	4295
2023	MA N	ASH CC	1	1	W-CC	2	DSB	4	160	149	10	60	61.5	4129
2023	MA N	ASH CC	1	1	W-CC	2	DSB	1	0	150	10	60	56.4	3789
2023	MA N	ASH CC	1	1	W-CC	5	R/C	5	240	151	10	.	66.5	4470
2023	MA N	ASH CC	1	1	W-CC	5	R/C	2	40	152	10	.	65.9	4427
2023	MA N	ASH CC	1	1	W-CC	5	R/C	4	160	153	9.9	60	61.5	4134
2023	MA N	ASH CC	1	1	W-CC	5	R/C	1	0	154	10	60	60.5	4066
2023	MA N	ASH CC	1	1	W-CC	5	R/C	3	80	155	10	60	59.8	4019
2023	MA N	ASH CC	1	1	W-CC	4	CR	5	240	156	10	60	67.2	4513
2023	MA N	ASH CC	1	1	W-CC	4	CR	2	40	157	9.9	60	67.6	4539
2023	MA N	ASH CC	1	1	W-CC	4	CR	4	160	158	10	60	60.4	4057
2023	MA N	ASH CC	1	1	W-CC	4	CR	3	80	159	9.8	60	63.5	4267
2023	MA N	ASH CC	1	1	W-CC	4	CR	1	0	160	9.9	60	59.6	4006
2023	MA N	ASH CC	2	1	W-CC	3	CC	3	80	261	9.1	58	47	3160
2023	MA N	ASH CC	2	1	W-CC	3	CC	2	40	262	9.4	58	51.3	3450

2023	MA N	ASH CC	2	1	W-CC	3	CC	5	240	263	9.1	57	36.5	2451
2023	MA N	ASH CC	2	1	W-CC	3	CC	4	160	264	9.3	58	41.8	2810
2023	MA N	ASH CC	2	1	W-CC	3	CC	1	0	265	9.5	59	46.5	3125
2023	MA N	ASH CC	2	1	W-CC	1	CF	5	240	266	9.4	59	63.8	4286
2023	MA N	ASH CC	2	1	W-CC	1	CF	4	160	267	9.7	60	65.8	4421
2023	MA N	ASH CC	2	1	W-CC	1	CF	3	80	268	9.6	60	62.7	4212
2023	MA N	ASH CC	2	1	W-CC	1	CF	2	40	269	9.5	59	56.4	3789
2023	MA N	ASH CC	2	1	W-CC	1	CF	1	0	270	9.6	60	63.3	4255
2023	MA N	ASH CC	2	1	W-CC	6	FTC	4	160	271	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	6	FTC	3	80	272	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	6	FTC	1	0	273	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	6	FTC	5	240	274	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	6	FTC	2	40	275	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	4	CR	5	240	276	9.3	60	65.5	4398
2023	MA N	ASH CC	2	1	W-CC	4	CR	4	160	277	9.6	60	66.5	4469
2023	MA N	ASH CC	2	1	W-CC	4	CR	2	40	278	9.6	60	63.3	4255
2023	MA N	ASH CC	2	1	W-CC	4	CR	3	80	279	9.4	60	63.1	4243
2023	MA N	ASH CC	2	1	W-CC	4	CR	1	0	280	9.5	60	65.9	4431
2023	MA N	ASH CC	2	1	W-CC	2	DSB	3	80	281	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	2	DSB	5	240	282	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	2	DSB	1	0	283	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	2	DSB	4	160	284	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	2	DSB	2	40	285	.	.	.	.
2023	MA N	ASH CC	2	1	W-CC	5	R/C	2	40	286	9.3	60	63.9	4290
2023	MA N	ASH CC	2	1	W-CC	5	R/C	5	240	287	9.4	60	68.6	4607
2023	MA N	ASH CC	2	1	W-CC	5	R/C	3	80	288	9.5	60	59.6	4003
2023	MA N	ASH CC	2	1	W-CC	5	R/C	1	0	289	9.6	59	59.5	3998

2023	MA N	ASH CC	2	1	W-CC	5	R/C	4	160	290	9.6	60	63.3	4255
2023	MA N	ASH CC	3	1	W-CC	1	CF	3	80	331	9.2	59	66.2	4445
2023	MA N	ASH CC	3	1	W-CC	1	CF	5	240	332	9.3	59	56.2	3775
2023	MA N	ASH CC	3	1	W-CC	1	CF	1	0	333	9.3	59	54.9	3690
2023	MA N	ASH CC	3	1	W-CC	1	CF	4	160	334	9.5	60	59.6	4003
2023	MA N	ASH CC	3	1	W-CC	1	CF	2	40	335	9.6	60	63	4233
2023	MA N	ASH CC	3	1	W-CC	3	CC	2	40	336	9.5	60	63.4	4259
2023	MA N	ASH CC	3	1	W-CC	3	CC	1	0	337	9.4	60	66.7	4478
2023	MA N	ASH CC	3	1	W-CC	3	CC	4	160	338	9.5	60	65.3	4388
2023	MA N	ASH CC	3	1	W-CC	3	CC	5	240	339	9.7	60	73.7	4955
2023	MA N	ASH CC	3	1	W-CC	3	CC	3	80	340	9.6	60	69.1	4640
2023	MA N	ASH CC	3	1	W-CC	6	FTC	4	160	341	9.5	60	67.6	4541
2023	MA N	ASH CC	3	1	W-CC	6	FTC	2	40	342	9.4	60	67	4500
2023	MA N	ASH CC	3	1	W-CC	6	FTC	1	0	343	9.5	60	66.9	4495
2023	MA N	ASH CC	3	1	W-CC	6	FTC	5	240	344	9.5	60	67.2	4516
2023	MA N	ASH CC	3	1	W-CC	6	FTC	3	80	345	9.6	60	58.2	3913
2023	MA N	ASH CC	3	1	W-CC	2	DSB	5	240	346	9.4	61	70.2	4714
2023	MA N	ASH CC	3	1	W-CC	2	DSB	2	40	347	9.4	60	61.9	4157
2023	MA N	ASH CC	3	1	W-CC	2	DSB	4	160	348	9.6	60	65.9	4426
2023	MA N	ASH CC	3	1	W-CC	2	DSB	3	80	349	9.5	60	69.5	4666
2023	MA N	ASH CC	3	1	W-CC	2	DSB	1	0	350	9.4	60	62.2	4178
2023	MA N	ASH CC	3	1	W-CC	4	CR	5	240	351	9.4	61	66.3	4456
2023	MA N	ASH CC	3	1	W-CC	4	CR	4	160	352	9.6	60	65.9	4426
2023	MA N	ASH CC	3	1	W-CC	4	CR	2	40	353	9.5	60	67.5	4538
2023	MA N	ASH CC	3	1	W-CC	4	CR	1	0	354	9.3	60	64.5	4333
2023	MA N	ASH CC	3	1	W-CC	4	CR	3	80	355	9.4	60	65.4	4393
2023	MA N	ASH CC	3	1	W-CC	5	R/C	4	160	356	9.3	61	67.1	4505

2023	MA N	ASH CC	3	1	W-CC	5	R/C	3	80	357	9.8	61	62.2	4181
2023	MA N	ASH CC	3	1	W-CC	5	R/C	5	240	358	9.5	61	67.5	4538
2023	MA N	ASH CC	3	1	W-CC	5	R/C	2	40	359	9.7	60	62.9	4229
2023	MA N	ASH CC	3	1	W-CC	5	R/C	1	0	360	9.6	61	64.3	4319
2023	MA N	ASH CC	4	1	W-CC	3	CC	4	160	461	9.5	60	58.9	3960
2023	MA N	ASH CC	4	1	W-CC	3	CC	5	240	462	9.5	60	58.3	3917
2023	MA N	ASH CC	4	1	W-CC	3	CC	2	40	463	9.5	60	58.3	3917
2023	MA N	ASH CC	4	1	W-CC	3	CC	3	80	464	9.6	60	55.1	3699
2023	MA N	ASH CC	4	1	W-CC	3	CC	1	0	465	9.6	60	57.6	3870
2023	MA N	ASH CC	4	1	W-CC	2	DSB	4	160	466	9.5	60	67.2	4516
2023	MA N	ASH CC	4	1	W-CC	2	DSB	2	40	467	9.5	60	64.4	4324
2023	MA N	ASH CC	4	1	W-CC	2	DSB	1	0	468	9.3	60	63.5	4269
2023	MA N	ASH CC	4	1	W-CC	2	DSB	5	240	469	9.3	60	69.9	4698
2023	MA N	ASH CC	4	1	W-CC	2	DSB	3	80	470	9.4	60	65.7	4414
2023	MA N	ASH CC	4	1	W-CC	1	CF	5	240	471	9.4	60	65.7	4414
2023	MA N	ASH CC	4	1	W-CC	1	CF	3	80	472	9.3	60	62.3	4183
2023	MA N	ASH CC	4	1	W-CC	1	CF	1	0	473	9.6	60	64.6	4340
2023	MA N	ASH CC	4	1	W-CC	1	CF	4	160	474	9.3	60	64.2	4312
2023	MA N	ASH CC	4	1	W-CC	1	CF	2	40	475	9.2	60	61.7	4145
2023	MA N	ASH CC	4	1	W-CC	6	FTC	4	160	476	9.4	61	61.6	4136
2023	MA N	ASH CC	4	1	W-CC	6	FTC	5	240	477	9.3	61	68	4569
2023	MA N	ASH CC	4	1	W-CC	6	FTC	1	0	478	9.4	60	69.8	4693
2023	MA N	ASH CC	4	1	W-CC	6	FTC	3	80	479	9.3	60	66.4	4462
2023	MA N	ASH CC	4	1	W-CC	6	FTC	2	40	480	9.3	60	66.1	4440
2023	MA N	ASH CC	4	1	W-CC	5	R/C	4	160	481	9.3	61	71.8	4827
2023	MA N	ASH CC	4	1	W-CC	5	R/C	5	240	482	9.6	61	66.2	4447
2023	MA N	ASH CC	4	1	W-CC	5	R/C	2	40	483	9.2	60	65.5	4402

2023	MA N	ASH CC	4	1	W-CC	5	R/C	3	80	484	9.3	61	62.9	4226
2023	MA N	ASH CC	4	1	W-CC	5	R/C	1	0	485	9.4	60	64.4	4328
2023	MA N	ASH CC	4	1	W-CC	4	CR	4	160	486	9.7	61	65.5	4399
2023	MA N	ASH CC	4	1	W-CC	4	CR	2	40	487	9.5	61	62.8	4217
2023	MA N	ASH CC	4	1	W-CC	4	CR	1	0	488	9.4	61	66	4436
2023	MA N	ASH CC	4	1	W-CC	4	CR	3	80	489	9.5	61	66.3	4452
2023	MA N	ASH CC	4	1	W-CC	4	CR	5	240	490	9.6	61	65.2	4383
2024	MA N	ASH CC	1	1	W-CC	5	R/C	4	160	161	7.2	58	37	2483
2024	MA N	ASH CC	1	1	W-CC	5	R/C	1	0	162	7.2	58	38.4	2579
2024	MA N	ASH CC	1	1	W-CC	5	R/C	3	80	163	7.2	58	36.1	2423
2024	MA N	ASH CC	1	1	W-CC	5	R/C	5	240	164	7.2	58	36.8	2475
2024	MA N	ASH CC	1	1	W-CC	5	R/C	2	40	165	7.2	58	44.7	3006
2024	MA N	ASH CC	1	1	W-CC	6	FTC	5	240	166	7.2	58	39.7	2667
2024	MA N	ASH CC	1	1	W-CC	6	FTC	3	80	167	7.2	58	38.1	2557
2024	MA N	ASH CC	1	1	W-CC	6	FTC	4	160	168	7.2	58	37.9	2549
2024	MA N	ASH CC	1	1	W-CC	6	FTC	2	40	169	5	58	38.8	2607
2024	MA N	ASH CC	1	1	W-CC	6	FTC	1	0	170	8	58	42.9	2884
2024	MA N	ASH CC	1	1	W-CC	2	DSB	4	160	171	7.2	58	43.2	2899
2024	MA N	ASH CC	1	1	W-CC	2	DSB	2	40	172	7.2	58	39.9	2680
2024	MA N	ASH CC	1	1	W-CC	2	DSB	3	80	173	7.2	58	41.3	2773
2024	MA N	ASH CC	1	1	W-CC	2	DSB	1	0	174	5.8	58	40.1	2694
2024	MA N	ASH CC	1	1	W-CC	2	DSB	5	240	175	7.2	58	45.1	3031
2024	MA N	ASH CC	1	1	W-CC	1	CF	5	240	176	6.7	58	41.7	2801
2024	MA N	ASH CC	1	1	W-CC	1	CF	3	80	177	8.1	58	46.7	3136
2024	MA N	ASH CC	1	1	W-CC	1	CF	1	0	178	6.3	58	40.3	2708
2024	MA N	ASH CC	1	1	W-CC	1	CF	4	160	179	7.2	58	41.4	2782
2024	MA N	ASH CC	1	1	W-CC	1	CF	2	40	180	6.4	58	48.3	3244

202 4	MA N	ASH CC	1	1	W- CC	4	CR	5	240	181	6	58	50.5	3392
202 4	MA N	ASH CC	1	1	W- CC	4	CR	4	160	182	8	58	49.4	3321
202 4	MA N	ASH CC	1	1	W- CC	4	CR	1	0	183	6.3	58	48.7	3273
202 4	MA N	ASH CC	1	1	W- CC	4	CR	3	80	184	7.2	58	49.9	3354
202 4	MA N	ASH CC	1	1	W- CC	4	CR	2	40	185	7.1	58	59	3963
202 4	MA N	ASH CC	1	1	W- CC	3	CC	1	0	186	5.8	58	56.3	3786
202 4	MA N	ASH CC	1	1	W- CC	3	CC	5	240	187	6.8	58	57.2	3844
202 4	MA N	ASH CC	1	1	W- CC	3	CC	3	80	188	7.2	58	48.5	3261
202 4	MA N	ASH CC	1	1	W- CC	3	CC	4	160	189	7.2	64	69.4	4660
202 4	MA N	ASH CC	1	1	W- CC	3	CC	2	40	190	7.2	62	57.5	3861
202 4	MA N	ASH CC	2	1	W- CC	2	DSB	2	40	201	8	58	66.2	4446
202 4	MA N	ASH CC	2	1	W- CC	2	DSB	5	240	202	7.6	58	57	3827
202 4	MA N	ASH CC	2	1	W- CC	2	DSB	1	0	203	7.2	57	50.6	3401
202 4	MA N	ASH CC	2	1	W- CC	2	DSB	3	80	204	7.2	55	60.9	4093
202 4	MA N	ASH CC	2	1	W- CC	2	DSB	4	160	205	7.2	61	51.1	3433
202 4	MA N	ASH CC	2	1	W- CC	4	CR	1	0	206	7.2	55	62.2	4179
202 4	MA N	ASH CC	2	1	W- CC	4	CR	5	240	207	6.7	57	50.2	3373
202 4	MA N	ASH CC	2	1	W- CC	4	CR	3	80	208	8.7	57	50.6	3400
202 4	MA N	ASH CC	2	1	W- CC	4	CR	2	40	209	8.3	56	50.9	3418
202 4	MA N	ASH CC	2	1	W- CC	4	CR	4	160	210	6.7	58	56.5	3797
202 4	MA N	ASH CC	2	1	W- CC	3	CC	2	40	211	7.2	58	65.5	4400
202 4	MA N	ASH CC	2	1	W- CC	3	CC	4	160	212	7.2	57	63.3	4252
202 4	MA N	ASH CC	2	1	W- CC	3	CC	5	240	213	8.7	56	72.4	4862
202 4	MA N	ASH CC	2	1	W- CC	3	CC	3	80	214	6.8	58	52	3491
202 4	MA N	ASH CC	2	1	W- CC	3	CC	1	0	215	7.2	56	63.5	4266
202 4	MA N	ASH CC	2	1	W- CC	5	R/C	1	0	216	7.4	58	52.5	3529
202 4	MA N	ASH CC	2	1	W- CC	5	R/C	2	40	217	8.5	58	71.2	4784

202 4	MA N	ASH CC	2	1	W- CC	5	R/C	4	160	218	7	57	59.5	4000
202 4	MA N	ASH CC	2	1	W- CC	5	R/C	3	80	219	7.1	57	58.1	3905
202 4	MA N	ASH CC	2	1	W- CC	5	R/C	5	240	220	7.8	57	61.4	4127
202 4	MA N	ASH CC	2	1	W- CC	6	FTC	1	0	221	8.6	61	70	4701
202 4	MA N	ASH CC	2	1	W- CC	6	FTC	2	40	222	7.8	60	67.9	4559
202 4	MA N	ASH CC	2	1	W- CC	6	FTC	3	80	223	7.7	59	62.5	4202
202 4	MA N	ASH CC	2	1	W- CC	6	FTC	5	240	224	7.8	58	62.4	4194
202 4	MA N	ASH CC	2	1	W- CC	6	FTC	4	160	225	7.8	58	64.7	4344
202 4	MA N	ASH CC	2	1	W- CC	1	CF	2	40	226	7.2	62	51.6	3463
202 4	MA N	ASH CC	2	1	W- CC	1	CF	4	160	227	8.2	59	58.6	3934
202 4	MA N	ASH CC	2	1	W- CC	1	CF	5	240	228	7.2	60	57.4	3855
202 4	MA N	ASH CC	2	1	W- CC	1	CF	3	80	229	7.2	57	58.8	3954
202 4	MA N	ASH CC	2	1	W- CC	1	CF	1	0	230	7.2	58	56.9	3825
202 4	MA N	ASH CC	3	1	W- CC	3	CC	4	160	361	7.2	58	41.9	2814
202 4	MA N	ASH CC	3	1	W- CC	3	CC	2	40	362	7.2	58	42.3	2845
202 4	MA N	ASH CC	3	1	W- CC	3	CC	1	0	363	7.2	58	40.3	2708
202 4	MA N	ASH CC	3	1	W- CC	3	CC	5	240	364	7.2	58	45.7	3069
202 4	MA N	ASH CC	3	1	W- CC	3	CC	3	80	365	7.2	58	49.1	3299
202 4	MA N	ASH CC	3	1	W- CC	2	DSB	3	80	366	7.2	58	39.9	2678
202 4	MA N	ASH CC	3	1	W- CC	2	DSB	4	160	367	7.2	58	45.5	3055
202 4	MA N	ASH CC	3	1	W- CC	2	DSB	2	40	368	6.3	58	41.3	2775
202 4	MA N	ASH CC	3	1	W- CC	2	DSB	5	240	369	7.2	58	50.5	3395
202 4	MA N	ASH CC	3	1	W- CC	2	DSB	1	0	370	7.2	58	48.9	3285
202 4	MA N	ASH CC	3	1	W- CC	5	R/C	5	240	371	5.6	58	41.5	2786
202 4	MA N	ASH CC	3	1	W- CC	5	R/C	4	160	372	7.6	58	46	3093
202 4	MA N	ASH CC	3	1	W- CC	5	R/C	3	80	373	6.5	58	43.5	2920
202 4	MA N	ASH CC	3	1	W- CC	5	R/C	2	40	374	6.8	58	49.2	3303

202 4	MA N	ASH CC	3	1	W- CC	5	R/C	1	0	375	7.2	58	49.4	3321
202 4	MA N	ASH CC	3	1	W- CC	4	CR	1	0	376	8.2	58	48.7	3273
202 4	MA N	ASH CC	3	1	W- CC	4	CR	2	40	377	5.5	58	48.1	3230
202 4	MA N	ASH CC	3	1	W- CC	4	CR	3	80	378	5.8	58	42.7	2869
202 4	MA N	ASH CC	3	1	W- CC	4	CR	5	240	379	6.3	58	43.4	2913
202 4	MA N	ASH CC	3	1	W- CC	4	CR	4	160	380	6.1	58	48.2	3239
202 4	MA N	ASH CC	3	1	W- CC	6	FTC	1	0	381	6.2	58	51.5	3462
202 4	MA N	ASH CC	3	1	W- CC	6	FTC	3	80	382	6.8	58	48.3	3246
202 4	MA N	ASH CC	3	1	W- CC	6	FTC	4	160	383	6.1	55	54.4	3657
202 4	MA N	ASH CC	3	1	W- CC	6	FTC	5	240	384	7.3	56	49.1	3296
202 4	MA N	ASH CC	3	1	W- CC	6	FTC	2	40	385	9	56	45.6	3061
202 4	MA N	ASH CC	3	1	W- CC	1	CF	4	160	386	7.1	58	56.4	3790
202 4	MA N	ASH CC	3	1	W- CC	1	CF	5	240	387	6	58	53.8	3614
202 4	MA N	ASH CC	3	1	W- CC	1	CF	1	0	388	5.7	56	45.7	3073
202 4	MA N	ASH CC	3	1	W- CC	1	CF	3	80	389	6.5	57	57.8	3886
202 4	MA N	ASH CC	3	1	W- CC	1	CF	2	40	390	7.9	56	49.5	3325
202 4	MA N	ASH CC	4	1	W- CC	4	CR	3	80	401	6.9	56	63.9	4293
202 4	MA N	ASH CC	4	1	W- CC	4	CR	2	40	402	6.4	56	52.1	3501
202 4	MA N	ASH CC	4	1	W- CC	4	CR	5	240	403	6.9	57	56	3764
202 4	MA N	ASH CC	4	1	W- CC	4	CR	4	160	404	6.2	56	51	3426
202 4	MA N	ASH CC	4	1	W- CC	4	CR	1	0	405	7.9	59	51.7	3474
202 4	MA N	ASH CC	4	1	W- CC	1	CF	4	160	406	7.2	60	53.1	3571
202 4	MA N	ASH CC	4	1	W- CC	1	CF	5	240	407	6	55	58.1	3902
202 4	MA N	ASH CC	4	1	W- CC	1	CF	1	0	408	6.4	55	57.9	3890
202 4	MA N	ASH CC	4	1	W- CC	1	CF	3	80	409	8.1	55	58.2	3913
202 4	MA N	ASH CC	4	1	W- CC	1	CF	2	40	410	6.5	59	57.7	3878
202 4	MA N	ASH CC	4	1	W- CC	2	DSB	2	40	411	8.3	59	61.8	4152

202 4	MA N	ASH CC	4	1	W- CC	2	DSB	1	0	412	7.4	60	60.1	4040
202 4	MA N	ASH CC	4	1	W- CC	2	DSB	4	160	413	6.7	58	57.4	3858
202 4	MA N	ASH CC	4	1	W- CC	2	DSB	3	80	414	7.3	59	67.4	4529
202 4	MA N	ASH CC	4	1	W- CC	2	DSB	5	240	415	7.2	60	53.6	3603
202 4	MA N	ASH CC	4	1	W- CC	6	FTC	1	0	416	8.3	61	63.9	4293
202 4	MA N	ASH CC	4	1	W- CC	6	FTC	2	40	417	8.5	59	62.9	4224
202 4	MA N	ASH CC	4	1	W- CC	6	FTC	4	160	418	6.9	59	51.2	3437
202 4	MA N	ASH CC	4	1	W- CC	6	FTC	5	240	419	8.1	60	53.5	3594
202 4	MA N	ASH CC	4	1	W- CC	6	FTC	3	80	420	7.2	57	57.8	3882
202 4	MA N	ASH CC	4	1	W- CC	3	CC	1	0	421	8.8	63	74	4975
202 4	MA N	ASH CC	4	1	W- CC	3	CC	2	40	422	8.2	61	64.3	4320
202 4	MA N	ASH CC	4	1	W- CC	3	CC	5	240	423	8.9	60	62.3	4183
202 4	MA N	ASH CC	4	1	W- CC	3	CC	3	80	424	8.7	59	68.9	4626
202 4	MA N	ASH CC	4	1	W- CC	3	CC	4	160	425	7.2	57	59	3962
202 4	MA N	ASH CC	4	1	W- CC	5	R/C	4	160	426	7.2	63	71.6	4811
202 4	MA N	ASH CC	4	1	W- CC	5	R/C	5	240	427	8.5	62	64.9	4358
202 4	MA N	ASH CC	4	1	W- CC	5	R/C	2	40	428	8.5	61	65.2	4377
202 4	MA N	ASH CC	4	1	W- CC	5	R/C	1	0	429	8.1	61	64.1	4304
202 4	MA N	ASH CC	4	1	W- CC	5	R/C	3	80	430	7.9	61	61.2	4110
202 5	MA N	ASH CC	1	1	W- CC	6	FTC	4	160	101	11	56	37.9	2547
202 5	MA N	ASH CC	1	1	W- CC	6	FTC	2	40	102	11	56	40.4	2716
202 5	MA N	ASH CC	1	1	W- CC	6	FTC	5	240	103	11	56	43.6	2932
202 5	MA N	ASH CC	1	1	W- CC	6	FTC	1	0	104	11	55	35.4	2377
202 5	MA N	ASH CC	1	1	W- CC	6	FTC	3	80	105	11	56	38.6	2591
202 5	MA N	ASH CC	1	1	W- CC	1	CF	3	80	106	11	55	42.5	2859
202 5	MA N	ASH CC	1	1	W- CC	1	CF	2	40	107	11	56	40.6	2730
202 5	MA N	ASH CC	1	1	W- CC	1	CF	4	160	108	11	56	41.5	2787

2025	MA N	ASH CC	1	1	W-CC	1	CF	1	0	109	11	55	39.1	2624
2025	MA N	ASH CC	1	1	W-CC	1	CF	5	240	110	11	56	40.2	2699
2025	MA N	ASH CC	1	1	W-CC	2	DSB	3	80	111	11	55	34.8	2339
2025	MA N	ASH CC	1	1	W-CC	2	DSB	4	160	112	11	56	37.5	2520
2025	MA N	ASH CC	1	1	W-CC	2	DSB	5	240	113	11	56	37.8	2540
2025	MA N	ASH CC	1	1	W-CC	2	DSB	2	40	114	11	56	37.8	2539
2025	MA N	ASH CC	1	1	W-CC	2	DSB	1	0	115	11	55	37.1	2490
2025	MA N	ASH CC	1	1	W-CC	5	R/C	5	240	116	11	54	35.9	2413
2025	MA N	ASH CC	1	1	W-CC	5	R/C	4	160	117	11	56	39.4	2646
2025	MA N	ASH CC	1	1	W-CC	5	R/C	3	80	118	10	54	35.4	2376
2025	MA N	ASH CC	1	1	W-CC	5	R/C	2	40	119	10	54	34.9	2347
2025	MA N	ASH CC	1	1	W-CC	5	R/C	1	0	120	10	53	33	2220
2025	MA N	ASH CC	1	1	W-CC	3	CC	3	80	121	11	55	34.7	2331
2025	MA N	ASH CC	1	1	W-CC	3	CC	2	40	122	11	56	34.8	2336
2025	MA N	ASH CC	1	1	W-CC	3	CC	1	0	123	11	55	32.9	2209
2025	MA N	ASH CC	1	1	W-CC	3	CC	5	240	124	11	55	36	2421
2025	MA N	ASH CC	1	1	W-CC	3	CC	4	160	125	11	54	35.4	2381
2025	MA N	ASH CC	1	1	W-CC	4	CR	4	160	126	10	55	36.8	2469
2025	MA N	ASH CC	1	1	W-CC	4	CR	1	0	127	10	54	31	2083
2025	MA N	ASH CC	1	1	W-CC	4	CR	2	40	128	10	54	30.3	2034
2025	MA N	ASH CC	1	1	W-CC	4	CR	3	80	129	11	55	35.4	2380
2025	MA N	ASH CC	1	1	W-CC	4	CR	5	240	130	11	55	34.7	2333
2025	MA N	ASH CC	2	1	W-CC	4	CR	4	160	231	11	55	37.6	2527
2025	MA N	ASH CC	2	1	W-CC	4	CR	3	80	232	11	56	37.4	2509
2025	MA N	ASH CC	2	1	W-CC	4	CR	2	40	233	11	55	37.3	2508
2025	MA N	ASH CC	2	1	W-CC	4	CR	5	240	234	11	55	35.9	2411
2025	MA N	ASH CC	2	1	W-CC	4	CR	1	0	235	11	54	38	2555

2025	MA N	ASH CC	2	1	W-CC	5	R/C	3	80	236	11	55	39.5	2651
2025	MA N	ASH CC	2	1	W-CC	5	R/C	1	0	237	11	56	42.1	2828
2025	MA N	ASH CC	2	1	W-CC	5	R/C	2	40	238	11	56	39.5	2653
2025	MA N	ASH CC	2	1	W-CC	5	R/C	5	240	239	11	56	41	2752
2025	MA N	ASH CC	2	1	W-CC	5	R/C	4	160	240	11	56	39.8	2674
2025	MA N	ASH CC	2	1	W-CC	3	CC	3	80	241	11	55	38.1	2557
2025	MA N	ASH CC	2	1	W-CC	3	CC	1	0	242	11	55	36.4	2443
2025	MA N	ASH CC	2	1	W-CC	3	CC	2	40	243	11	56	37.3	2506
2025	MA N	ASH CC	2	1	W-CC	3	CC	4	160	244	11	55	36.9	2479
2025	MA N	ASH CC	2	1	W-CC	3	CC	5	240	245	11	55	37.6	2525
2025	MA N	ASH CC	2	1	W-CC	1	CF	3	80	246	11	55	37.2	2500
2025	MA N	ASH CC	2	1	W-CC	1	CF	1	0	247	11	55	36	2417
2025	MA N	ASH CC	2	1	W-CC	1	CF	4	160	248	11	56	38.1	2559
2025	MA N	ASH CC	2	1	W-CC	1	CF	5	240	249	11	54	36	2417
2025	MA N	ASH CC	2	1	W-CC	1	CF	2	40	250	11	54	34.5	2317
2025	MA N	ASH CC	2	1	W-CC	2	DSB	2	40	251	11	55	36.2	2433
2025	MA N	ASH CC	2	1	W-CC	2	DSB	1	0	252	11	55	36.1	2426
2025	MA N	ASH CC	2	1	W-CC	2	DSB	5	240	253	11	55	38.1	2562
2025	MA N	ASH CC	2	1	W-CC	2	DSB	3	80	254	11	55	36.8	2474
2025	MA N	ASH CC	2	1	W-CC	2	DSB	4	160	255	11	54	34.6	2325
2025	MA N	ASH CC	2	1	W-CC	6	FTC	4	160	256	10	55	37.2	2499
2025	MA N	ASH CC	2	1	W-CC	6	FTC	1	0	257	11	55	38.1	2561
2025	MA N	ASH CC	2	1	W-CC	6	FTC	5	240	258	11	54	37.8	2536
2025	MA N	ASH CC	2	1	W-CC	6	FTC	2	40	259	11	54	35.2	2362
2025	MA N	ASH CC	2	1	W-CC	6	FTC	3	80	260	11	54	34.1	2291
2025	MA N	ASH CC	3	1	W-CC	2	DSB	4	160	301	11	55	38.4	2582
2025	MA N	ASH CC	3	1	W-CC	2	DSB	3	80	302	11	55	37.9	2545

2025	MA N	ASH CC	3	1	W-CC	2	DSB	2	40	303	11	55	37.6	2524
2025	MA N	ASH CC	3	1	W-CC	2	DSB	5	240	304	11	55	40.3	2707
2025	MA N	ASH CC	3	1	W-CC	2	DSB	1	0	305	11	54	37.8	2543
2025	MA N	ASH CC	3	1	W-CC	6	FTC	1	0	306	11	55	38.5	2584
2025	MA N	ASH CC	3	1	W-CC	6	FTC	2	40	307	11	54	34.4	2311
2025	MA N	ASH CC	3	1	W-CC	6	FTC	5	240	308	11	54	34.8	2338
2025	MA N	ASH CC	3	1	W-CC	6	FTC	4	160	309	11	55	36.5	2450
2025	MA N	ASH CC	3	1	W-CC	6	FTC	3	80	310	10	54	47.8	3209
2025	MA N	ASH CC	3	1	W-CC	3	CC	5	240	311	11	56	46.6	3131
2025	MA N	ASH CC	3	1	W-CC	3	CC	1	0	312	11	54	43.2	2905
2025	MA N	ASH CC	3	1	W-CC	3	CC	4	160	313	11	54	43.9	2950
2025	MA N	ASH CC	3	1	W-CC	3	CC	3	80	314	11	54	39.9	2684
2025	MA N	ASH CC	3	1	W-CC	3	CC	2	40	315	11	54	43.3	2906
2025	MA N	ASH CC	3	1	W-CC	4	CR	2	40	316	10	54	42.8	2877
2025	MA N	ASH CC	3	1	W-CC	4	CR	1	0	317	10	55	45.9	3080
2025	MA N	ASH CC	3	1	W-CC	4	CR	5	240	318	10	55	49.3	3311
2025	MA N	ASH CC	3	1	W-CC	4	CR	4	160	319	11	55	45.3	3040
2025	MA N	ASH CC	3	1	W-CC	4	CR	3	80	320	10	54	42.6	2859
2025	MA N	ASH CC	3	1	W-CC	1	CF	2	40	321	11	55	45	3022
2025	MA N	ASH CC	3	1	W-CC	1	CF	5	240	322	10	55	51	3425
2025	MA N	ASH CC	3	1	W-CC	1	CF	3	80	323	10	54	46.8	3146
2025	MA N	ASH CC	3	1	W-CC	1	CF	4	160	324	10	54	43.2	2905
2025	MA N	ASH CC	3	1	W-CC	1	CF	1	0	325	11	54	39.2	2636
2025	MA N	ASH CC	3	1	W-CC	5	R/C	5	240	326	10	55	51.8	3480
2025	MA N	ASH CC	3	1	W-CC	5	R/C	1	0	327	10	54	50.9	3423
2025	MA N	ASH CC	3	1	W-CC	5	R/C	3	80	328	10	55	51	3429
2025	MA N	ASH CC	3	1	W-CC	5	R/C	4	160	329	10	54	46.3	3109

2025	MA N	ASH CC	3	1	W-CC	5	R/C	2	40	330	10	54	44.8	3011
2025	MA N	ASH CC	4	1	W-CC	3	CC	1	0	431	11	54	41.6	2792
2025	MA N	ASH CC	4	1	W-CC	3	CC	5	240	432	11	55	45.7	3069
2025	MA N	ASH CC	4	1	W-CC	3	CC	2	40	433	11	53	46.2	3102
2025	MA N	ASH CC	4	1	W-CC	3	CC	4	160	434	10	53	44	2959
2025	MA N	ASH CC	4	1	W-CC	3	CC	3	80	435	10	53	39.5	2654
2025	MA N	ASH CC	4	1	W-CC	6	FTC	4	160	436	10	54	53.9	3622
2025	MA N	ASH CC	4	1	W-CC	6	FTC	3	80	437	11	54	46.6	3133
2025	MA N	ASH CC	4	1	W-CC	6	FTC	1	0	438	10	54	46.5	3122
2025	MA N	ASH CC	4	1	W-CC	6	FTC	2	40	439	10	54	46.4	3115
2025	MA N	ASH CC	4	1	W-CC	6	FTC	5	240	440	10	54	46.1	3100
2025	MA N	ASH CC	4	1	W-CC	5	R/C	4	160	441	10	55	48.8	3276
2025	MA N	ASH CC	4	1	W-CC	5	R/C	3	80	442	10	55	47.5	3194
2025	MA N	ASH CC	4	1	W-CC	5	R/C	5	240	443	10	55	47	3159
2025	MA N	ASH CC	4	1	W-CC	5	R/C	1	0	444	10	53	43.7	2934
2025	MA N	ASH CC	4	1	W-CC	5	R/C	2	40	445	10	53	41.6	2792
2025	MA N	ASH CC	4	1	W-CC	4	CR	2	40	446	10	55	48.4	3253
2025	MA N	ASH CC	4	1	W-CC	4	CR	4	160	447	10	54	47.2	3169
2025	MA N	ASH CC	4	1	W-CC	4	CR	3	80	448	10	54	43.9	2951
2025	MA N	ASH CC	4	1	W-CC	4	CR	5	240	449	10	53	46.6	3128
2025	MA N	ASH CC	4	1	W-CC	4	CR	1	0	450	10	53	43.3	2908
2025	MA N	ASH CC	4	1	W-CC	1	CF	2	40	451	10	54	49.1	3301
2025	MA N	ASH CC	4	1	W-CC	1	CF	3	80	452	10	54	47.7	3207
2025	MA N	ASH CC	4	1	W-CC	1	CF	5	240	453	10	54	45.8	3080
2025	MA N	ASH CC	4	1	W-CC	1	CF	1	0	454	10	53	44.2	2968
2025	MA N	ASH CC	4	1	W-CC	1	CF	4	160	455	10	53	45.2	3035
2025	MA N	ASH CC	4	1	W-CC	2	DSB	2	40	456	10	55	49.4	3317

2025	MA N	ASH CC	4	1	W-CC	2	DSB	5	240	457	10	54	47.3	3175
2025	MA N	ASH CC	4	1	W-CC	2	DSB	1	0	458	10	54	46.1	3098
2025	MA N	ASH CC	4	1	W-CC	2	DSB	4	160	459	10	54	44	2957
2025	MA N	ASH CC	4	1	W-CC	2	DSB	3	80	460	10	54	47.8	3208
2020	MA N	ASH CC	1	0	DSB	2	DSB	2	40	146	9.1	.	25	1680
2020	MA N	ASH CC	1	0	DSB	2	DSB	3	80	147	9.1	.	19.7	1321
2020	MA N	ASH CC	1	0	DSB	2	DSB	5	240	148	9.1	.	18.2	1222
2020	MA N	ASH CC	1	0	DSB	2	DSB	4	160	149	9.1	.	18.7	1254
2020	MA N	ASH CC	1	0	DSB	2	DSB	1	0	150	9.1	55	19	1274
2020	MA N	ASH CC	2	0	DSB	2	DSB	3	80	281	9.3	.	25.8	1731
2020	MA N	ASH CC	2	0	DSB	2	DSB	5	240	282	9.3	.	21.1	1419
2020	MA N	ASH CC	2	0	DSB	2	DSB	1	0	283	9.3	56	25.8	1731
2020	MA N	ASH CC	2	0	DSB	2	DSB	4	160	284	9.3	.	25.5	1713
2020	MA N	ASH CC	2	0	DSB	2	DSB	2	40	285	9.3	.	26.3	1765
2020	MA N	ASH CC	3	0	DSB	2	DSB	5	240	346	9.6	.	28.5	1914
2020	MA N	ASH CC	3	0	DSB	2	DSB	2	40	347	9.6	.	22.3	1500
2020	MA N	ASH CC	3	0	DSB	2	DSB	4	160	348	9.6	.	28	1879
2020	MA N	ASH CC	3	0	DSB	2	DSB	3	80	349	9.6	.	20.3	1362
2020	MA N	ASH CC	3	0	DSB	2	DSB	1	0	350	9.6	57	26.2	1759
2020	MA N	ASH CC	4	0	DSB	2	DSB	4	160	466	9.4	.	22.4	1504
2020	MA N	ASH CC	4	0	DSB	2	DSB	2	40	467	9.4	.	23.9	1608
2020	MA N	ASH CC	4	0	DSB	2	DSB	1	0	468	9.4	57	21.9	1469
2020	MA N	ASH CC	4	0	DSB	2	DSB	5	240	469	9.4	.	23.2	1556
2020	MA N	ASH CC	4	0	DSB	2	DSB	3	80	470	9.4	.	21.5	1444
2021	MA N	ASH CC	1	0	DSB	2	DSB	4	160	171	9	57	22.2	1494
2021	MA N	ASH CC	1	0	DSB	2	DSB	2	40	172	9	57	21.4	1438
2021	MA N	ASH CC	1	0	DSB	2	DSB	3	80	173	9	54	31.7	2130

202 1	MA N	ASH CC	1	0	DSB	2	DSB	1	0	174	9	55	24.6	1655
202 1	MA N	ASH CC	1	0	DSB	2	DSB	5	240	175	9	55	25.9	1743
202 1	MA N	ASH CC	2	0	DSB	2	DSB	2	40	201	9	57	25.5	1710
202 1	MA N	ASH CC	2	0	DSB	2	DSB	5	240	202	9	57	19	1275
202 1	MA N	ASH CC	2	0	DSB	2	DSB	1	0	203	9	57	26.3	1766
202 1	MA N	ASH CC	2	0	DSB	2	DSB	3	80	204	9	57	28.2	1892
202 1	MA N	ASH CC	2	0	DSB	2	DSB	4	160	205	9	57	25.5	1716
202 1	MA N	ASH CC	3	0	DSB	2	DSB	3	80	366	9	58	22	1476
202 1	MA N	ASH CC	3	0	DSB	2	DSB	4	160	367	9	58	21.3	1428
202 1	MA N	ASH CC	3	0	DSB	2	DSB	2	40	368	9	56	30.9	2073
202 1	MA N	ASH CC	3	0	DSB	2	DSB	5	240	369	9	56	20.6	1384
202 1	MA N	ASH CC	3	0	DSB	2	DSB	1	0	370	9	57	25.1	1685
202 1	MA N	ASH CC	4	0	DSB	2	DSB	2	40	411	9	57	23.2	1556
202 1	MA N	ASH CC	4	0	DSB	2	DSB	1	0	412	9	57	22.9	1536
202 1	MA N	ASH CC	4	0	DSB	2	DSB	4	160	413	9	56	26.8	1803
202 1	MA N	ASH CC	4	0	DSB	2	DSB	3	80	414	9	56	28.1	1888
202 1	MA N	ASH CC	4	0	DSB	2	DSB	5	240	415	9	57	24.2	1627
202 2	MA N	ASH CC	1	0	DSB	2	DSB	3	80	111	9	.	27.9	1873
202 2	MA N	ASH CC	1	0	DSB	2	DSB	4	160	112	9	.	27.9	1873
202 2	MA N	ASH CC	1	0	DSB	2	DSB	5	240	113	9	.	27.9	1873
202 2	MA N	ASH CC	1	0	DSB	2	DSB	2	40	114	9	.	27.9	1873
202 2	MA N	ASH CC	1	0	DSB	2	DSB	1	0	115	9	.	27.9	1873
202 2	MA N	ASH CC	2	0	DSB	2	DSB	2	40	251	9	.	26.3	1765
202 2	MA N	ASH CC	2	0	DSB	2	DSB	1	0	252	9	.	26.3	1765
202 2	MA N	ASH CC	2	0	DSB	2	DSB	5	240	253	9	.	26.3	1765
202 2	MA N	ASH CC	2	0	DSB	2	DSB	3	80	254	9	.	26.3	1765
202 2	MA N	ASH CC	2	0	DSB	2	DSB	4	160	255	9	.	26.3	1765

202 2	MA N	ASH CC	3	0	DSB	2	DSB	4	160	301	9	.	25	1682
202 2	MA N	ASH CC	3	0	DSB	2	DSB	3	80	302	9	.	25	1682
202 2	MA N	ASH CC	3	0	DSB	2	DSB	2	40	303	9	.	25	1682
202 2	MA N	ASH CC	3	0	DSB	2	DSB	5	240	304	9	.	25	1682
202 2	MA N	ASH CC	3	0	DSB	2	DSB	1	0	305	9	.	25	1682
202 2	MA N	ASH CC	4	0	DSB	2	DSB	2	40	456	9	.	26	1744
202 2	MA N	ASH CC	4	0	DSB	2	DSB	5	240	457	9	.	26	1744
202 2	MA N	ASH CC	4	0	DSB	2	DSB	1	0	458	9	.	26	1744
202 2	MA N	ASH CC	4	0	DSB	2	DSB	4	160	459	9	.	26	1744
202 2	MA N	ASH CC	4	0	DSB	2	DSB	3	80	460	9	.	26	1744
202 5	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	160	101	.	.	17556
202 5	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	40	102	.	.	14233
202 5	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	240	103	.	.	17576
202 5	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	0	104	.	.	10417
202 5	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	80	105	.	.	15458
202 5	MA N	ASH CC	1	.	TOT A	L	.	CF	.	80	106	.	.	18097
202 5	MA N	ASH CC	1	.	TOT A	L	.	CF	.	40	107	.	.	16733
202 5	MA N	ASH CC	1	.	TOT A	L	.	CF	.	160	108	.	.	17902
202 5	MA N	ASH CC	1	.	TOT A	L	.	CF	.	0	109	.	.	16129
202 5	MA N	ASH CC	1	.	TOT A	L	.	CF	.	240	110	.	.	18087
202 5	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	80	111	.	.	17857
202 5	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	160	112	.	.	19038
202 5	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	240	113	.	.	18789
202 5	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	40	114	.	.	17571
202 5	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	0	115	.	.	15150
202 5	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	240	116	.	.	16697
202 5	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	160	117	.	.	17066

202 5	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	80	118	.	.	15147
202 5	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	40	119	.	.	11990
202 5	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	0	120	.	.	9469
202 5	MA N	ASH CC	1	.	TOT A	L	.	CC	.	80	121	.	.	16582
202 5	MA N	ASH CC	1	.	TOT A	L	.	CC	.	40	122	.	.	15185
202 5	MA N	ASH CC	1	.	TOT A	L	.	CC	.	0	123	.	.	13999
202 5	MA N	ASH CC	1	.	TOT A	L	.	CC	.	240	124	.	.	17331
202 5	MA N	ASH CC	1	.	TOT A	L	.	CC	.	160	125	.	.	17283
202 5	MA N	ASH CC	1	.	TOT A	L	.	CR	.	160	126	.	.	16660
202 5	MA N	ASH CC	1	.	TOT A	L	.	CR	.	0	127	.	.	9718
202 5	MA N	ASH CC	1	.	TOT A	L	.	CR	.	40	128	.	.	9919
202 5	MA N	ASH CC	1	.	TOT A	L	.	CR	.	80	129	.	.	12960
202 5	MA N	ASH CC	1	.	TOT A	L	.	CR	.	240	130	.	.	15663
202 3	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	0	131	.	.	9860
202 3	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	80	132	.	.	14196
202 3	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	40	133	.	.	9915
202 3	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	160	134	.	.	14843
202 3	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	240	135	.	.	15406
202 3	MA N	ASH CC	1	.	TOT A	L	.	CC	.	80	136	.	.	16973
202 3	MA N	ASH CC	1	.	TOT A	L	.	CC	.	40	137	.	.	14491
202 3	MA N	ASH CC	1	.	TOT A	L	.	CC	.	160	138	.	.	16209
202 3	MA N	ASH CC	1	.	TOT A	L	.	CC	.	0	139	.	.	11517
202 3	MA N	ASH CC	1	.	TOT A	L	.	CC	.	240	140	.	.	16106
202 3	MA N	ASH CC	1	.	TOT A	L	.	CF	.	240	141	.	.	18838
202 3	MA N	ASH CC	1	.	TOT A	L	.	CF	.	80	142	.	.	18516
202 3	MA N	ASH CC	1	.	TOT A	L	.	CF	.	160	143	.	.	17313
202 3	MA N	ASH CC	1	.	TOT A	L	.	CF	.	40	144	.	.	14543

202 3	MA N	ASH CC	1	.	TOT A	L	.	CF	.	0	145	.	.	12521
202 3	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	40	146	.	.	17629
202 3	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	80	147	.	.	19710
202 3	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	240	148	.	.	19372
202 3	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	160	149	.	.	16583
202 3	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	0	150	.	.	15388
202 3	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	240	151	.	.	17669
202 3	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	40	152	.	.	12498
202 3	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	160	153	.	.	16985
202 3	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	0	154	.	.	9551
202 3	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	80	155	.	.	13971
202 3	MA N	ASH CC	1	.	TOT A	L	.	CR	.	240	156	.	.	18318
202 3	MA N	ASH CC	1	.	TOT A	L	.	CR	.	40	157	.	.	12644
202 3	MA N	ASH CC	1	.	TOT A	L	.	CR	.	160	158	.	.	17077
202 3	MA N	ASH CC	1	.	TOT A	L	.	CR	.	80	159	.	.	13737
202 3	MA N	ASH CC	1	.	TOT A	L	.	CR	.	0	160	.	.	8723
202 4	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	160	161	.	.	12822
202 4	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	0	162	.	.	8627
202 4	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	80	163	.	.	10673
202 4	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	240	164	.	.	12622
202 4	MA N	ASH CC	1	.	TOT A	L	.	R/ C	.	40	165	.	.	9803
202 4	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	240	166	.	.	14285
202 4	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	80	167	.	.	13392
202 4	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	160	168	.	.	14963
202 4	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	40	169	.	.	10617
202 4	MA N	ASH CC	1	.	TOT A	L	.	FT C	.	0	170	.	.	8638
202 4	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	160	171	.	.	18288

202 4	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	40	172	.	.	16591
202 4	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	80	173	.	.	18029
202 4	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	0	174	.	.	13766
202 4	MA N	ASH CC	1	.	TOT A	L	.	DS B	.	240	175	.	.	17299
202 4	MA N	ASH CC	1	.	TOT A	L	.	CF	.	240	176	.	.	15902
202 4	MA N	ASH CC	1	.	TOT A	L	.	CF	.	80	177	.	.	15782
202 4	MA N	ASH CC	1	.	TOT A	L	.	CF	.	0	178	.	.	12255
202 4	MA N	ASH CC	1	.	TOT A	L	.	CF	.	160	179	.	.	16903
202 4	MA N	ASH CC	1	.	TOT A	L	.	CF	.	40	180	.	.	13410
202 4	MA N	ASH CC	1	.	TOT A	L	.	CR	.	240	181	.	.	13665
202 4	MA N	ASH CC	1	.	TOT A	L	.	CR	.	160	182	.	.	13931
202 4	MA N	ASH CC	1	.	TOT A	L	.	CR	.	0	183	.	.	8110
202 4	MA N	ASH CC	1	.	TOT A	L	.	CR	.	80	184	.	.	11624
202 4	MA N	ASH CC	1	.	TOT A	L	.	CR	.	40	185	.	.	9141
202 4	MA N	ASH CC	1	.	TOT A	L	.	CC	.	0	186	.	.	13117
202 4	MA N	ASH CC	1	.	TOT A	L	.	CC	.	240	187	.	.	17079
202 4	MA N	ASH CC	1	.	TOT A	L	.	CC	.	80	188	.	.	15858
202 4	MA N	ASH CC	1	.	TOT A	L	.	CC	.	160	189	.	.	17071
202 4	MA N	ASH CC	1	.	TOT A	L	.	CC	.	40	190	.	.	14319
202 4	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	40	201	.	.	17055
202 4	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	240	202	.	.	18147
202 4	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	0	203	.	.	14600
202 4	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	80	204	.	.	18189
202 4	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	160	205	.	.	16702
202 4	MA N	ASH CC	2	.	TOT A	L	.	CR	.	0	206	.	.	7591
202 4	MA N	ASH CC	2	.	TOT A	L	.	CR	.	240	207	.	.	14006
202 4	MA N	ASH CC	2	.	TOT A	L	.	CR	.	80	208	.	.	12376

202 4	MA N	ASH CC	2	.	TOT A	L	.	CR	.	40	209	.	.	9037
202 4	MA N	ASH CC	2	.	TOT A	L	.	CR	.	160	210	.	.	14499
202 4	MA N	ASH CC	2	.	TOT A	L	.	CC	.	40	211	.	.	15771
202 4	MA N	ASH CC	2	.	TOT A	L	.	CC	.	160	212	.	.	17677
202 4	MA N	ASH CC	2	.	TOT A	L	.	CC	.	240	213	.	.	17248
202 4	MA N	ASH CC	2	.	TOT A	L	.	CC	.	80	214	.	.	15478
202 4	MA N	ASH CC	2	.	TOT A	L	.	CC	.	0	215	.	.	11814
202 4	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	0	216	.	.	7014
202 4	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	40	217	.	.	12938
202 4	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	160	218	.	.	14148
202 4	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	80	219	.	.	13597
202 4	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	240	220	.	.	15267
202 4	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	0	221	.	.	9875
202 4	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	40	222	.	.	13329
202 4	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	80	223	.	.	14245
202 4	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	240	224	.	.	17114
202 4	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	160	225	.	.	14614
202 4	MA N	ASH CC	2	.	TOT A	L	.	CF	.	40	226	.	.	14025
202 4	MA N	ASH CC	2	.	TOT A	L	.	CF	.	160	227	.	.	17423
202 4	MA N	ASH CC	2	.	TOT A	L	.	CF	.	240	228	.	.	17245
202 4	MA N	ASH CC	2	.	TOT A	L	.	CF	.	80	229	.	.	16288
202 4	MA N	ASH CC	2	.	TOT A	L	.	CF	.	0	230	.	.	13295
202 5	MA N	ASH CC	2	.	TOT A	L	.	CR	.	160	231	.	.	17775
202 5	MA N	ASH CC	2	.	TOT A	L	.	CR	.	80	232	.	.	14880
202 5	MA N	ASH CC	2	.	TOT A	L	.	CR	.	40	233	.	.	15246
202 5	MA N	ASH CC	2	.	TOT A	L	.	CR	.	240	234	.	.	17159
202 5	MA N	ASH CC	2	.	TOT A	L	.	CR	.	0	235	.	.	9559

202 5	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	80	236	.	.	17393
202 5	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	0	237	.	.	11290
202 5	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	40	238	.	.	13773
202 5	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	240	239	.	.	18061
202 5	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	160	240	.	.	18960
202 5	MA N	ASH CC	2	.	TOT A	L	.	CC	.	80	241	.	.	17826
202 5	MA N	ASH CC	2	.	TOT A	L	.	CC	.	0	242	.	.	15197
202 5	MA N	ASH CC	2	.	TOT A	L	.	CC	.	40	243	.	.	18236
202 5	MA N	ASH CC	2	.	TOT A	L	.	CC	.	160	244	.	.	18940
202 5	MA N	ASH CC	2	.	TOT A	L	.	CC	.	240	245	.	.	18175
202 5	MA N	ASH CC	2	.	TOT A	L	.	CF	.	80	246	.	.	18417
202 5	MA N	ASH CC	2	.	TOT A	L	.	CF	.	0	247	.	.	16204
202 5	MA N	ASH CC	2	.	TOT A	L	.	CF	.	160	248	.	.	19537
202 5	MA N	ASH CC	2	.	TOT A	L	.	CF	.	240	249	.	.	16890
202 5	MA N	ASH CC	2	.	TOT A	L	.	CF	.	40	250	.	.	18555
202 5	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	40	251	.	.	17049
202 5	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	0	252	.	.	15477
202 5	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	240	253	.	.	20601
202 5	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	80	254	.	.	18560
202 5	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	160	255	.	.	20081
202 5	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	160	256	.	.	16325
202 5	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	0	257	.	.	13476
202 5	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	240	258	.	.	18255
202 5	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	40	259	.	.	15360
202 5	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	80	260	.	.	16076
202 3	MA N	ASH CC	2	.	TOT A	L	.	CC	.	80	261	.	.	12661
202 3	MA N	ASH CC	2	.	TOT A	L	.	CC	.	40	262	.	.	12742

2023	MA N	ASH CC	2	.	TOT A	L	.	CC	.	240	263	.	.	13689
2023	MA N	ASH CC	2	.	TOT A	L	.	CC	.	160	264	.	.	13325
2023	MA N	ASH CC	2	.	TOT A	L	.	CC	.	0	265	.	.	9371
2023	MA N	ASH CC	2	.	TOT A	L	.	CF	.	240	266	.	.	17355
2023	MA N	ASH CC	2	.	TOT A	L	.	CF	.	160	267	.	.	19495
2023	MA N	ASH CC	2	.	TOT A	L	.	CF	.	80	268	.	.	16459
2023	MA N	ASH CC	2	.	TOT A	L	.	CF	.	40	269	.	.	13628
2023	MA N	ASH CC	2	.	TOT A	L	.	CF	.	0	270	.	.	13118
2023	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	160	271	.	.	16244
2023	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	80	272	.	.	12523
2023	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	0	273	.	.	10802
2023	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	240	274	.	.	17873
2023	MA N	ASH CC	2	.	TOT A	L	.	FT C	.	40	275	.	.	9971
2023	MA N	ASH CC	2	.	TOT A	L	.	CR	.	240	276	.	.	18282
2023	MA N	ASH CC	2	.	TOT A	L	.	CR	.	160	277	.	.	17190
2023	MA N	ASH CC	2	.	TOT A	L	.	CR	.	40	278	.	.	10582
2023	MA N	ASH CC	2	.	TOT A	L	.	CR	.	80	279	.	.	13650
2023	MA N	ASH CC	2	.	TOT A	L	.	CR	.	0	280	.	.	10023
2023	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	80	281	.	.	17223
2023	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	240	282	.	.	19495
2023	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	0	283	.	.	14640
2023	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	160	284	.	.	19881
2023	MA N	ASH CC	2	.	TOT A	L	.	DS B	.	40	285	.	.	15829
2023	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	40	286	.	.	10472
2023	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	240	287	.	.	17613
2023	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	80	288	.	.	13344
2023	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	0	289	.	.	9994

202 3	MA N	ASH CC	2	.	TOT A	L	.	R/ C	.	160	290	.	.	15449
202 5	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	160	301	.	.	17912
202 5	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	80	302	.	.	16762
202 5	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	40	303	.	.	16088
202 5	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	240	304	.	.	18954
202 5	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	0	305	.	.	14298
202 5	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	0	306	.	.	10441
202 5	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	40	307	.	.	12413
202 5	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	240	308	.	.	15430
202 5	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	160	309	.	.	16850
202 5	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	80	310	.	.	15601
202 5	MA N	ASH CC	3	.	TOT A	L	.	CC	.	240	311	.	.	15423
202 5	MA N	ASH CC	3	.	TOT A	L	.	CC	.	0	312	.	.	13491
202 5	MA N	ASH CC	3	.	TOT A	L	.	CC	.	160	313	.	.	16897
202 5	MA N	ASH CC	3	.	TOT A	L	.	CC	.	80	314	.	.	17203
202 5	MA N	ASH CC	3	.	TOT A	L	.	CC	.	40	315	.	.	16068
202 5	MA N	ASH CC	3	.	TOT A	L	.	CR	.	40	316	.	.	12265
202 5	MA N	ASH CC	3	.	TOT A	L	.	CR	.	0	317	.	.	10571
202 5	MA N	ASH CC	3	.	TOT A	L	.	CR	.	240	318	.	.	16405
202 5	MA N	ASH CC	3	.	TOT A	L	.	CR	.	160	319	.	.	19016
202 5	MA N	ASH CC	3	.	TOT A	L	.	CR	.	80	320	.	.	14718
202 5	MA N	ASH CC	3	.	TOT A	L	.	CF	.	40	321	.	.	17029
202 5	MA N	ASH CC	3	.	TOT A	L	.	CF	.	240	322	.	.	18553
202 5	MA N	ASH CC	3	.	TOT A	L	.	CF	.	80	323	.	.	18974
202 5	MA N	ASH CC	3	.	TOT A	L	.	CF	.	160	324	.	.	17624
202 5	MA N	ASH CC	3	.	TOT A	L	.	CF	.	0	325	.	.	15164
202 5	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	240	326	.	.	16555

202 5	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	0	327	.	.	12374
202 5	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	80	328	.	.	15439
202 5	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	160	329	.	.	18691
202 5	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	40	330	.	.	12827
202 3	MA N	ASH CC	3	.	TOT A	L	.	CF	.	80	331	.	.	18679
202 3	MA N	ASH CC	3	.	TOT A	L	.	CF	.	240	332	.	.	18091
202 3	MA N	ASH CC	3	.	TOT A	L	.	CF	.	0	333	.	.	12951
202 3	MA N	ASH CC	3	.	TOT A	L	.	CF	.	160	334	.	.	18812
202 3	MA N	ASH CC	3	.	TOT A	L	.	CF	.	40	335	.	.	16230
202 3	MA N	ASH CC	3	.	TOT A	L	.	CC	.	40	336	.	.	12625
202 3	MA N	ASH CC	3	.	TOT A	L	.	CC	.	0	337	.	.	12979
202 3	MA N	ASH CC	3	.	TOT A	L	.	CC	.	160	338	.	.	16669
202 3	MA N	ASH CC	3	.	TOT A	L	.	CC	.	240	339	.	.	18831
202 3	MA N	ASH CC	3	.	TOT A	L	.	CC	.	80	340	.	.	16106
202 3	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	160	341	.	.	16547
202 3	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	40	342	.	.	13451
202 3	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	0	343	.	.	10953
202 3	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	240	344	.	.	20390
202 3	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	80	345	.	.	13510
202 3	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	240	346	.	.	18603
202 3	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	40	347	.	.	15904
202 3	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	160	348	.	.	21150
202 3	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	80	349	.	.	20163
202 3	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	0	350	.	.	15773
202 3	MA N	ASH CC	3	.	TOT A	L	.	CR	.	240	351	.	.	17451
202 3	MA N	ASH CC	3	.	TOT A	L	.	CR	.	160	352	.	.	15943
202 3	MA N	ASH CC	3	.	TOT A	L	.	CR	.	40	353	.	.	10649

2023	MA N	ASH CC	3	.	TOT A	L	.	CR	.	0	354	.	.	9470
2023	MA N	ASH CC	3	.	TOT A	L	.	CR	.	80	355	.	.	12626
2023	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	160	356	.	.	15699
2023	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	80	357	.	.	13414
2023	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	240	358	.	.	17823
2023	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	40	359	.	.	12179
2023	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	0	360	.	.	9788
2024	MA N	ASH CC	3	.	TOT A	L	.	CC	.	160	361	.	.	13170
2024	MA N	ASH CC	3	.	TOT A	L	.	CC	.	40	362	.	.	10180
2024	MA N	ASH CC	3	.	TOT A	L	.	CC	.	0	363	.	.	9354
2024	MA N	ASH CC	3	.	TOT A	L	.	CC	.	240	364	.	.	13787
2024	MA N	ASH CC	3	.	TOT A	L	.	CC	.	80	365	.	.	12911
2024	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	80	366	.	.	15739
2024	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	160	367	.	.	16302
2024	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	40	368	.	.	15548
2024	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	240	369	.	.	16706
2024	MA N	ASH CC	3	.	TOT A	L	.	DS B	.	0	370	.	.	12989
2024	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	240	371	.	.	11836
2024	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	160	372	.	.	13375
2024	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	80	373	.	.	11402
2024	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	40	374	.	.	10033
2024	MA N	ASH CC	3	.	TOT A	L	.	R/ C	.	0	375	.	.	7751
2024	MA N	ASH CC	3	.	TOT A	L	.	CR	.	0	376	.	.	6488
2024	MA N	ASH CC	3	.	TOT A	L	.	CR	.	40	377	.	.	9894
2024	MA N	ASH CC	3	.	TOT A	L	.	CR	.	80	378	.	.	11020
2024	MA N	ASH CC	3	.	TOT A	L	.	CR	.	240	379	.	.	13486
2024	MA N	ASH CC	3	.	TOT A	L	.	CR	.	160	380	.	.	12706

202 4	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	0	381	.	.	9096
202 4	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	80	382	.	.	13098
202 4	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	160	383	.	.	14087
202 4	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	240	384	.	.	15048
202 4	MA N	ASH CC	3	.	TOT A	L	.	FT C	.	40	385	.	.	10574
202 4	MA N	ASH CC	3	.	TOT A	L	.	CF	.	160	386	.	.	14524
202 4	MA N	ASH CC	3	.	TOT A	L	.	CF	.	240	387	.	.	16471
202 4	MA N	ASH CC	3	.	TOT A	L	.	CF	.	0	388	.	.	11439
202 4	MA N	ASH CC	3	.	TOT A	L	.	CF	.	80	389	.	.	16167
202 4	MA N	ASH CC	3	.	TOT A	L	.	CF	.	40	390	.	.	13245
202 4	MA N	ASH CC	4	.	TOT A	L	.	CR	.	80	401	.	.	11089
202 4	MA N	ASH CC	4	.	TOT A	L	.	CR	.	40	402	.	.	10745
202 4	MA N	ASH CC	4	.	TOT A	L	.	CR	.	240	403	.	.	14452
202 4	MA N	ASH CC	4	.	TOT A	L	.	CR	.	160	404	.	.	14627
202 4	MA N	ASH CC	4	.	TOT A	L	.	CR	.	0	405	.	.	7897
202 4	MA N	ASH CC	4	.	TOT A	L	.	CF	.	160	406	.	.	14755
202 4	MA N	ASH CC	4	.	TOT A	L	.	CF	.	240	407	.	.	16108
202 4	MA N	ASH CC	4	.	TOT A	L	.	CF	.	0	408	.	.	12951
202 4	MA N	ASH CC	4	.	TOT A	L	.	CF	.	80	409	.	.	15733
202 4	MA N	ASH CC	4	.	TOT A	L	.	CF	.	40	410	.	.	15404
202 4	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	40	411	.	.	15738
202 4	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	0	412	.	.	14209
202 4	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	160	413	.	.	16291
202 4	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	80	414	.	.	17851
202 4	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	240	415	.	.	17022
202 4	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	0	416	.	.	9202
202 4	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	40	417	.	.	11244

202 4	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	160	418	.	.	13585
202 4	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	240	419	.	.	14522
202 4	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	80	420	.	.	13413
202 4	MA N	ASH CC	4	.	TOT A	L	.	CC	.	0	421	.	.	11781
202 4	MA N	ASH CC	4	.	TOT A	L	.	CC	.	40	422	.	.	15137
202 4	MA N	ASH CC	4	.	TOT A	L	.	CC	.	240	423	.	.	13783
202 4	MA N	ASH CC	4	.	TOT A	L	.	CC	.	80	424	.	.	15093
202 4	MA N	ASH CC	4	.	TOT A	L	.	CC	.	160	425	.	.	14052
202 4	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	160	426	.	.	13719
202 4	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	240	427	.	.	13185
202 4	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	40	428	.	.	9673
202 4	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	0	429	.	.	9914
202 4	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	80	430	.	.	11910
202 5	MA N	ASH CC	4	.	TOT A	L	.	CC	.	0	431	.	.	13739
202 5	MA N	ASH CC	4	.	TOT A	L	.	CC	.	240	432	.	.	17142
202 5	MA N	ASH CC	4	.	TOT A	L	.	CC	.	40	433	.	.	15939
202 5	MA N	ASH CC	4	.	TOT A	L	.	CC	.	160	434	.	.	17826
202 5	MA N	ASH CC	4	.	TOT A	L	.	CC	.	80	435	.	.	16759
202 5	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	160	436	.	.	17112
202 5	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	80	437	.	.	15950
202 5	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	0	438	.	.	12556
202 5	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	40	439	.	.	14624
202 5	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	240	440	.	.	17670
202 5	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	160	441	.	.	15454
202 5	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	80	442	.	.	14003
202 5	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	240	443	.	.	15557
202 5	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	0	444	.	.	10741

202 5	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	40	445	.	.	12457
202 5	MA N	ASH CC	4	.	TOT A	L	.	CR	.	40	446	.	.	12066
202 5	MA N	ASH CC	4	.	TOT A	L	.	CR	.	160	447	.	.	15344
202 5	MA N	ASH CC	4	.	TOT A	L	.	CR	.	80	448	.	.	13412
202 5	MA N	ASH CC	4	.	TOT A	L	.	CR	.	240	449	.	.	16299
202 5	MA N	ASH CC	4	.	TOT A	L	.	CR	.	0	450	.	.	10328
202 5	MA N	ASH CC	4	.	TOT A	L	.	CF	.	40	451	.	.	14369
202 5	MA N	ASH CC	4	.	TOT A	L	.	CF	.	80	452	.	.	15858
202 5	MA N	ASH CC	4	.	TOT A	L	.	CF	.	240	453	.	.	17297
202 5	MA N	ASH CC	4	.	TOT A	L	.	CF	.	0	454	.	.	14902
202 5	MA N	ASH CC	4	.	TOT A	L	.	CF	.	160	455	.	.	17556
202 5	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	40	456	.	.	16466
202 5	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	240	457	.	.	17003
202 5	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	0	458	.	.	14156
202 5	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	160	459	.	.	17432
202 5	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	80	460	.	.	18947
202 3	MA N	ASH CC	4	.	TOT A	L	.	CC	.	160	461	.	.	14914
202 3	MA N	ASH CC	4	.	TOT A	L	.	CC	.	240	462	.	.	15319
202 3	MA N	ASH CC	4	.	TOT A	L	.	CC	.	40	463	.	.	10202
202 3	MA N	ASH CC	4	.	TOT A	L	.	CC	.	80	464	.	.	11438
202 3	MA N	ASH CC	4	.	TOT A	L	.	CC	.	0	465	.	.	8920
202 3	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	160	466	.	.	19131
202 3	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	40	467	.	.	15525
202 3	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	0	468	.	.	13700
202 3	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	240	469	.	.	18082
202 3	MA N	ASH CC	4	.	TOT A	L	.	DS B	.	80	470	.	.	16578
202 3	MA N	ASH CC	4	.	TOT A	L	.	CF	.	240	471	.	.	18241

2023	MA N	ASH CC	4	.	TOT A	L	.	CF	.	80	472	.	.	17578
2023	MA N	ASH CC	4	.	TOT A	L	.	CF	.	0	473	.	.	13510
2023	MA N	ASH CC	4	.	TOT A	L	.	CF	.	160	474	.	.	18014
2023	MA N	ASH CC	4	.	TOT A	L	.	CF	.	40	475	.	.	13347
2023	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	160	476	.	.	16957
2023	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	240	477	.	.	17323
2023	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	0	478	.	.	10713
2023	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	80	479	.	.	13574
2023	MA N	ASH CC	4	.	TOT A	L	.	FT C	.	40	480	.	.	10119
2023	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	160	481	.	.	14639
2023	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	240	482	.	.	16487
2023	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	40	483	.	.	10750
2023	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	80	484	.	.	12961
2023	MA N	ASH CC	4	.	TOT A	L	.	R/ C	.	0	485	.	.	9934
2023	MA N	ASH CC	4	.	TOT A	L	.	CR	.	160	486	.	.	15588
2023	MA N	ASH CC	4	.	TOT A	L	.	CR	.	40	487	.	.	10052
2023	MA N	ASH CC	4	.	TOT A	L	.	CR	.	0	488	.	.	9116
2023	MA N	ASH CC	4	.	TOT A	L	.	CR	.	80	489	.	.	12039
2023	MA N	ASH CC	4	.	TOT A	L	.	CR	.	240	490	.	.	15795

Corn Yield Data

YEAR	BLOC	CCROP	N_kgha	PLOT	Wt	MST	TW	YIELD_kgha
2023	1	FTC	180	101	42.1	12.3	56.8	11380.2
2023	1	FTC	45	102	29.2	12.4	56	7883.9
2023	1	FTC	270	103	41.7	12.4	56.6	11254.7
2023	1	FTC	0	104	15.7	12.3	54	4243.3
2023	1	FTC	90	105	33.3	12.1	56.2	9020.0
2023	1	CF	90	106	42.1	12	56.6	11417.9
2023	1	CF	45	107	38.5	11.9	56.1	10451.2
2023	1	CF	180	108	41.9	12.3	56.9	11323.7

2023	1	CF	0	109	35.7	12.2	56.4	9660.3
2023	1	CF	270	110	42.3	12.1	56.6	11455.5
2023	1	DSB	90	111	36.4	12.4	55.3	9823.5
2023	1	DSB	180	112	40	12.2	55.9	10821.5
2023	1	DSB	270	113	38.1	11.7	55.6	10369.6
2023	1	DSB	45	114	34	12.2	56	9202.1
2023	1	DSB	0	115	25.5	12.1	56.8	6904.7
2023	1	R/C	270	116	39.1	12.3	56.3	10570.5
2023	1	R/C	180	117	39	12.2	56.6	10551.6
2023	1	R/C	90	118	32.3	12.3	56.5	8731.3
2023	1	R/C	45	119	20.5	12.1	53.5	5555.1
2023	1	R/C	0	120	11.6	13.2	51.4	3100.8
2023	1	CC	90	121	37.9	12.3	57	10244.1
2023	1	CC	45	122	32.5	11.7	49.2	8844.3
2023	1	CC	0	123	28.5	12.3	51.2	7701.9
2023	1	CC	270	124	39.6	12	56.2	10739.9
2023	1	CC	180	125	39.8	12.1	54.3	10783.9
2023	1	CR	180	126	38.9	12.5	52.6	10488.9
2023	1	CR	0	127	14.6	12.7	50.6	3929.4
2023	1	CR	45	128	16.6	12.5	52.6	4475.5
2023	1	CR	90	129	25.7	12.9	56.5	6898.4
2023	1	CR	270	130	36.2	12	52.9	9817.2
2021	1	FTC	0	131	18.2	16.2	55.5	4481.8
2021	1	FTC	90	132	33.4	15	57	8335.9
2021	1	FTC	45	133	20	15.7	54.2	4952.6
2021	1	FTC	180	134	39.5	15.5	56.9	9804.7
2021	1	FTC	270	135	40.2	15.4	56.5	9986.7
2021	1	CC	90	136	39.8	14.9	57.4	9949.0
2021	1	CC	45	137	31.8	15.2	55.9	7921.6
2021	1	CC	180	138	41.7	15.2	57.2	10388.4
2021	1	CC	0	139	22.4	16.8	54.6	5473.5
2021	1	CC	270	140	40.7	16	56.5	10043.2
2021	1	CF	270	141	46	15	57.8	11480.6
2021	1	CF	90	142	46.6	14.8	58.4	11662.7
2021	1	CF	180	143	44.7	15.1	59.1	11148.0
2021	1	CF	45	144	34.1	15.5	56.1	8461.4
2021	1	CF	0	145	29	17	54.4	7067.9
2021	1	DSB	45	146	36	15.5	57.6	8932.2
2021	1	DSB	90	147	45.5	14.8	58.2	11386.5
2021	1	DSB	270	148	40.4	15	57.2	11273.5
2021	1	DSB	180	149	36.4	14.9	57.6	9095.4
2021	1	DSB	0	150	31	15	56.8	7739.5
2021	1	R/C	270	151	41.4	15.3	56.5	10300.6

2021	1	R/C	45	152	21.7	15.6	55	5379.4
2021	1	R/C	180	153	39.6	15.88	56.5	10325.7
2021	1	R/C	0	154	13.9	17.7	53.9	3358.2
2021	1	R/C	90	155	29.3	15.5	55.3	7268.8
2021	1	CR	270	156	47.6	15.9	57.6	11756.8
2021	1	CR	45	157	20.5	15.3	55.1	5096.9
2021	1	CR	180	158	41.5	15.2	57.5	10338.2
2021	1	CR	90	159	27.1	15.8	55.7	6703.8
2021	1	CR	0	160	11.8	18.2	52.4	2837.2
2022	1	R/C	180	161	35.8	13.6	58.1	8511.6
2022	1	R/C	0	162	18.7	13.3	56.3	4462.9
2022	1	R/C	90	163	26.9	13.6	58.3	6396.3
2022	1	R/C	270	164	35.3	14	57.9	8354.7
2022	1	R/C	45	165	21.7	12.7	55.9	5209.9
2022	1	FTC	270	166	41.7	13.5	58.5	9923.9
2022	1	FTC	90	167	37	13.1	58.4	8844.3
2022	1	FTC	180	168	42.2	13.7	59.8	10018.1
2022	1	FTC	45	169	26	12.9	58.4	6233.1
2022	1	FTC	0	170	16.7	12.3	55.5	4029.8
2022	1	DSB	180	171	49.6	13.4	58.7	11819.6
2022	1	DSB	45	172	43.9	13.2	58.2	10482.6
2022	1	DSB	90	173	45.5	13.4	58.5	10840.4
2022	1	DSB	0	174	30	13.2	58.3	7162.1
2022	1	DSB	270	175	44.3	13.5	57.5	10545.4
2022	1	CF	270	176	46.6	13.6	58.8	11078.9
2022	1	CF	90	177	43.7	13.5	58	10401.0
2022	1	CF	0	178	31.6	12.9	58.5	7576.3
2022	1	CF	180	179	50	13.6	58	11888.6
2022	1	CF	45	180	33.5	13.2	58.7	8003.2
2022	1	CR	270	181	34.9	14.4	59	8222.9
2022	1	CR	180	182	36.5	14	58.3	8637.2
2022	1	CR	0	183	10.7	13.8	56.3	2535.9
2022	1	CR	90	184	24.8	13.6	56.7	5894.1
2022	1	CR	45	185	12.4	13.2	55.8	2962.7
2022	1	CC	0	186	28.9	12.8	57.5	6936.1
2022	1	CC	270	187	46.2	13.7	58.8	10972.2
2022	1	CC	90	188	43.7	13	59.1	10463.8
2022	1	CC	180	189	43.3	13.1	58.7	10350.8
2022	1	CC	45	190	33	12.8	58.6	7915.3
2022	2	DSB	45	201	37.9	13.4	58.4	9032.6
2022	2	DSB	270	202	47.3	13.7	58.3	11229.6
2022	2	DSB	0	203	30.3	13.1	58.4	7243.7
2022	2	DSB	90	204	42.1	13.6	58.5	10005.5

2022	2	DSB	180	205	40.2	13.4	59	9578.7
2022	2	CR	0	206	4.1	13.8	54.6	972.9
2022	2	CR	270	207	35.6	14.7	58.2	8354.7
2022	2	CR	90	208	27.4	13.6	57.5	6515.5
2022	2	CR	45	209	14.5	13.6	56.4	3446.1
2022	2	CR	180	210	37.3	14.2	58	8806.6
2022	2	CC	45	211	36.3	13.5	59	8637.2
2022	2	CC	180	212	46	14.2	58.8	10859.2
2022	2	CC	270	213	42.5	13.8	58.8	10080.9
2022	2	CC	90	214	41.4	13.5	58.8	9854.9
2022	2	CC	0	215	23.3	13.6	58.1	5536.3
2022	2	R/C	0	216	5	12.7	50.9	1198.9
2022	2	R/C	45	217	23.7	13.6	56.3	5636.7
2022	2	R/C	180	218	34.3	14.3	57.5	8091.1
2022	2	R/C	90	219	30.1	13.7	58.2	7149.5
2022	2	R/C	270	220	38.2	13.9	57.7	9051.4
2022	2	FTC	0	221	13.1	13	56.8	3138.5
2022	2	FTC	45	222	25.6	13.2	58	6113.8
2022	2	FTC	90	223	31.6	13.2	57.6	7545.0
2022	2	FTC	270	224	44	14.1	58.6	10401.0
2022	2	FTC	180	225	34.8	14	59	8235.4
2022	2	CF	45	226	35.8	12.6	57.9	8612.0
2022	2	CF	180	227	46.7	12.7	58.3	11217.0
2022	2	CF	270	228	45.3	13.2	59.5	10821.5
2022	2	CF	90	229	42.8	12.8	56.7	10269.2
2022	2	CF	0	230	29.3	12.5	57.2	7055.3
2023	2	CR	180	231	37.8	12.5	57.8	10193.8
2023	2	CR	90	232	33.2	12.6	57.6	8944.7
2023	2	CR	45	233	26.7	12.6	55.8	7193.4
2023	2	CR	270	234	40.1	12.7	57.4	10790.2
2023	2	CR	0	235	9.7	13.1	53.1	2598.7
2023	2	R/C	90	236	33	12.6	57.5	8888.2
2023	2	R/C	0	237	12.4	13.5	55.6	3308.0
2023	2	R/C	45	238	22.8	12.8	55.2	6126.4
2023	2	R/C	270	239	38.8	12.4	56.2	10476.3
2023	2	R/C	180	240	41.2	12.5	56.6	11110.3
2023	2	CC	90	241	38.5	12.5	56.8	10382.2
2023	2	CC	0	242	31.7	12.7	57.5	8530.4
2023	2	CC	45	243	40.6	12.7	57.7	10922.0
2023	2	CC	180	244	44	12.9	56.9	11813.3
2023	2	CC	270	245	41.4	12.5	57.2	11160.5
2023	2	CF	90	246	39.5	12.4	57.4	10664.6
2023	2	CF	0	247	33	12.3	57.4	8919.6

2023	2	CF	180	248	44.4	12.3	57.3	12001.6
2023	2	CF	270	249	38.8	12.3	56.4	10488.9
2023	2	CF	45	250	42.4	12.6	57.8	11417.9
2023	2	DSB	45	251	29.8	12.2	57.3	8065.9
2023	2	DSB	0	252	24.1	12.3	56	6515.5
2023	2	DSB	270	253	39.3	12.1	56.5	10645.8
2023	2	DSB	90	254	39	12	56.4	10576.7
2023	2	DSB	180	255	40.1	12.4	56.1	10827.8
2023	2	FTC	180	256	38.7	12.1	56.1	10482.6
2023	2	FTC	0	257	18.7	12.2	55.2	5059.3
2023	2	FTC	270	258	38.9	12.3	55.6	10514.0
2023	2	FTC	45	259	28	12.6	56.4	7538.7
2023	2	FTC	90	260	37.6	12.3	57.3	10162.5
2021	2	CC	90	261	30.3	17.4	54.8	7350.4
2021	2	CC	45	262	25.5	18.3	53	6120.1
2021	2	CC	270	263	39.8	20.6	51	9283.7
2021	2	CC	180	264	34	20.9	51.4	7896.5
2021	2	CC	0	265	15.7	18.8	53	3741.1
2021	2	CF	270	266	43.6	17	57.4	10627.0
2021	2	CF	180	267	48.7	16.2	57.2	11982.8
2021	2	CF	90	268	39.7	16.3	58.1	9760.7
2021	2	CF	45	269	30.9	16.4	56.1	7588.9
2021	2	CF	0	270	28.8	16.6	56	7055.3
2021	2	FTC	180	271	35.7	16.5	56.5	10206.4
2021	2	FTC	90	272	28.8	17.8	54.2	6954.9
2021	2	FTC	0	273	18.5	17.3	55.2	4494.3
2021	2	FTC	270	274	45.5	17.2	55.8	11066.4
2021	2	FTC	45	275	16.5	17.1	53.6	4017.3
2021	2	CR	270	276	42.2	15.8	57.6	11662.7
2021	2	CR	180	277	39.8	16	57	9817.2
2021	2	CR	45	278	17.2	15.9	55.7	4249.5
2021	2	CR	90	279	24.9	16.3	55.6	6841.9
2021	2	CR	0	280	13.1	18.9	52.3	3119.7
2021	2	DSB	90	281	39	15.1	58.4	9723.1
2021	2	DSB	270	282	46.4	15.8	57.6	11474.4
2021	2	DSB	0	283	27.5	15.7	56.1	6810.5
2021	2	DSB	180	284	45.9	15.8	57.5	11348.8
2021	2	DSB	45	285	31.5	16.1	56.3	7764.6
2021	2	R/C	45	286	17.4	15.4	55.5	4324.9
2021	2	R/C	270	287	40.8	15.4	56.7	10137.4
2021	2	R/C	90	288	27.4	15.1	56.4	6829.4
2021	2	R/C	0	289	12.5	17.6	53.2	3339.4
2021	2	R/C	180	290	37.7	15.6	55.7	9346.5

2023	3	DSB	180	301	34.2	11.9	55	9283.7
2023	3	DSB	90	302	31.3	12	55.5	8486.5
2023	3	DSB	45	303	26.3	12.3	55.6	7105.6
2023	3	DSB	270	304	33.5	12.1	54.7	9076.5
2023	3	DSB	0	305	25.7	12.7	57.2	6917.3
2023	3	FTC	0	306	16.8	11.9	55	4563.4
2023	3	FTC	45	307	21.5	12.3	55.7	5812.5
2023	3	FTC	270	308	32.1	11.5	54.3	8756.4
2023	3	FTC	180	309	35.7	11.7	55	9716.8
2023	3	FTC	90	310	29.5	12	55.9	8003.2
2023	3	CC	270	311	31.9	11.8	55.8	8668.5
2023	3	CC	0	312	24.8	12	56	6722.7
2023	3	CC	180	313	35.7	12.2	57	9660.3
2023	3	CC	90	314	37.9	12.2	57.6	10256.6
2023	3	CC	45	315	32.4	12.2	57	8769.0
2023	3	CR	45	316	20.4	12.5	54.2	5498.7
2023	3	CR	0	317	12.7	12.7	51.9	3414.7
2023	3	CR	270	318	32.3	12.1	56.4	8750.1
2023	3	CR	180	319	40.3	12.2	56.6	10903.1
2023	3	CR	90	320	27.4	12.3	55.1	7406.9
2023	3	CF	45	321	35.7	12.2	57.5	9660.3
2023	3	CF	270	322	37.9	12	56.7	10275.4
2023	3	CF	90	323	41.2	12	57.5	11173.1
2023	3	CF	180	324	38.5	12.5	56.9	10382.2
2023	3	CF	0	325	32.6	12.3	56.5	8812.9
2023	3	R/C	270	326	31	12	55.9	8404.9
2023	3	R/C	0	327	14.8	12.6	53	3985.9
2023	3	R/C	90	328	27.3	12.3	56.3	7375.5
2023	3	R/C	180	329	39.7	12.5	56.4	10702.3
2023	3	R/C	45	330	19	12.6	55.4	5115.8
2021	3	CF	90	331	46.1	15.2	57.4	11480.6
2021	3	CF	270	332	45.3	15.3	57.5	11267.2
2021	3	CF	0	333	27.5	15.9	56.3	6791.7
2021	3	CF	180	334	49.2	15.7	58	12183.7
2021	3	CF	45	335	36.1	15.9	57	8919.6
2021	3	CC	45	336	25.6	15.8	55.3	6333.5
2021	3	CC	0	337	25	16.5	53.8	6132.6
2021	3	CC	180	338	35.2	16.1	54.6	8674.8
2021	3	CC	270	339	44.3	15.6	55.1	10978.5
2021	3	CC	90	340	37.2	15.8	55.5	9202.1
2021	3	FTC	180	341	39.2	15.4	56.8	9741.9
2021	3	FTC	45	342	25	15.6	54	6195.4
2021	3	FTC	0	343	16	16.6	54.4	3916.8

2021	3	FTC	270	344	49.8	15.7	57.2	12328.0
2021	3	FTC	90	345	30.4	15.5	55.7	7545.0
2021	3	DSB	270	346	39.5	15.1	57.2	9848.6
2021	3	DSB	45	347	33.4	15.2	57.7	8317.0
2021	3	DSB	180	348	46.4	15.1	57.4	11568.5
2021	3	DSB	90	349	44.5	15.3	57.6	11072.6
2021	3	DSB	0	350	32.9	15.4	56.8	8172.7
2021	3	CR	270	351	42.7	15.5	56.9	10595.6
2021	3	CR	180	352	36.1	15.4	56.8	9735.6
2021	3	CR	45	353	15.1	16.6	54.2	3697.2
2021	3	CR	0	354	11.7	16.6	53	2868.6
2021	3	CR	90	355	25.1	15.8	55.4	6208.0
2021	3	R/C	180	356	38.2	15.4	57.5	9490.8
2021	3	R/C	90	357	30.9	16	55.1	7620.3
2021	3	R/C	270	358	42.7	15.9	55.5	10545.4
2021	3	R/C	45	359	20	15.7	55.4	5373.1
2021	3	R/C	0	360	16.3	17.9	53.4	3929.4
2022	3	CC	180	361	37.6	13.1	54.2	8988.7
2022	3	CC	45	362	23.2	12.9	57.4	5561.4
2022	3	CC	0	363	20.9	13.9	58.6	4952.6
2022	3	CC	270	364	37.9	13.4	58	9032.6
2022	3	CC	90	365	32.1	12.7	58.1	7708.2
2022	3	DSB	90	366	40.7	13.1	58.7	9729.4
2022	3	DSB	180	367	40.6	13.5	58.9	9660.3
2022	3	DSB	45	368	34.4	12.6	58	8273.1
2022	3	DSB	270	369	38.8	13.3	57.8	9258.6
2022	3	DSB	0	370	24.9	12.8	57.4	5975.7
2022	3	R/C	270	371	31.5	13.9	56.6	7463.4
2022	3	R/C	180	372	34.8	14	56.3	8235.4
2022	3	R/C	90	373	25.4	13.4	57	6051.0
2022	3	R/C	45	374	18.9	13.1	54.1	4519.4
2022	3	R/C	0	375	9.8	13.5	54.9	2335.0
2022	3	CR	0	376	6.1	14.4	53.4	1437.4
2022	3	CR	45	377	18.6	13.5	53.2	4425.3
2022	3	CR	90	378	25.2	13.9	55.4	5969.4
2022	3	CR	270	379	35.1	13.9	56	8317.0
2022	3	CR	180	380	31.4	14.4	57.2	7394.3
2022	3	FTC	0	381	16	13	56.9	3829.0
2022	3	FTC	90	382	31.3	12.8	58	7507.3
2022	3	FTC	180	383	34.8	13.6	58.4	8273.1
2022	3	FTC	270	384	40.2	13.2	57.3	9603.8
2022	3	FTC	45	385	23.8	12.4	56.6	5737.2
2022	3	CF	180	386	38.5	12.9	58.8	9227.2

2022	3	CF	270	387	44.1	12.9	58	10570.5
2022	3	CF	0	388	26.3	12.7	57.7	6314.7
2022	3	CF	90	389	40.8	12.7	58.4	9798.4
2022	3	CF	45	390	33.3	12.6	59.5	8009.5
2022	4	CR	90	401	22.2	13.8	57.2	5266.4
2022	4	CR	45	402	20.6	14	57.4	4877.2
2022	4	CR	270	403	37.4	14.4	57.2	8806.6
2022	4	CR	180	404	38.5	14.3	58.2	9076.5
2022	4	CR	0	405	10.4	13.3	53.6	2479.4
2022	4	CF	180	406	39	12.8	58.4	9359.0
2022	4	CF	270	407	43.1	12.9	59.5	10331.9
2022	4	CF	0	408	31.2	12.6	58.4	7501.0
2022	4	CF	90	409	40.1	13.1	59.3	9591.3
2022	4	CF	45	410	37.8	12.7	58.9	9082.8
2022	4	DSB	45	411	35.1	12.3	57.6	8467.7
2022	4	DSB	0	412	27.6	12.9	57.2	6616.0
2022	4	DSB	180	413	35.7	13.2	58.6	8524.2
2022	4	DSB	90	414	38.1	13	57.7	9120.5
2022	4	DSB	270	415	41.3	12.8	57.4	9911.4
2022	4	FTC	0	416	12	13.4	56.1	2862.3
2022	4	FTC	45	417	20.6	12.3	56.4	4971.4
2022	4	FTC	180	418	33.7	13.5	58.8	8022.0
2022	4	FTC	270	419	35.9	13.4	57.8	8555.6
2022	4	FTC	90	420	30.8	13	57.9	7375.5
2022	4	CC	0	421	20.8	12.2	56.6	5027.9
2022	4	CC	45	422	37.1	12.8	56.8	8900.8
2022	4	CC	270	423	32.9	13	56.7	7877.6
2022	4	CC	90	424	34.3	13.1	58	8204.0
2022	4	CC	180	425	33.4	12.8	57.7	8015.7
2022	4	R/C	180	426	30.6	13.4	57.5	7293.9
2022	4	R/C	270	427	29.9	13	56.7	7155.8
2022	4	R/C	45	428	12.1	13.2	54.4	2887.4
2022	4	R/C	0	429	13.4	13.1	55.6	3201.3
2022	4	R/C	90	430	24.3	13.2	57.1	5806.2
2023	4	CC	0	431	24.6	12.2	55.9	6653.6
2023	4	CC	270	432	35.4	11.8	52.2	9622.6
2023	4	CC	45	433	32	12.5	57.6	8630.9
2023	4	CC	180	434	38.3	12.2	56.3	10363.3
2023	4	CC	90	435	35.5	12	54.9	9628.9
2023	4	FTC	180	436	32.7	11.6	55.2	8907.1
2023	4	FTC	90	437	31	12.1	55.2	8398.6
2023	4	FTC	0	438	17.9	12.2	53.4	4845.8
2023	4	FTC	45	439	24.9	12.7	55.7	6697.6

2023	4	FTC	270	440	34.8	11.9	55.8	9446.9
2023	4	R/C	180	441	26.7	11.7	54.5	7262.5
2023	4	R/C	90	442	25.9	12.3	56	6998.9
2023	4	R/C	270	443	29.7	12	54.9	8053.4
2023	4	R/C	0	444	12.5	12.9	54.7	3358.2
2023	4	R/C	45	445	19.8	12.4	54.8	5348.0
2023	4	CR	45	446	14.8	12.3	54.2	3998.4
2023	4	CR	180	447	30.7	11.8	56	8342.1
2023	4	CR	90	448	22.2	12.2	55.8	6007.1
2023	4	CR	270	449	30.2	11.6	53.2	8229.1
2023	4	CR	0	450	9.8	13	51.6	2630.1
2023	4	CF	45	451	27.2	12.2	56.4	7356.6
2023	4	CF	90	452	32.4	12.1	55.8	8775.2
2023	4	CF	270	453	31.7	12	56.2	8599.5
2023	4	CF	0	454	28.5	12.2	56.5	7714.4
2023	4	CF	180	455	35	11.8	54.8	9515.9
2023	4	DSB	45	456	23.4	11.8	55	6358.6
2023	4	DSB	270	457	30.3	11.8	53.6	8235.4
2023	4	DSB	0	458	19.5	11.8	53.5	5297.8
2023	4	DSB	180	459	30	11.6	53	8172.7
2023	4	DSB	90	460	34.3	11.7	54.3	9333.9
2021	4	CC	180	461	35.7	16.3	55.8	8775.2
2021	4	CC	270	462	39.5	16.5	55.8	9685.4
2021	4	CC	45	463	16.1	17	54	3923.1
2021	4	CC	90	464	24.6	17.4	54.7	5969.4
2021	4	CC	0	465	13.3	19.3	52.3	3151.1
2021	4	DSB	180	466	44.2	15.9	57.5	10915.7
2021	4	DSB	45	467	31.6	15.6	56.6	7833.7
2021	4	DSB	0	468	24.1	16.2	55.9	5931.8
2021	4	DSB	270	469	39.2	15.5	56.5	9729.4
2021	4	DSB	90	470	35.5	15	57.4	8863.1
2021	4	CF	270	471	44.9	15.4	57.7	11154.2
2021	4	CF	90	472	44.1	15.9	57.4	10890.6
2021	4	CF	0	473	29.2	16.4	55.6	7168.3
2021	4	CF	180	474	45.5	15.1	57.8	11342.5
2021	4	CF	45	475	30.3	15.6	56.4	7513.6
2021	4	FTC	180	476	41.6	15.5	57.7	10325.7
2021	4	FTC	270	477	42.4	16.3	57.1	10419.8
2021	4	FTC	0	478	15.9	18.6	54	3803.9
2021	4	FTC	90	479	24.8	16.4	55.2	6728.9
2021	4	FTC	45	480	16.7	16.2	55.2	4111.4
2021	4	R/C	180	481	34.1	16.1	55.8	8404.9
2021	4	R/C	270	482	37.8	17.5	54.8	9158.1

2021	4	R/C	45	483	18.1	16.8	53.9	4425.3
2021	4	R/C	90	484	27.1	16.5	54.8	6647.3
2021	4	R/C	0	485	15	19.2	51.7	3559.1
2021	4	CR	180	486	36.7	15.8	57.5	9076.5
2021	4	CR	45	487	14.9	17.2	55.1	3621.8
2021	4	CR	0	488	10.8	20.7	50.3	2517.1
2021	4	CR	90	489	23.4	16.5	54	5737.2
2021	4	CR	270	490	39.7	15.9	55.7	9804.7

Corn population, days-to-bloom, stands, lodging, SPAD R1 and grain N removed

YEAR	BLOC	CCROP	N kg/ha	PLOT	POP	DAYS BLOOM	STAND	LODGE	SPAD R1	Grain N Mg/ha
2023	1	FTC	180	101	22009	.	96	0	.	0.18
2023	1	FTC	45	102	25907	73	113	0	51	0.11
2023	1	FTC	270	103	24760	70	108	0	50.6	0.18
2023	1	FTC	0	104	24990	.	109	0	.	0.05
2023	1	FTC	90	105	25677	73	112	0	50.5	0.13
2023	1	CF	90	106	23614	70	103	0	56	0.18
2023	1	CF	45	107	24990	70	109	0	53.3	0.16
2023	1	CF	180	108	25907	70	113	0	58.6	0.18
2023	1	CF	0	109	26365	73	115	0	52.2	0.14
2023	1	CF	270	110	25907	70	113	0	62.2	0.18
2023	1	DSB	90	111	23156	73	101	0	50.3	0.15
2023	1	DSB	180	112	26136	73	114	0	54.5	0.17
2023	1	DSB	270	113	21321	73	93	0	50.9	0.16
2023	1	DSB	45	114	25677	73	112	0	47.3	0.13
2023	1	DSB	0	115	25677	77	112	0	37.5	0.09
2023	1	R/C	270	116	24302	73	106	0	50	0.16
2023	1	R/C	180	117	23385	73	102	0	62.6	0.16
2023	1	R/C	90	118	25677	73	112	0	56.7	0.12
2023	1	R/C	45	119	24531	77	107	0	36.7	0.07
2023	1	R/C	0	120	22926	.	100	0	.	0.03
2023	1	CC	90	121	24760	70	108	0	59.1	0.16
2023	1	CC	45	122	25677	73	112	0	43.3	0.13
2023	1	CC	0	123	26136	73	114	0	39.4	0.10
2023	1	CC	270	124	27053	70	118	0	60.1	0.17
2023	1	CC	180	125	26136	73	114	0	57.3	0.17
2023	1	CR	180	126	25219	77	110	0	62.9	0.16
2023	1	CR	0	127	26136	.	114	0	.	0.04
2023	1	CR	45	128	24073	77	105	0	44.1	0.05
2023	1	CR	90	129	26824	77	117	0	39.3	0.09
2023	1	CR	270	130	25219	77	110	0	61.7	0.15

2021	1	FTC	0	131	25448	76	111	0	.	0.05
2021	1	FTC	90	132	24990	74	109	0	.	0.12
2021	1	FTC	45	133	25448	74	111	0	.	0.06
2021	1	FTC	180	134	25907	73	113	0	.	0.15
2021	1	FTC	270	135	26595	75	116	0	.	0.15
2021	1	CC	90	136	27053	70	118	0	.	0.15
2021	1	CC	45	137	27282	73	119	0	.	0.11
2021	1	CC	180	138	25907	74	113	0	.	0.16
2021	1	CC	0	139	25907	76	113	0	.	0.06
2021	1	CC	270	140	25219	74	110	0	.	0.15
2021	1	CF	270	141	25448	73	111	0	.	0.18
2021	1	CF	90	142	27282	70	119	0	.	0.19
2021	1	CF	180	143	26824	70	117	0	.	0.18
2021	1	CF	45	144	26595	72	116	0	.	0.12
2021	1	CF	0	145	27282	76	119	0	.	0.09
2021	1	DSB	45	146	26365	70	115	0	.	0.13
2021	1	DSB	90	147	27512	71	120	0	.	0.18
2021	1	DSB	270	148	27417	71	107	0	.	0.18
2021	1	DSB	180	149	25907	72	113	0	.	0.13
2021	1	DSB	0	150	27970	73	122	0	.	0.10
2021	1	R/C	270	151	25677	71	112	0	.	0.16
2021	1	R/C	45	152	25677	74	112	0	.	0.06
2021	1	R/C	180	153	27878	72	112	0	.	0.16
2021	1	R/C	0	154	26824	82	117	0	.	0.03
2021	1	R/C	90	155	27512	74	120	0	.	0.10
2021	1	CR	270	156	27741	73	121	0	.	0.19
2021	1	CR	45	157	23843	76	104	0	.	0.06
2021	1	CR	180	158	26365	72	115	0	.	0.16
2021	1	CR	90	159	25907	73	113	0	.	0.09
2021	1	CR	0	160	28658	83	125	0	.	0.03
2022	1	R/C	180	161	22287	63	110	0	56.1	0.12
2022	1	R/C	0	162	21071	76	104	9	40.8	0.05
2022	1	R/C	90	163	19247	68	95	3	57.6	0.08
2022	1	R/C	270	164	18640	68	92	2	59.4	0.12
2022	1	R/C	45	165	19450	68	96	2	50.1	0.06
2022	1	FTC	270	166	22894	64	113	0	63.8	0.15
2022	1	FTC	90	167	20868	64	103	4	53.7	0.13
2022	1	FTC	180	168	24313	64	120	1	62.6	0.15
2022	1	FTC	45	169	21881	64	108	0	56.7	0.08
2022	1	FTC	0	170	22084	76	109	1	37.3	0.04
2022	1	DSB	180	171	24313	63	120	3	61.3	0.19
2022	1	DSB	45	172	23097	64	114	9	60.2	0.16
2022	1	DSB	90	173	23907	64	118	2	53.9	0.17

2022	1	DSB	0	174	21476	66	106	2	50.6	0.09
2022	1	DSB	270	175	22692	63	112	3	61.3	0.16
2022	1	CF	270	176	21476	63	106	2	66.1	0.17
2022	1	CF	90	177	19247	64	95	4	60.4	0.16
2022	1	CF	0	178	25933	68	128	2	46.6	0.10
2022	1	CF	180	179	22692	62	112	0	56.8	0.19
2022	1	CF	45	180	22489	68	111	5	56.1	0.11
2022	1	CR	270	181	17019	68	84	2	59.6	0.11
2022	1	CR	180	182	19855	68	98	11	60.1	0.12
2022	1	CR	0	183	19247	76	95	8	39.6	0.02
2022	1	CR	90	184	20058	72	99	2	53	0.07
2022	1	CR	45	185	20463	72	101	9	45.4	0.03
2022	1	CC	0	186	22489	68	111	4	46.6	0.09
2022	1	CC	270	187	18234	63	90	2	67.1	0.17
2022	1	CC	90	188	23097	63	114	0	61.4	0.16
2022	1	CC	180	189	22489	63	111	1	64.4	0.16
2022	1	CC	45	190	21476	68	106	1	51.8	0.11
2022	2	DSB	45	201	22489	64	111	8	50.3	0.13
2022	2	DSB	270	202	19045	62	94	7	63	0.18
2022	2	DSB	0	203	20260	65	100	5	63.3	0.09
2022	2	DSB	90	204	24515	62	121	2	62.3	0.15
2022	2	DSB	180	205	20868	63	103	0	61.5	0.14
2022	2	CR	0	206	17627	76	87	50	37.9	0.01
2022	2	CR	270	207	17019	72	84	7	57.2	0.12
2022	2	CR	90	208	18640	70	92	5	47.8	0.08
2022	2	CR	45	209	19247	72	95	11	55	0.04
2022	2	CR	180	210	21881	70	108	0	54.4	0.13
2022	2	CC	45	211	20868	64	103	3	54.5	0.12
2022	2	CC	180	212	19653	64	97	2	63.4	0.17
2022	2	CC	270	213	21273	63	105	4	59.3	0.15
2022	2	CC	90	214	20868	61	103	4	59.5	0.15
2022	2	CC	0	215	21476	70	106	2	48.8	0.07
2022	2	R/C	0	216	15601		77	49	38.5	0.01
2022	2	R/C	45	217	17221	70	85	7	47.5	0.07
2022	2	R/C	180	218	19211	68	86	7	62.1	0.11
2022	2	R/C	90	219	20058	70	99	1	56	0.09
2022	2	R/C	270	220	21071	70	104	2	56	0.13
2022	2	FTC	0	221	21273	72	105	49	45.3	0.03
2022	2	FTC	45	222	21273	68	105	4	48.3	0.08
2022	2	FTC	90	223	21071	64	104	9	63.7	0.10
2022	2	FTC	270	224	22489	63	111	1	62.7	0.16
2022	2	FTC	180	225	19450	64	96	0	65.5	0.11
2022	2	CF	45	226	24349	62	109	8	58	0.12

2022	2	CF	180	227	22489	64	111	8	65.2	0.18
2022	2	CF	270	228	21071	62	104	0	63.7	0.17
2022	2	CF	90	229	24515	63	121	2	62.1	0.16
2022	2	CF	0	230	20260	68	100	8	51.4	0.09
2023	2	CR	180	231	24073	73	105	0	54.5	0.15
2023	2	CR	90	232	22697	73	99	0	49	0.13
2023	2	CR	45	233	22697	73	99	0	41.9	0.09
2023	2	CR	270	234	20863	73	91	0	52.9	0.17
2023	2	CR	0	235	19487	.	85	0	.	0.03
2023	2	R/C	90	236	23156	77	101	0	51.5	0.13
2023	2	R/C	0	237	20175	.	88	0	.	0.03
2023	2	R/C	45	238	21551	77	94	0	44.4	0.08
2023	2	R/C	270	239	22009	73	96	0	53.5	0.16
2023	2	R/C	180	240	27053	73	118	0	44.3	0.18
2023	2	CC	90	241	23843	73	104	0	51.8	0.16
2023	2	CC	0	242	25219	73	110	0	47.2	0.12
2023	2	CC	45	243	23843	73	104	0	52.6	0.17
2023	2	CC	180	244	23156	73	101	0	50.1	0.19
2023	2	CC	270	245	23843	73	104	0	49.5	0.18
2023	2	CF	90	246	22239	73	97	0	56.2	0.17
2023	2	CF	0	247	23156	73	101	0	44.4	0.13
2023	2	CF	180	248	24531	73	107	0	58.3	0.20
2023	2	CF	270	249	22468	70	98	0	56.1	0.16
2023	2	CF	45	250	21780	73	95	0	54.2	0.18
2023	2	DSB	45	251	24760	73	108	0	50.4	0.11
2023	2	DSB	0	252	22697	77	99	0	36.3	0.08
2023	2	DSB	270	253	23156	73	101	0	48.8	0.16
2023	2	DSB	90	254	23843	73	104	0	45.4	0.16
2023	2	DSB	180	255	22239	73	97	0	46.1	0.17
2023	2	FTC	180	256	23156	73	101	0	51.8	0.16
2023	2	FTC	0	257	24990	81	109	0	33.3	0.06
2023	2	FTC	270	258	22926	73	100	0	47.8	0.16
2023	2	FTC	45	259	23156	73	101	0	40.5	0.10
2023	2	FTC	90	260	25677	.	112	0	.	0.15
2021	2	CC	90	261	22697	76	99	0	.	0.10
2021	2	CC	45	262	26595	76	116	0	.	0.08
2021	2	CC	270	263	26824	76	117	0	.	0.13
2021	2	CC	180	264	26595	77	116	0	.	0.11
2021	2	CC	0	265	25677	79	112	0	.	0.04
2021	2	CF	270	266	25219	72	110	0	.	0.16
2021	2	CF	180	267	26136	71	114	0	.	0.20
2021	2	CF	90	268	25219	72	110	0	.	0.15
2021	2	CF	45	269	26595	73	116	0	.	0.10

2021	2	CF	0	270	25448	73	111	0	.	0.09
2021	2	FTC	180	271	24962	75	101	0	.	0.15
2021	2	FTC	90	272	25219	76	110	0	.	0.09
2021	2	FTC	0	273	26136	81	114	0	.	0.05
2021	2	FTC	270	274	24760	74	108	0	.	0.17
2021	2	FTC	45	275	25448	77	111	0	.	0.04
2021	2	CR	270	276	26620	75	110	0	.	0.19
2021	2	CR	180	277	24760	75	108	0	.	0.15
2021	2	CR	45	278	26365	78	115	0	.	0.05
2021	2	CR	90	279	29487	76	110	0	.	0.09
2021	2	CR	0	280	27512	83	120	0	.	0.03
2021	2	DSB	90	281	27741	73	121	0	.	0.14
2021	2	DSB	270	282	28199	73	123	0	.	0.18
2021	2	DSB	0	283	27970	75	122	0	.	0.09
2021	2	DSB	180	284	27282	72	119	0	.	0.18
2021	2	DSB	45	285	27282	73	119	0	.	0.10
2021	2	R/C	45	286	27053	74	118	0	.	0.05
2021	2	R/C	270	287	27282	74	119	0	.	0.15
2021	2	R/C	90	288	26365	76	115	0	.	0.09
2021	2	R/C	0	289	27878	82	116	0	.	0.03
2021	2	R/C	180	290	26824	74	117	0	.	0.14
2023	3	DSB	180	301	23156	73	101	0	56.7	0.13
2023	3	DSB	90	302	24990	73	109	0	48.5	0.12
2023	3	DSB	45	303	24531	73	107	0	51.2	0.09
2023	3	DSB	270	304	25219	73	110	0	45.8	0.13
2023	3	DSB	0	305	25219	77	110	0	38.6	0.09
2023	3	FTC	0	306	24302	81	106	0	35.4	0.05
2023	3	FTC	45	307	25448	77	111	0	42.2	0.07
2023	3	FTC	270	308	25448	73	111	0	56.6	0.12
2023	3	FTC	180	309	24302	73	106	0	56.7	0.14
2023	3	FTC	90	310	23156	73	101	0	45.6	0.11
2023	3	CC	270	311	26595	73	116	0	53.8	0.12
2023	3	CC	0	312	24302	77	106	0	37.6	0.09
2023	3	CC	180	313	24760	73	108	0	57.2	0.14
2023	3	CC	90	314	24073	73	105	0	59	0.16
2023	3	CC	45	315	24760	73	108	0	44.2	0.12
2023	3	CR	45	316	24073	77	105	0	37.3	0.07
2023	3	CR	0	317	20404	.	89	0	.	0.04
2023	3	CR	270	318	24531	77	107	0	61.2	0.12
2023	3	CR	180	319	23843	73	104	0	58.1	0.17
2023	3	CR	90	320	25907	77	113	0	49.5	0.10
2023	3	CF	45	321	22926	70	100	0	52.8	0.14
2023	3	CF	270	322	25677	73	112	0	57.1	0.16

2023	3	CF	90	323	23843	70	104	0	52.8	0.18
2023	3	CF	180	324	23843	70	104	0	55.5	0.16
2023	3	CF	0	325	23614	73	103	0	41.2	0.13
2023	3	R/C	270	326	22468	77	98	0	48.3	0.12
2023	3	R/C	0	327	24302		106	0		0.04
2023	3	R/C	90	328	24073	77	105	0	52.8	0.10
2023	3	R/C	180	329	21321	73	93	0	51.5	0.17
2023	3	R/C	45	330	24531	81	107	0	33.7	0.06
2021	3	CF	90	331	27053	71	118	0		0.18
2021	3	CF	270	332	27053	71	118	0		0.18
2021	3	CF	0	333	26824	72	117	0		0.09
2021	3	CF	180	334	27053	72	118	0		0.20
2021	3	CF	45	335	26365	72	115	0		0.13
2021	3	CC	45	336	25907	78	113	0		0.08
2021	3	CC	0	337	24302	79	106	0		0.08
2021	3	CC	180	338	24990	76	109	0		0.12
2021	3	CC	270	339	24760	75	108	0		0.17
2021	3	CC	90	340	26136	74	114	0		0.13
2021	3	FTC	180	341	24990	75	109	0		0.14
2021	3	FTC	45	342	26136	78	114	0		0.08
2021	3	FTC	0	343	26365	83	115	0		0.04
2021	3	FTC	270	344	24760	74	108	0		0.21
2021	3	FTC	90	345	25677	75	112	0		0.10
2021	3	DSB	270	346	27053	73	118	0		0.15
2021	3	DSB	45	347	26365	72	115	0		0.12
2021	3	DSB	180	348	27053	73	118	0		0.19
2021	3	DSB	90	349	27282	73	119	0		0.17
2021	3	DSB	0	350	27053	74	118	0		0.11
2021	3	CR	270	351	26365	75	115	0		0.16
2021	3	CR	180	352	27210	75	114	0		0.14
2021	3	CR	45	353	27282	80	119	0		0.04
2021	3	CR	0	354	27970	83	122	0		0.03
2021	3	CR	90	355	27512	76	120	0		0.08
2021	3	R/C	180	356	26595	77	116	0		0.14
2021	3	R/C	90	357	25907	78	113	0		0.10
2021	3	R/C	270	358	25448	75	111	0		0.16
2021	3	R/C	45	359	33893	81	142	0		0.06
2021	3	R/C	0	360	25677	83	112	0		0.04
2022	3	CC	180	361	23300	64	115	1	56.9	0.13
2022	3	CC	45	362	21679	66	107	3	49.3	0.07
2022	3	CC	0	363	22894	70	113	1	39.9	0.06
2022	3	CC	270	364	21881	64	108	0	58.2	0.13
2022	3	CC	90	365	19855	65	98	1	60.8	0.10

2022	3	DSB	90	366	20463	64	101	2	57.1	0.14
2022	3	DSB	180	367	20260	62	100	3	54.3	0.14
2022	3	DSB	45	368	21476	64	106	2	55.3	0.11
2022	3	DSB	270	369	21273	62	105	1	55.1	0.13
2022	3	DSB	0	370	21679	68	107	0	48.5	0.07
2022	3	R/C	270	371	23097	67	114	0	53.5	0.10
2022	3	R/C	180	372	17424	67	86	1	57.2	0.11
2022	3	R/C	90	373	22692	70	112	1	48.1	0.07
2022	3	R/C	45	374	22489	72	111	1	41.5	0.05
2022	3	R/C	0	375	19855	76	98	5	36.4	0.02
2022	3	CR	0	376	18234	76	90	4	35.5	0.01
2022	3	CR	45	377	18437	70	91	2	45.2	0.05
2022	3	CR	90	378	23097	70	114	2	49.7	0.07
2022	3	CR	270	379	17019	70	84	2	52.7	0.12
2022	3	CR	180	380	17829	70	88	0	53.8	0.10
2022	3	FTC	0	381	18842	72	93	2	42.1	0.04
2022	3	FTC	90	382	19045	68	94	0	52	0.10
2022	3	FTC	180	383	20260	64	100	1	57.8	0.11
2022	3	FTC	270	384	21476	64	106	0	58.1	0.14
2022	3	FTC	45	385	20058	68	99	1	48.4	0.07
2022	3	CF	180	386	18640	63	92	3	59	0.13
2022	3	CF	270	387	19247	64	95	2	61	0.16
2022	3	CF	0	388	19855	70	98	2	44.6	0.08
2022	3	CF	90	389	18842	64	93	1	58.7	0.15
2022	3	CF	45	390	19653	64	97	1	55.9	0.11
2022	4	CR	90	401	18437	70	91	3	45	0.06
2022	4	CR	45	402	18234	70	90	2	48	0.06
2022	4	CR	270	403	19653	70	97	1	58.5	0.13
2022	4	CR	180	404	19855	68	98	2	56.9	0.13
2022	4	CR	0	405	17019	76	84	7	38.6	0.02
2022	4	CF	180	406	21881	64	108	4	60.4	0.14
2022	4	CF	270	407	19450	64	96	0	63	0.16
2022	4	CF	0	408	20666	68	102	1	53	0.10
2022	4	CF	90	409	20058	63	99	2	60.4	0.14
2022	4	CF	45	410	19653	64	97	2	56.5	0.13
2022	4	DSB	45	411	22894	63	113	0	52.3	0.12
2022	4	DSB	0	412	20666	68	102	3	51	0.08
2022	4	DSB	180	413	20463	63	101	2	59.4	0.12
2022	4	DSB	90	414	20868	64	103	1	59.8	0.13
2022	4	DSB	270	415	21273	63	105	1	62	0.15
2022	4	FTC	0	416	17221	72	85	8	42.1	0.03
2022	4	FTC	45	417	22287	68	110	1	50.1	0.06
2022	4	FTC	180	418	19855	68	98	1	59.3	0.11

2022	4	FTC	270	419	19045	64	94	3	65.3	0.12
2022	4	FTC	90	420	21071	68	104	0	53.9	0.10
2022	4	CC	0	421	16614	70	82	1	44.6	0.06
2022	4	CC	45	422	19247	64	95	2	57.8	0.13
2022	4	CC	270	423	18842	68	93	0	56.9	0.11
2022	4	CC	90	424	20058	64	99	1	56.8	0.11
2022	4	CC	180	425	20666	63	102	1	60.8	0.11
2022	4	R/C	180	426	19855	66	98	7	54.1	0.10
2022	4	R/C	270	427	19045	68	94	5	56	0.09
2022	4	R/C	45	428	18842	76	93	31	34.5	0.03
2022	4	R/C	0	429	14993	76	74	13	36.5	0.03
2022	4	R/C	90	430	17221	68	85	4	54.3	0.07
2023	4	CC	0	431	22926	77	100	0	38.5	0.08
2023	4	CC	270	432	24073	73	105	0	51.9	0.14
2023	4	CC	45	433	23614	73	103	0	48.3	0.12
2023	4	CC	180	434	21092	73	92	0	52.9	0.16
2023	4	CC	90	435	23843		104	0		0.14
2023	4	FTC	180	436	23614	73	103	0	52.6	0.13
2023	4	FTC	90	437	22926	73	100	0	46.1	0.12
2023	4	FTC	0	438	25219	81	110	0	35.6	0.06
2023	4	FTC	45	439	25677	77	112	0	43.8	0.09
2023	4	FTC	270	440	19717	73	86	0	50.2	0.14
2023	4	R/C	180	441	21321	77	93	0	52.7	0.10
2023	4	R/C	90	442	19487	77	85	0	54.3	0.09
2023	4	R/C	270	443	23614	77	103	0	53.4	0.11
2023	4	R/C	0	444	24531		107	0		0.03
2023	4	R/C	45	445	22468	81	98	0	36.9	0.06
2023	4	CR	45	446	21780	81	95	0	35.6	0.04
2023	4	CR	180	447	22926	77	100	0	51.2	0.12
2023	4	CR	90	448	23843	77	104	0	42.3	0.07
2023	4	CR	270	449	22239	77	97	0	51.1	0.11
2023	4	CR	0	450	23385		102	0		0.03
2023	4	CF	45	451	25448	73	111	0	45.2	0.10
2023	4	CF	90	452	24990	73	109	0	48.3	0.12
2023	4	CF	270	453	21321	73	93	0	53.3	0.12
2023	4	CF	0	454	24990	73	109	0	39.3	0.10
2023	4	CF	180	455	24990	73	109	0	53.7	0.14
2023	4	DSB	45	456	23614	77	103	0	46.1	0.08
2023	4	DSB	270	457	24990	73	109	0	48.4	0.11
2023	4	DSB	0	458	25219	77	110	0	42	0.06
2023	4	DSB	180	459	24531	73	107	0	46.6	0.11
2023	4	DSB	90	460	23385	73	102	0	51.1	0.14
2021	4	CC	180	461	26365	77	115	0		0.12

2021	4	CC	270	462	26595	75	116	0	.	0.14
2021	4	CC	45	463	24073	80	105	0	.	0.04
2021	4	CC	90	464	26824	75	117	0	.	0.07
2021	4	CC	0	465	26824	84	117	0	.	0.03
2021	4	DSB	180	466	26136	73	114	0	.	0.17
2021	4	DSB	45	467	26595	73	116	0	.	0.11
2021	4	DSB	0	468	26824	76	117	0	.	0.07
2021	4	DSB	270	469	26595	72	116	0	.	0.14
2021	4	DSB	90	470	26595	72	116	0	.	0.13
2021	4	CF	270	471	27282	73	119	0	.	0.18
2021	4	CF	90	472	27512	73	120	0	.	0.17
2021	4	CF	0	473	27282	75	119	0	.	0.09
2021	4	CF	180	474	27512	73	120	0	.	0.18
2021	4	CF	45	475	27512	72	120	0	.	0.10
2021	4	FTC	180	476	26595	75	116	0	.	0.16
2021	4	FTC	270	477	39663	75	173	0	.	0.16
2021	4	FTC	0	478	26595	82	116	0	.	0.04
2021	4	FTC	90	479	27638	78	115	0	.	0.09
2021	4	FTC	45	480	25677	80	112	0	.	0.04
2021	4	R/C	180	481	26365	74	115	0	.	0.12
2021	4	R/C	270	482	25219	76	110	0	.	0.13
2021	4	R/C	45	483	26136	79	114	0	.	0.05
2021	4	R/C	90	484	28199	77	123	0	.	0.08
2021	4	R/C	0	485	24531	84	107	0	.	0.04
2021	4	CR	180	486	24760	77	108	0	.	0.13
2021	4	CR	45	487	25219	82	110	0	.	0.04
2021	4	CR	0	488	26595	84	116	0	.	0.02
2021	4	CR	90	489	26824	77	117	0	.	0.07
2021	4	CR	270	490	26365	75	115	0	.	0.15

Preplant Soil Inorganic N

Season	Year	State	Rep	Depth (cm)	Cover crop treatment	N rate level	NH4-N (mg/kg)	NO3-N (mg/kg)	Inorganic N
Spring	2021	KS	1	0_15	CF	All	10.33	4.76	15.09
Spring	2021	KS	1	15_30	CF	All	9.08	7.29	16.37
Spring	2021	KS	1	0_15	CR	All	9.74	<0.8	9.74
Spring	2021	KS	1	15_30	CR	All	8.58	<0.8	8.58
Spring	2021	KS	1	0_15	CC	All	12.19	<0.8	12.19
Spring	2021	KS	1	15_30	CC	All	10.04	<0.8	10.04
Spring	2021	KS	1	0_15	R/C	All	11.18	<0.8	11.18
Spring	2021	KS	1	15_30	R/C	All	10.06	<0.8	10.06

Spring	2021	KS	2	0_15	CF	All	10.97	4.11	15.08
Spring	2021	KS	2	15_30	CF	All	7.84	5.43	13.27
Spring	2021	KS	2	0_15	CR	All	11.09	<0.8	11.09
Spring	2021	KS	2	15_30	CR	All	8.54	<0.8	8.54
Spring	2021	KS	2	0_15	CC	All	11.29	<0.8	11.29
Spring	2021	KS	2	15_30	CC	All	8.9	<0.8	8.9
Spring	2021	KS	2	0_15	R/C	All	11.61	<0.8	11.61
Spring	2021	KS	2	15_30	R/C	All	8.78	<0.8	8.78
Spring	2021	KS	3	0_15	CF	All	10.81	5.36	16.17
Spring	2021	KS	3	15_30	CF	All	9.12	5.21	14.33
Spring	2021	KS	3	0_15	CR	All	10.73	<0.8	10.73
Spring	2021	KS	3	15_30	CR	All	8.98	<0.8	8.98
Spring	2021	KS	3	0_15	CC	All	11.79	2.18	13.97
Spring	2021	KS	3	15_30	CC	All	9.39	<0.8	9.39
Spring	2021	KS	3	0_15	R/C	All	10.22	<0.8	10.22
Spring	2021	KS	3	15_30	R/C	All	7.62	<0.8	7.62
Spring	2021	KS	4	0_15	CF	All	10.71	2.16	12.87
Spring	2021	KS	4	15_30	CF	All	8.16	3.81	11.97
Spring	2021	KS	4	0_15	CR	All	11.02	<0.8	11.02
Spring	2021	KS	4	15_30	CR	All	8.18	<0.8	8.18
Spring	2021	KS	4	0_15	CC	All	11.49	<0.8	11.49
Spring	2021	KS	4	15_30	CC	All	7.56	<0.8	7.56
Spring	2021	KS	4	0_15	R/C	All	10.91	<0.8	10.91
Spring	2021	KS	4	15_30	R/C	All	7.51	<0.8	7.51
Spring	2022	KS	1	0_15	R/C	All	3.4968	<0.8	3.4968
Spring	2022	KS	1	15_30	R/C	All	2.2752	<0.8	2.2752
Spring	2022	KS	1	0_15	CR	All	5.1568	<0.8	5.1568
Spring	2022	KS	1	15_30	CR	All	2.3024	<0.8	2.3024
Spring	2022	KS	1	0_15	CC	All	3.4816	1.0968	4.5784
Spring	2022	KS	1	15_30	CC	All	2.3944	<0.8	2.3944
Spring	2022	KS	1	0_15	CF	All	3.6272	3.5384	7.1656
Spring	2022	KS	1	15_30	CF	All	2.3448	6.6376	8.9824
Spring	2022	KS	2	0_15	R/C	All	4.2696	<0.8	4.2696
Spring	2022	KS	2	15_30	R/C	All	2.4888	<0.8	2.4888
Spring	2022	KS	2	0_15	CR	All	3.7256	<0.8	3.7256
Spring	2022	KS	2	15_30	CR	All	3.0696	<0.8	3.0696
Spring	2022	KS	2	0_15	CC	All	4.5552	3.4336	7.9888
Spring	2022	KS	2	15_30	CC	All	2.8416	1.552	4.3936
Spring	2022	KS	2	0_15	CF	All	3.2504	5.7232	8.9736
Spring	2022	KS	2	15_30	CF	All	2.6664	9.608	12.2744
Spring	2022	KS	3	0_15	R/C	All	3.8256	<0.8	3.8256

Spring	2022	KS	3	15_30	R/C	All	2.0832	<0.8	2.0832
Spring	2022	KS	3	0_15	CR	All	4.336	<0.8	4.336
Spring	2022	KS	3	15_30	CR	All	2.2552	<0.8	2.2552
Spring	2022	KS	3	0_15	CC	All	4.6712	3.572	8.2432
Spring	2022	KS	3	15_30	CC	All	2.62	1.172	3.792
Spring	2022	KS	3	0_15	CF	All	2.7504	5.048	7.7984
Spring	2022	KS	3	15_30	CF	All	2.3888	6.376	8.7648
Spring	2022	KS	4	0_15	R/C	All	5.9536	1.6528	7.6064
Spring	2022	KS	4	15_30	R/C	All	2.2224	<0.8	2.2224
Spring	2022	KS	4	0_15	CR	All	4.3624	<0.8	4.3624
Spring	2022	KS	4	15_30	CR	All	2.7344	<0.8	2.7344
Spring	2022	KS	4	0_15	CC	All	6.104	4.0712	10.1752
Spring	2022	KS	4	15_30	CC	All	2.7072	1.34	4.0472
Spring	2022	KS	4	0_15	CF	All	3.4984	4.1608	7.6592
Spring	2022	KS	4	15_30	CF	All	2.7208	6.42	9.1408
Spring	2023	KS	1	0_15	CF	All	4.6	5.1	9.7
Spring	2023	KS	1	15_30	CF	All	2.9	6.8	9.7
Spring	2023	KS	1	0_15	CR	All	5.2	0.3	5.5
Spring	2023	KS	1	15_30	CR	All	4	0.3	4.3
Spring	2023	KS	1	0_15	CC	All	8.9	2.2	11.1
Spring	2023	KS	1	15_30	CC	All	10	1.1	11.1
Spring	2023	KS	1	0_15	R/C	All	11.4	0.3	11.7
Spring	2023	KS	1	15_30	R/C	All	9.4	0.3	9.7
Spring	2023	KS	2	0_15	CF	All	9.9	5.5	15.4
Spring	2023	KS	2	15_30	CF	All	10.5	6.8	17.3
Spring	2023	KS	2	0_15	CR	All	4.2	0.6	4.8
Spring	2023	KS	2	15_30	CR	All	2.8	0.5	3.3
Spring	2023	KS	2	0_15	CC	All	4.4	3.1	7.5
Spring	2023	KS	2	15_30	CC	All	3.4	1.4	4.8
Spring	2023	KS	2	0_15	R/C	All	4.4	0.3	4.7
Spring	2023	KS	2	15_30	R/C	All	3.4	0.4	3.8
Spring	2023	KS	3	0_15	CF	All	2.7	10.3	13
Spring	2023	KS	3	15_30	CF	All	2.1	8.7	10.8
Spring	2023	KS	3	0_15	CR	All	3.1	0.2	3.3
Spring	2023	KS	3	15_30	CR	All	2.2	0.3	2.5
Spring	2023	KS	3	0_15	CC	All	5.5	2.6	8.1
Spring	2023	KS	3	15_30	CC	All	2.4	1.1	3.5
Spring	2023	KS	3	0_15	R/C	All	3.3	0.3	3.6
Spring	2023	KS	3	15_30	R/C	All	2.4	0.4	2.8
Spring	2023	KS	4	0_15	CF	All	2.8	7	9.8
Spring	2023	KS	4	15_30	CF	All	2.5	6	8.5

Spring	2023	KS	4	0_15	CR	All	3.4	0.4	3.8
Spring	2023	KS	4	15_30	CR	All	2.6	0.7	3.3
Spring	2023	KS	4	0_15	CC	All	3.4	1.8	5.2
Spring	2023	KS	4	15_30	CC	All	2.4	1.1	3.5
Spring	2023	KS	4	0_15	R/C	All	3.5	0.4	3.9
Spring	2023	KS	4	15_30	R/C	All	2.8	0.7	3.5
Spring	2021	KS	1	0_15	FTC	All	10.9	1.1	12
Spring	2021	KS	1	15_30	FTC	All	7.4	0.6	8
Spring	2021	KS	2	0_15	FTC	All	9.8	0.8	10.6
Spring	2021	KS	2	15_30	FTC	All	7.9	0.7	8.6
Spring	2021	KS	3	0_15	FTC	All	10.2	0.9	11.1
Spring	2021	KS	3	15_30	FTC	All	7.7	0.6	8.3
Spring	2021	KS	4	0_15	FTC	All	7.3	0.8	8.1
Spring	2021	KS	4	15_30	FTC	All	11.2	0.9	12.1
Spring	2021	KS	1	0_15	DSB	All	11.5	3.9	15.4
Spring	2021	KS	1	15_30	DSB	All	7.8	3.2	11
Spring	2021	KS	2	0_15	DSB	All	10	2.6	12.6
Spring	2021	KS	2	15_30	DSB	All	8.5	3.1	11.6
Spring	2021	KS	3	0_15	DSB	All	8.8	2.4	11.2
Spring	2021	KS	3	15_30	DSB	All	8.1	2.6	10.7
Spring	2021	KS	4	0_15	DSB	All	10.4	2.4	12.8
Spring	2021	KS	4	15_30	DSB	All	7.3	2.6	9.9
Spring	2022	KS	1	0_15	FTC	All	5.1	0.5	5.6
Spring	2022	KS	1	15_30	FTC	All	4	0.4	4.4
Spring	2022	KS	2	0_15	FTC	All	6.4	0.4	6.8
Spring	2022	KS	2	15_30	FTC	All	4.1	0.3	4.4
Spring	2022	KS	3	0_15	FTC	All	5.2	0.9	6.1
Spring	2022	KS	3	15_30	FTC	All	3.5	0.4	3.9
Spring	2022	KS	4	0_15	FTC	All	5.5	0.5	6
Spring	2022	KS	4	15_30	FTC	All	3	0.4	3.4
Spring	2022	KS	1	0_15	DSB	All	4.9	2.9	7.8
Spring	2022	KS	1	15_30	DSB	All	3.4	3.6	7
Spring	2022	KS	2	0_15	DSB	All	6.1	2.7	8.8
Spring	2022	KS	2	15_30	DSB	All	3.9	4	7.9
Spring	2022	KS	3	0_15	DSB	All	4.9	2.4	7.3
Spring	2022	KS	3	15_30	DSB	All	3.4	3.8	7.2
Spring	2022	KS	4	0_15	DSB	All	5.1	3.7	8.8
Spring	2022	KS	4	15_30	DSB	All	3.1	4.5	7.6
Spring	2023	KS	1	0_15	FTC	All	2.8	0.7	3.5
Spring	2023	KS	1	15_30	FTC	All	3.3	0.6	3.9
Spring	2023	KS	2	0_15	FTC	All	2.9	0.6	3.5

Spring	2023	KS	2	15_30	FTC	All	3.8	0.8	4.6
Spring	2023	KS	3	0_15	FTC	All	2.7	0.6	3.3
Spring	2023	KS	3	15_30	FTC	All	3.3	1.1	4.4
Spring	2023	KS	4	0_15	FTC	All	3	0.9	3.9
Spring	2023	KS	4	15_30	FTC	All	5	5.1	10.1
Spring	2023	KS	1	0_15	DSB	All	2.7	2.1	4.8
Spring	2023	KS	1	15_30	DSB	All	4.3	2.5	6.8
Spring	2023	KS	2	0_15	DSB	All	3	1.5	4.5
Spring	2023	KS	2	15_30	DSB	All	4	3.9	7.9
Spring	2023	KS	3	0_15	DSB	All	2.7	3	5.7
Spring	2023	KS	3	15_30	DSB	All	4	3	7
Spring	2023	KS	4	0_15	DSB	All	3.1	2.1	5.2
Spring	2023	KS	4	15_30	DSB	All			0

Bulk Density, C, and N content in soils from fall sampling

plot	Year	Rep	Depth (cm)	Cover crop treatment	N rate level	%N	%C	Bulk Density
101	2022	1	0_15	FTC	4	0.15	1.33	1.412796294
101	2022	1	15_30	FTC	4	0.13	1.07	1.355634597
101	2022	1	30_60	FTC	4	0.12	0.89	1.403736005
102	2022	1	0_15	FTC	2	0.15	1.38	1.412796294
102	2022	1	15_30	FTC	2	0.13	1.08	1.355634597
102	2022	1	30_60	FTC	2	0.12	0.89	1.403736005
103	2022	1	0_15	FTC	5	0.15	1.44	1.412796294
103	2022	1	15_30	FTC	5	0.14	1.15	1.355634597
103	2022	1	30_60	FTC	5	0.13	0.98	1.403736005
104	2022	1	0_15	FTC	1	0.15	1.46	1.412796294
104	2022	1	15_30	FTC	1	0.14	1.2	1.355634597
104	2022	1	30_60	FTC	1	0.11	0.98	1.403736005
105	2022	1	0_15	FTC	3	0.17	1.57	1.412796294
105	2022	1	15_30	FTC	3	0.13	1.21	1.355634597
105	2022	1	30_60	FTC	3	0.13	1.04	1.403736005
106	2022	1	0_15	CF	3	0.1376	1.3552	1.412796294
106	2022	1	15_30	CF	3	0.103	1.0537	1.355634597
106	2022	1	30_60	CF	3	0.0943	0.9201	1.403736005
107	2022	1	0_15	CF	2	0.1467	1.421	1.412796294
107	2022	1	15_30	CF	2	0.114	1.1359	1.355634597

107	2022	1	30_60	CF	2	0.0983	0.95	1.403736005
108	2022	1	0_15	CF	4	0.1365	1.3606	1.412796294
108	2022	1	15_30	CF	4	0.1139	1.1684	1.355634597
108	2022	1	30_60	CF	4	0.1019	1.0006	1.403736005
109	2022	1	0_15	CF	1	0.1461	1.4827	1.412796294
109	2022	1	15_30	CF	1	0.1187	1.2188	1.355634597
109	2022	1	30_60	CF	1	0.1019	0.9715	1.403736005
110	2022	1	0_15	CF	5	0.1475	1.4564	1.412796294
110	2022	1	15_30	CF	5	0.117	1.2208	1.355634597
110	2022	1	30_60	CF	5	0.0958	0.9234	1.403736005
111	2022	1	0_15	DSB	3	0.14	1.3	1.412796294
111	2022	1	15_30	DSB	3	0.12	1.05	1.355634597
111	2022	1	30_60	DSB	3	0.11	0.81	1.403736005
112	2022	1	0_15	DSB	4	0.16	1.31	1.412796294
112	2022	1	15_30	DSB	4	0.13	1.1	1.355634597
112	2022	1	30_60	DSB	4	0.11	0.82	1.403736005
113	2022	1	0_15	DSB	5	0.16	1.35	1.412796294
113	2022	1	15_30	DSB	5	0.13	1.18	1.355634597
113	2022	1	30_60	DSB	5	0.13	0.98	1.403736005
114	2022	1	0_15	DSB	2	0.16	1.45	1.412796294
114	2022	1	15_30	DSB	2	0.13	1.23	1.355634597
114	2022	1	30_60	DSB	2	0.13	0.99	1.403736005
115	2022	1	0_15	DSB	1	0.14	1.36	1.412796294
115	2022	1	15_30	DSB	1	0.13	1.22	1.355634597
115	2022	1	30_60	DSB	1	0.13	0.94	1.403736005
116	2022	1	0_15	R/C	5	0.14	1.3783	1.412796294
116	2022	1	15_30	R/C	5	0.1083	1.0967	1.355634597
116	2022	1	30_60	R/C	5	0.1005	0.99	1.403736005
117	2022	1	0_15	R/C	4	0.1518	1.5167	1.412796294
117	2022	1	15_30	R/C	4	0.1111	1.123	1.355634597
117	2022	1	30_60	R/C	4	0.1001	0.9541	1.403736005
118	2022	1	0_15	R/C	3	0.1449	1.4687	1.412796294
118	2022	1	15_30	R/C	3	0.1163	1.1879	1.355634597
118	2022	1	30_60	R/C	3	0.1015	0.9637	1.403736005
119	2022	1	0_15	R/C	2	0.1501	1.5032	1.412796294
119	2022	1	15_30	R/C	2	0.1199	1.2608	1.355634597
119	2022	1	30_60	R/C	2	0.0961	0.8755	1.403736005
120	2022	1	0_15	R/C	1	0.1572	1.5857	1.412796294
120	2022	1	15_30	R/C	1	0.1169	1.2068	1.355634597

120	2022	1	30_60	R/C	1	0.0975	0.9115	1.403736005
121	2022	1	0_15	CC	3	0.1504	1.5018	1.412796294
121	2022	1	15_30	CC	3	0.1079	1.0985	1.355634597
121	2022	1	30_60	CC	3	0.1	1.0039	1.403736005
122	2022	1	0_15	CC	2	0.1395	1.3628	1.412796294
122	2022	1	15_30	CC	2	0.1128	1.1447	1.355634597
122	2022	1	30_60	CC	2	0.1	0.9538	1.403736005
123	2022	1	0_15	CC	1	0.144	1.4441	1.412796294
123	2022	1	15_30	CC	1	0.1181	1.2149	1.355634597
123	2022	1	30_60	CC	1	0.1174	1.2089	1.403736005
124	2022	1	0_15	CC	5	0.1576	1.5946	1.412796294
124	2022	1	15_30	CC	5	0.1188	1.2104	1.355634597
124	2022	1	30_60	CC	5	0.0953	0.8539	1.403736005
125	2022	1	0_15	CC	4	0.1483	1.5087	1.412796294
125	2022	1	15_30	CC	4	0.1151	1.1531	1.355634597
125	2022	1	30_60	CC	4	0.088	0.7721	1.403736005
126	2022	1	0_15	CR	4	0.147	1.4767	1.412796294
126	2022	1	15_30	CR	4	0.1108	1.1427	1.355634597
126	2022	1	30_60	CR	4	0.0989	1.0125	1.403736005
127	2022	1	0_15	CR	1	0.1548	1.5537	1.412796294
127	2022	1	15_30	CR	1	0.1117	1.1502	1.355634597
127	2022	1	30_60	CR	1	0.1015	1.0172	1.403736005
128	2022	1	0_15	CR	2	0.1465	1.4914	1.412796294
128	2022	1	15_30	CR	2	0.115	1.2007	1.355634597
128	2022	1	30_60	CR	2	0.0967	0.937	1.403736005
129	2022	1	0_15	CR	3	0.1573	1.5923	1.412796294
129	2022	1	15_30	CR	3	0.1176	1.2192	1.355634597
129	2022	1	30_60	CR	3	0.0895	0.8118	1.403736005
130	2022	1	0_15	CR	5	0.155	1.5413	1.412796294
130	2022	1	15_30	CR	5	0.1105	1.1409	1.355634597
130	2022	1	30_60	CR	5	0.0804	0.6973	1.403736005
131	2020	1	0_15	FTC	1	0.16	1.56	1.426382052
131	2020	1	15_30	FTC	1	0.14	1.2	1.33994837
131	2020	1	30_60	FTC	1	0.13	1.06	1.401333201
132	2020	1	0_15	FTC	3	0.18	1.77	1.426382052
132	2020	1	15_30	FTC	3	0.15	1.24	1.33994837
132	2020	1	30_60	FTC	3	0.13	1.02	1.401333201
133	2020	1	0_15	FTC	2	0.18	1.7	1.426382052

133	2020	1	15_30	FTC	2	0.14	1.23	1.33994837
133	2020	1	30_60	FTC	2	0.12	0.84	1.401333201
134	2020	1	0_15	FTC	4	0.17	1.78	1.426382052
134	2020	1	15_30	FTC	4	0.13	1.2	1.33994837
134	2020	1	30_60	FTC	4	0.12	0.78	1.401333201
135	2020	1	0_15	FTC	5	0.17	1.82	1.426382052
135	2020	1	15_30	FTC	5	0.13	1.22	1.33994837
135	2020	1	30_60	FTC	5	0.12	0.81	1.401333201
136	2020	1	0_15	CC	3	0.155	1.611	1.426382052
136	2020	1	15_30	CC	3	0.117	1.226	1.33994837
136	2020	1	30_60	CC	3	0.104	1.04	1.401333201
137	2020	1	0_15	CC	2	0.149	1.575	1.426382052
137	2020	1	15_30	CC	2	0.116	1.259	1.33994837
137	2020	1	30_60	CC	2	0.103	1.032	1.401333201
138	2020	1	0_15	CC	4	0.167	1.852	1.426382052
138	2020	1	15_30	CC	4	0.117	1.243	1.33994837
138	2020	1	30_60	CC	4	0.095	0.892	1.401333201
139	2020	1	0_15	CC	1	0.165	1.76	1.426382052
139	2020	1	15_30	CC	1	0.114	1.193	1.33994837
139	2020	1	30_60	CC	1	0.091	0.807	1.401333201
140	2020	1	0_15	CC	5	0.163	1.699	1.426382052
140	2020	1	15_30	CC	5	0.117	1.209	1.33994837
140	2020	1	30_60	CC	5	0.091	0.8	1.401333201
141	2020	1	0_15	CF	5	0.152	1.623	1.426382052
141	2020	1	15_30	CF	5	0.117	1.265	1.33994837
141	2020	1	30_60	CF	5	0.111	1.15	1.401333201
142	2020	1	0_15	CF	3	0.155	1.652	1.426382052
142	2020	1	15_30	CF	3	0.119	1.267	1.33994837
142	2020	1	30_60	CF	3	0.105	1.053	1.401333201
143	2020	1	0_15	CF	4	0.149	1.564	1.426382052
143	2020	1	15_30	CF	4	0.117	1.231	1.33994837
143	2020	1	30_60	CF	4	0.094	0.869	1.401333201
144	2020	1	0_15	CF	2	0.149	1.585	1.426382052
144	2020	1	15_30	CF	2	0.112	1.18	1.33994837
144	2020	1	30_60	CF	2	0.087	0.76	1.401333201
145	2020	1	0_15	CF	1	0.149	1.591	1.426382052
145	2020	1	15_30	CF	1	0.121	1.255	1.33994837
145	2020	1	30_60	CF	1	0.094	0.839	1.401333201
146	2020	1	0_15	DSB	2	.	.	1.426382052

146	2020	1	15_30	DSB	2	.	.	1.33994837
146	2020	1	30_60	DSB	2	.	.	1.401333201
147	2020	1	0_15	DSB	3	.	.	1.426382052
147	2020	1	15_30	DSB	3	.	.	1.33994837
147	2020	1	30_60	DSB	3	.	.	1.401333201
148	2020	1	0_15	DSB	5	.	.	1.426382052
148	2020	1	15_30	DSB	5	.	.	1.33994837
148	2020	1	30_60	DSB	5	.	.	1.401333201
149	2020	1	0_15	DSB	4	.	.	1.426382052
149	2020	1	15_30	DSB	4	.	.	1.33994837
149	2020	1	30_60	DSB	4	.	.	1.401333201
150	2020	1	0_15	DSB	1	.	.	1.426382052
150	2020	1	15_30	DSB	1	.	.	1.33994837
150	2020	1	30_60	DSB	1	.	.	1.401333201
151	2020	1	0_15	R/C	5	0.169	1.799	1.426382052
151	2020	1	15_30	R/C	5	0.123	1.332	1.33994837
151	2020	1	30_60	R/C	5	0.117	1.205	1.401333201
152	2020	1	0_15	R/C	2	0.159	1.686	1.426382052
152	2020	1	15_30	R/C	2	0.119	1.297	1.33994837
152	2020	1	30_60	R/C	2	0.119	1.205	1.401333201
153	2020	1	0_15	R/C	4	0.18	1.92	1.426382052
153	2020	1	15_30	R/C	4	0.13	1.375	1.33994837
153	2020	1	30_60	R/C	4	0.112	1.044	1.401333201
154	2020	1	0_15	R/C	1	0.169	1.815	1.426382052
154	2020	1	15_30	R/C	1	0.13	1.36	1.33994837
154	2020	1	30_60	R/C	1	0.104	0.958	1.401333201
155	2020	1	0_15	R/C	3	0.164	1.773	1.426382052
155	2020	1	15_30	R/C	3	0.126	1.317	1.33994837
155	2020	1	30_60	R/C	3	0.101	0.919	1.401333201
156	2020	1	0_15	CR	5	0.125	1.359	1.426382052
156	2020	1	15_30	CR	5	0.167	1.801	1.33994837
156	2020	1	30_60	CR	5	0.121	1.247	1.401333201
157	2020	1	0_15	CR	2	0.157	1.687	1.426382052
157	2020	1	15_30	CR	2	0.12	1.311	1.33994837
157	2020	1	30_60	CR	2	0.114	1.112	1.401333201
158	2020	1	0_15	CR	4	0.158	1.728	1.426382052
158	2020	1	15_30	CR	4	0.127	1.373	1.33994837
158	2020	1	30_60	CR	4	0.112	1.067	1.401333201

159	2020	1	0_15	CR	3	0.171	1.819	1.426382052
159	2020	1	15_30	CR	3	0.127	1.349	1.33994837
159	2020	1	30_60	CR	3	0.108	0.969	1.401333201
160	2020	1	0_15	CR	1	0.169	1.851	1.426382052
160	2020	1	15_30	CR	1	0.122	1.302	1.33994837
160	2020	1	30_60	CR	1	0.107	0.999	1.401333201
161	2021	1	0_15	R/C	4	0.1522	1.635	1.357056458
161	2021	1	15_30	R/C	4	0.1282	1.407	1.367421935
161	2021	1	30_60	R/C	4	0.124	1.2641	1.510910113
162	2021	1	0_15	R/C	1	0.1616	1.7483	1.357056458
162	2021	1	15_30	R/C	1	0.1248	1.3745	1.367421935
162	2021	1	30_60	R/C	1	0.126	1.2602	1.510910113
163	2021	1	0_15	R/C	3	0.1699	1.8321	1.357056458
163	2021	1	15_30	R/C	3	0.1322	1.4169	1.367421935
163	2021	1	30_60	R/C	3	0.1183	1.1788	1.510910113
164	2021	1	0_15	R/C	5	0.1715	1.8469	1.357056458
164	2021	1	15_30	R/C	5	0.1306	1.3764	1.367421935
164	2021	1	30_60	R/C	5	0.1103	1.0453	1.510910113
165	2021	1	0_15	R/C	2	0.1666	1.7754	1.357056458
165	2021	1	15_30	R/C	2	0.1301	1.348	1.367421935
165	2021	1	30_60	R/C	2	0.1061	0.9508	1.510910113
166	2021	4	0_15	FTC	5	0.18	1.79	1.357056458
166	2021	1	15_30	FTC	5	0.15	1.43	1.367421935
166	2021	1	30_60	FTC	5	0.14	1.33	1.510910113
167	2021	1	0_15	FTC	3	0.17	2.01	1.357056458
167	2021	1	15_30	FTC	3	0.14	1.36	1.367421935
167	2021	1	30_60	FTC	3	0.14	1.21	1.510910113
168	2021	1	0_15	FTC	4	0.16	1.82	1.357056458
168	2021	1	15_30	FTC	4	0.14	1.44	1.367421935
168	2021	1	30_60	FTC	4	0.13	1.07	1.510910113
169	2021	1	0_15	FTC	2	0.16	1.83	1.357056458
169	2021	1	15_30	FTC	2	0.16	1.39	1.367421935
169	2021	1	30_60	FTC	2	0.12	1.04	1.510910113
170	2021	1	0_15	FTC	1	0.17	1.85	1.357056458
170	2021	1	15_30	FTC	1	0.15	1.39	1.367421935
170	2021	1	30_60	FTC	1	0.12	0.98	1.510910113
171	2021	1	0_15	DSB	4	0.17	1.86	1.357056458
171	2021	1	15_30	DSB	4	0.14	1.43	1.367421935
171	2021	1	30_60	DSB	4	0.14	1.22	1.510910113

172	2021	1	0_15	DSB	2	0.16	1.56	1.357056458
172	2021	1	15_30	DSB	2	0.15	1.37	1.367421935
172	2021	1	30_60	DSB	2	0.13	0.95	1.510910113
173	2021	1	0_15	DSB	3	0.17	1.78	1.357056458
173	2021	1	15_30	DSB	3	0.14	1.45	1.367421935
173	2021	1	30_60	DSB	3	0.13	1.03	1.510910113
174	2021	1	0_15	DSB	1	0.17	1.88	1.357056458
174	2021	1	15_30	DSB	1	0.15	1.43	1.367421935
174	2021	1	30_60	DSB	1	0.13	0.94	1.510910113
175	2021	1	0_15	DSB	5	0.17	1.61	1.357056458
175	2021	1	15_30	DSB	5	0.15	1.42	1.367421935
175	2021	1	30_60	DSB	5	0.12	1.01	1.510910113
176	2021	1	0_15	CF	5	0.1539	1.6369	1.357056458
176	2021	1	15_30	CF	5	0.1284	1.4014	1.367421935
176	2021	1	30_60	CF	5	0.1226	1.2092	1.510910113
177	2021	1	0_15	CF	3	0.1649	1.7495	1.357056458
177	2021	1	15_30	CF	3	0.1282	1.4039	1.367421935
177	2021	1	30_60	CF	3	0.1154	1.0949	1.510910113
178	2021	1	0_15	CF	1	0.1677	1.7923	1.357056458
178	2021	1	15_30	CF	1	0.1264	1.3435	1.367421935
178	2021	1	30_60	CF	1	0.1054	0.955	1.510910113
179	2021	1	0_15	CF	4	0.154	1.6629	1.357056458
179	2021	1	15_30	CF	4	0.1305	1.3983	1.367421935
179	2021	1	30_60	CF	4	0.1001	0.9186	1.510910113
180	2021	1	0_15	CF	2	0.1531	1.6397	1.357056458
180	2021	1	15_30	CF	2	0.1293	1.3754	1.367421935
180	2021	1	30_60	CF	2	0.0966	0.8635	1.510910113
181	2021	1	0_15	CR	5	0.1702	1.8865	1.357056458
181	2021	1	15_30	CR	5	0.1312	1.4121	1.367421935
181	2021	1	30_60	CR	5	0.1167	1.0824	1.510910113
182	2021	1	0_15	CR	4	0.1609	1.7165	1.357056458
182	2021	1	15_30	CR	4	0.1231	1.345	1.367421935
182	2021	1	30_60	CR	4	0.1102	1.0172	1.510910113
183	2021	1	0_15	CR	1	0.1801	1.9508	1.357056458
183	2021	1	15_30	CR	1	0.1277	1.5223	1.367421935
183	2021	1	30_60	CR	1	0.0998	0.8863	1.510910113
184	2021	1	0_15	CR	3	0.1725	1.8321	1.357056458
184	2021	1	15_30	CR	3	0.1258	1.3187	1.367421935

184	2021	1	30_60	CR	3	0.0993	0.9262	1.510910113
185	2021	1	0_15	CR	2	0.1878	1.9413	1.357056458
185	2021	1	15_30	CR	2	0.1243	1.2532	1.367421935
185	2021	1	30_60	CR	2	0.0911	0.7869	1.510910113
186	2021	1	0_15	CC	1	0.1757	1.8764	1.357056458
186	2021	1	15_30	CC	1	0.1316	1.3848	1.367421935
186	2021	1	30_60	CC	1	0.1152	1.0537	1.510910113
187	2021	1	0_15	CC	5	0.1788	1.9166	1.357056458
187	2021	1	15_30	CC	5	0.1312	1.3768	1.367421935
187	2021	1	30_60	CC	5	0.1134	1.0519	1.510910113
188	2021	1	0_15	CC	3	0.1627	1.729	1.357056458
188	2021	1	15_30	CC	3	0.1251	1.3054	1.367421935
188	2021	1	30_60	CC	3	0.0995	0.8891	1.510910113
189	2021	1	0_15	CC	4	0.1687	1.7702	1.357056458
189	2021	1	15_30	CC	4	0.1241	1.1803	1.367421935
189	2021	1	30_60	CC	4	0.0946	0.8545	1.510910113
190	2021	1	0_15	CC	2	0.1591	1.634	1.357056458
190	2021	1	15_30	CC	2	0.1188	1.1333	1.367421935
190	2021	1	30_60	CC	2	0.091	0.8172	1.510910113
201	2021	1	0_15	DSB	2	0.17	1.68	1.356737889
201	2021	2	15_30	DSB	2	0.15	1.36	1.379934649
202	2021	2	0_15	DSB	5	0.17	1.87	1.356737889
202	2021	2	15_30	DSB	5	0.15	1.31	1.379934649
202	2021	2	30_60	DSB	5	0.13	0.87	1.538002858
203	2021	2	0_15	DSB	1	0.16	1.72	1.356737889
203	2021	2	15_30	DSB	1	0.14	1.17	1.379934649
203	2021	2	30_60	DSB	1	0.13	0.85	1.538002858
204	2021	2	0_15	DSB	3	0.17	1.77	1.356737889
204	2021	2	15_30	DSB	3	0.14	1.24	1.379934649
204	2021	2	30_60	DSB	3	0.12	0.82	1.538002858
205	2021	2	0_15	DSB	4	0.17	1.83	1.356737889
205	2021	2	15_30	DSB	4	0.14	1.31	1.379934649
205	2021	2	30_60	DSB	4	0.11	0.88	1.538002858
206	2021	2	0_15	CR	1	0.1739	1.8291	1.356737889
206	2021	2	15_30	CR	1	0.1306	1.3381	1.379934649
206	2021	2	30_60	CR	1	0.1093	0.9898	1.538002858
207	2021	2	0_15	CR	5	0.1873	1.9779	1.356737889
207	2021	2	15_30	CR	5	0.1248	1.2971	1.379934649
207	2021	2	30_60	CR	5	0.1044	0.9446	1.538002858

208	2021	2	0_15	CR	3	0.1653	1.7306	1.356737889
208	2021	2	15_30	CR	3	0.119	1.1666	1.379934649
208	2021	2	30_60	CR	3	0.092	0.8292	1.538002858
209	2021	2	0_15	CR	2	0.1731	1.8141	1.356737889
209	2021	2	15_30	CR	2	0.1267	1.2209	1.379934649
209	2021	2	30_60	CR	2	0.0926	0.8368	1.538002858
210	2021	2	0_15	CR	4	0.1698	1.76	1.356737889
210	2021	2	15_30	CR	4	0.1231	1.2111	1.379934649
210	2021	2	30_60	CR	4	0.0994	0.936	1.538002858
211	2021	2	0_15	CC	2	0.173	1.8174	1.356737889
211	2021	2	15_30	CC	2	0.1261	1.3315	1.379934649
211	2021	2	30_60	CC	2	0.1095	1.0042	1.538002858
212	2021	2	0_15	CC	4	0.1714	1.7833	1.356737889
212	2021	2	15_30	CC	4	0.1313	1.3086	1.379934649
212	2021	2	30_60	CC	4	0.1011	0.9004	1.538002858
213	2021	2	0_15	CC	5	0.1806	1.8689	1.356737889
213	2021	2	15_30	CC	5	0.1281	1.3172	1.379934649
213	2021	2	30_60	CC	5	0.1005	0.9007	1.538002858
214	2021	2	0_15	CC	3	0.1674	1.7387	1.356737889
214	2021	2	15_30	CC	3	0.1259	1.2562	1.379934649
214	2021	2	30_60	CC	3	0.0965	0.8691	1.538002858
215	2021	2	0_15	CC	1	0.1775	1.8387	1.356737889
215	2021	2	15_30	CC	1	0.1223	1.2148	1.379934649
215	2021	2	30_60	CC	1	0.0957	0.8627	1.538002858
216	2021	2	0_15	R/C	1	0.1876	1.9895	1.356737889
216	2021	2	15_30	R/C	1	0.1254	1.2785	1.379934649
216	2021	2	30_60	R/C	1	0.0971	0.8632	1.538002858
217	2021	2	0_15	R/C	2	0.1733	1.8056	1.356737889
217	2021	2	15_30	R/C	2	0.1261	1.2941	1.379934649
217	2021	2	30_60	R/C	2	0.1005	0.8998	1.538002858
218	2021	2	0_15	R/C	4	0.1707	1.763	1.356737889
218	2021	2	15_30	R/C	4	0.1308	1.3301	1.379934649
218	2021	2	30_60	R/C	4	0.0903	0.7908	1.538002858
219	2021	2	0_15	R/C	3	0.187	2.0198	1.356737889
219	2021	2	15_30	R/C	3	0.1369	1.3796	1.379934649
219	2021	2	30_60	R/C	3	0.1032	0.9252	1.538002858
220	2021	2	0_15	R/C	5	0.1956	2.077	1.356737889
220	2021	2	15_30	R/C	5	0.1311	1.2225	1.379934649

220	2021	2	30_60	R/C	5	0.0978	0.7784	1.538002858
221	2021	2	0_15	FTC	1	0.16	1.64	1.356737889
221	2021	2	15_30	FTC	1	0.14	1.31	1.379934649
221	2021	2	30_60	FTC	1	0.12	0.9	1.538002858
222	2021	2	0_15	FTC	2	0.17	1.8	1.356737889
222	2021	2	15_30	FTC	2	0.15	1.37	1.379934649
222	2021	2	30_60	FTC	2	0.11	0.95	1.538002858
223	2021	2	0_15	FTC	3	0.18	1.78	1.356737889
223	2021	2	15_30	FTC	3	0.15	1.35	1.379934649
223	2021	2	30_60	FTC	3	0.13	0.88	1.538002858
224	2021	2	0_15	FTC	5	0.18	1.77	1.356737889
224	2021	2	15_30	FTC	5	0.15	1.29	1.379934649
224	2021	2	30_60	FTC	5	0.13	0.81	1.538002858
225	2021	2	0_15	FTC	4	0.19	1.79	1.356737889
225	2021	2	15_30	FTC	4	0.15	1.27	1.379934649
225	2021	2	30_60	FTC	4	0.12	0.86	1.538002858
226	2021	2	0_15	CF	2	0.1615	1.7027	1.356737889
226	2021	2	15_30	CF	2	0.1209	1.208	1.379934649
226	2021	2	30_60	CF	2	0.0664	0.5518	1.538002858
227	2021	2	0_15	CF	4	0.1677	1.733	1.356737889
227	2021	2	15_30	CF	4	0.1234	1.2541	1.379934649
227	2021	2	30_60	CF	4	0.0958	0.8447	1.538002858
228	2021	2	0_15	CF	5	0.1945	1.8559	1.356737889
228	2021	2	15_30	CF	5	0.149	1.3361	1.379934649
228	2021	2	30_60	CF	5	0.1026	0.9161	1.538002858
229	2021	2	0_15	CF	3	0.163	1.7158	1.356737889
229	2021	2	15_30	CF	3	0.1278	1.266	1.379934649
229	2021	2	30_60	CF	3	0.0913	0.7983	1.538002858
230	2021	2	0_15	CF	1	0.1683	1.7365	1.356737889
230	2021	2	15_30	CF	1	0.1258	1.1838	1.379934649
230	2021	2	30_60	CF	1	0.0906	0.81	1.538002858
231	2022	2	0_15	CR	4	0.163	1.6501	1.370656919
231	2022	2	15_30	CR	4	0.1202	1.1763	1.427628033
231	2022	2	30_60	CR	4	0.1005	0.8751	1.551576431
232	2022	2	0_15	CR	3	0.1636	1.6606	1.370656919
232	2022	2	15_30	CR	3	0.123	1.2006	1.427628033
232	2022	2	30_60	CR	3	0.0893	0.7701	1.551576431
233	2022	2	0_15	CR	2	0.1588	1.6126	1.370656919
233	2022	2	15_30	CR	2	0.1199	1.167	1.427628033

233	2022	2	30_60	CR	2	0.0875	0.75	1.551576431
234	2022	2	0_15	CR	5	0.1719	1.7499	1.370656919
234	2022	2	15_30	CR	5	0.1324	1.262	1.427628033
234	2022	2	30_60	CR	5	0.095	0.8141	1.551576431
235	2022	2	0_15	CR	1	0.1738	1.7956	1.370656919
235	2022	2	15_30	CR	1	0.1265	1.1805	1.427628033
235	2022	2	30_60	CR	1	0.0904	0.7542	1.551576431
236	2022	2	0_15	R/C	3	0.1691	1.7	1.370656919
236	2022	2	15_30	R/C	3	0.1229	1.1608	1.427628033
236	2022	2	30_60	R/C	3	0.0866	0.7405	1.551576431
237	2022	2	0_15	R/C	1	0.1646	1.6395	1.370656919
237	2022	2	15_30	R/C	1	0.1254	1.2155	1.427628033
237	2022	2	30_60	R/C	1	0.0917	0.786	1.551576431
238	2022	2	0_15	R/C	2	0.1596	1.6012	1.370656919
238	2022	2	15_30	R/C	2	0.1272	1.2566	1.427628033
238	2022	2	30_60	R/C	2	0.0957	0.8308	1.551576431
239	2022	2	0_15	R/C	5	0.1737	1.7669	1.370656919
239	2022	2	15_30	R/C	5	0.1266	1.2245	1.427628033
239	2022	2	30_60	R/C	5	0.0916	0.7871	1.551576431
240	2022	2	0_15	R/C	4	0.1686	1.6853	1.370656919
240	2022	2	15_30	R/C	4	0.1208	1.1163	1.427628033
240	2022	2	30_60	R/C	4	0.0902	0.7694	1.551576431
241	2022	2	0_15	CC	3	0.1666	1.6438	1.370656919
241	2022	2	15_30	CC	3	0.119	1.1497	1.427628033
241	2022	2	30_60	CC	3	0.0893	0.7838	1.551576431
242	2022	2	0_15	CC	1	0.1655	1.6487	1.370656919
242	2022	2	15_30	CC	1	0.1193	1.1848	1.427628033
242	2022	2	30_60	CC	1	0.0979	0.8828	1.551576431
243	2022	2	0_15	CC	2	0.1703	1.7187	1.370656919
243	2022	2	15_30	CC	2	0.129	1.2718	1.427628033
243	2022	2	30_60	CC	2	0.0969	0.8338	1.551576431
244	2022	2	0_15	CC	4	0.1624	1.5997	1.370656919
244	2022	2	15_30	CC	4	0.1251	1.2145	1.427628033
244	2022	2	30_60	CC	4	0.091	0.7747	1.551576431
245	2022	2	0_15	CC	5	0.1727	1.7863	1.370656919
245	2022	2	15_30	CC	5	0.1243	1.1182	1.427628033
245	2022	2	30_60	CC	5	0.0874	0.7416	1.551576431
246	2022	2	0_15	CF	3	0.1462	1.4273	1.370656919

246	2022	2	15_30	CF	3	0.1177	1.1031	1.427628033
246	2022	2	30_60	CF	3	0.092	0.8131	1.551576431
247	2022	2	0_15	CF	1	0.1661	1.6788	1.370656919
247	2022	2	15_30	CF	1	0.1295	1.2387	1.427628033
247	2022	2	30_60	CF	1	0.0954	0.8221	1.551576431
248	2022	2	0_15	CF	4	0.162	1.6217	1.370656919
248	2022	2	15_30	CF	4	0.1248	1.2395	1.427628033
248	2022	2	30_60	CF	4	0.0982	0.8487	1.551576431
249	2022	2	0_15	CF	5	0.1646	1.6439	1.370656919
249	2022	2	15_30	CF	5	0.1198	1.1275	1.427628033
249	2022	2	30_60	CF	5	0.0916	0.7598	1.551576431
250	2022	2	0_15	CF	2	0.1553	1.533	1.370656919
250	2022	2	15_30	CF	2	0.116	1.0334	1.427628033
250	2022	2	30_60	CF	2	0.0874	0.744	1.551576431
251	2022	2	0_15	DSB	2	0.17	1.51	1.370656919
251	2022	2	15_30	DSB	2	0.14	1.09	1.427628033
251	2022	2	30_60	DSB	2	0.12	0.81	1.551576431
252	2022	2	0_15	DSB	1	0.15	1.43	1.370656919
252	2022	2	15_30	DSB	1	0.14	1.11	1.427628033
252	2022	2	30_60	DSB	1	0.13	0.76	1.551576431
253	2022	2	0_15	DSB	5	0.15	1.59	1.370656919
253	2022	2	15_30	DSB	5	0.14	1.24	1.427628033
253	2022	2	30_60	DSB	5	0.13	0.82	1.551576431
254	2022	2	0_15	DSB	3	0.16	1.61	1.370656919
254	2022	2	15_30	DSB	3	0.15	1.19	1.427628033
254	2022	2	30_60	DSB	3	0.11	0.8	1.551576431
255	2022	2	0_15	DSB	4	0.16	1.49	1.370656919
255	2022	2	15_30	DSB	4	0.15	1.12	1.427628033
255	2022	2	30_60	DSB	4	0.11	0.79	1.551576431
256	2022	2	0_15	FTC	4	0.17	1.66	1.370656919
256	2022	2	15_30	FTC	4	0.13	1.08	1.427628033
256	2022	2	30_60	FTC	4	0.12	0.78	1.551576431
257	2022	2	0_15	FTC	1	0.17	1.76	1.370656919
257	2022	2	15_30	FTC	1	0.14	1.18	1.427628033
257	2022	2	30_60	FTC	1	0.12	0.75	1.551576431
258	2022	2	0_15	FTC	5	0.18	1.75	1.370656919
258	2022	2	15_30	FTC	5	0.13	1.23	1.427628033
258	2022	2	30_60	FTC	5	0.13	0.81	1.551576431
259	2022	2	0_15	FTC	2	0.18	1.73	1.370656919

259	2022	2	15_30	FTC	2	0.15	1.25	1.427628033
259	2022	2	30_60	FTC	2	0.13	0.83	1.551576431
260	2022	2	0_15	FTC	3	0.16	1.64	1.370656919
260	2022	2	15_30	FTC	3	0.14	1.08	1.427628033
260	2022	2	30_60	FTC	3	0.13	0.77	1.551576431
261	2020	2	0_15	CC	3	0.15	1.538	1.43684583
261	2020	2	15_30	CC	3	0.111	1.056	1.367965966
261	2020	2	30_60	CC	3	0.087	0.745	1.596594997
262	2020	2	0_15	CC	2	0.147	1.514	1.43684583
262	2020	2	15_30	CC	2	0.117	1.169	1.367965966
262	2020	2	30_60	CC	2	0.088	0.765	1.596594997
263	2020	2	0_15	CC	5	0.167	1.754	1.43684583
263	2020	2	15_30	CC	5	0.12	1.208	1.367965966
263	2020	2	30_60	CC	5	0.095	0.832	1.596594997
264	2020	2	0_15	CC	4	0.151	1.552	1.43684583
264	2020	2	15_30	CC	4	0.121	1.16	1.367965966
264	2020	2	30_60	CC	4	0.089	0.75	1.596594997
265	2020	2	0_15	CC	1	0.154	1.56	1.43684583
265	2020	2	15_30	CC	1	0.117	1.089	1.367965966
265	2020	2	30_60	CC	1	0.075	0.606	1.596594997
266	2020	2	0_15	CF	5	0.148	1.478	1.43684583
266	2020	2	15_30	CF	5	0.111	1.039	1.367965966
266	2020	2	30_60	CF	5	0.089	0.769	1.596594997
267	2020	2	0_15	CF	4	0.161	1.669	1.43684583
267	2020	2	15_30	CF	4	0.114	1.111	1.367965966
267	2020	2	30_60	CF	4	0.083	0.675	1.596594997
268	2020	2	0_15	CF	3	0.166	1.776	1.43684583
268	2020	2	15_30	CF	3	0.121	1.204	1.367965966
268	2020	2	30_60	CF	3	0.092	0.825	1.596594997
269	2020	2	0_15	CF	2	0.158	1.681	1.43684583
269	2020	2	15_30	CF	2	0.084	0.726	1.367965966
269	2020	2	30_60	CF	2	0.085	0.725	1.596594997
270	2020	2	0_15	CF	1	0.151	1.566	1.43684583
270	2020	2	15_30	CF	1	0.119	1.112	1.367965966
270	2020	2	30_60	CF	1	0.084	0.707	1.596594997
271	2020	2	0_15	FTC	4	0.17	1.86	1.43684583
271	2020	2	15_30	FTC	4	0.14	1.43	1.367965966
271	2020	2	30_60	FTC	4	0.14	1.22	1.596594997
272	2020	2	0_15	FTC	3	0.16	1.56	1.43684583

272	2020	2	15_30	FTC	3	0.15	1.37	1.367965966
272	2020	2	30_60	FTC	3	0.13	0.95	1.596594997
273	2020	2	0_15	FTC	1	0.17	1.78	1.43684583
273	2020	2	15_30	FTC	1	0.14	1.45	1.367965966
273	2020	2	30_60	FTC	1	0.13	1.03	1.596594997
274	2020	2	0_15	FTC	5	0.17	1.88	1.43684583
274	2020	2	15_30	FTC	5	0.15	1.43	1.367965966
274	2020	2	30_60	FTC	5	0.13	0.94	1.596594997
275	2020	2	0_15	FTC	2	0.17	1.61	1.43684583
275	2020	2	15_30	FTC	2	0.15	1.42	1.367965966
275	2020	2	30_60	FTC	2	0.12	1.01	1.596594997
276	2020	2	0_15	CR	5	0.152	1.533	1.43684583
276	2020	2	15_30	CR	5	0.102	0.991	1.367965966
276	2020	2	30_60	CR	5	0.087	0.724	1.596594997
277	2020	2	0_15	CR	4	0.134	1.346	1.43684583
277	2020	2	15_30	CR	4	0.108	1.018	1.367965966
277	2020	2	30_60	CR	4	0.087	0.726	1.596594997
278	2020	2	0_15	CR	2	0.143	1.472	1.43684583
278	2020	2	15_30	CR	2	0.112	1.046	1.367965966
278	2020	2	30_60	CR	2	0.087	0.761	1.596594997
279	2020	2	0_15	CR	3	0.144	1.459	1.43684583
279	2020	2	15_30	CR	3	0.112	1.07	1.367965966
279	2020	2	30_60	CR	3	0.088	0.768	1.596594997
280	2020	2	0_15	CR	1	0.156	1.57	1.43684583
280	2020	2	15_30	CR	1	0.119	1.132	1.367965966
280	2020	2	30_60	CR	1	0.084	0.705	1.596594997
281	2020	2	0_15	DSB	3	.	.	1.43684583
281	2020	2	15_30	DSB	3	.	.	1.367965966
281	2020	2	30_60	DSB	3	.	.	1.596594997
282	2020	2	0_15	DSB	5	.	.	1.43684583
282	2020	2	15_30	DSB	5	.	.	1.367965966
282	2020	2	30_60	DSB	5	.	.	1.596594997
283	2020	2	0_15	DSB	1	.	.	1.43684583
283	2020	2	15_30	DSB	1	.	.	1.367965966
283	2020	2	30_60	DSB	1	.	.	1.596594997
284	2020	2	0_15	DSB	4	.	.	1.43684583
284	2020	2	15_30	DSB	4	.	.	1.367965966
284	2020	2	30_60	DSB	4	.	.	1.596594997

285	2020	2	0_15	DSB	2	.	.	1.43684583
285	2020	2	15_30	DSB	2	.	.	1.367965966
285	2020	2	30_60	DSB	2	.	.	1.596594997
286	2020	2	0_15	R/C	2	0.145	1.497	1.43684583
286	2020	2	15_30	R/C	2	0.129	1.291	1.367965966
286	2020	2	30_60	R/C	2	0.082	0.674	1.596594997
287	2020	2	0_15	R/C	5	0.158	1.634	1.43684583
287	2020	2	15_30	R/C	5	0.119	1.24	1.367965966
287	2020	2	30_60	R/C	5	0.097	0.832	1.596594997
288	2020	2	0_15	R/C	3	0.164	1.74	1.43684583
288	2020	2	15_30	R/C	3	0.119	1.181	1.367965966
288	2020	2	30_60	R/C	3	0.091	0.8	1.596594997
289	2020	2	0_15	R/C	1	0.156	1.596	1.43684583
289	2020	2	15_30	R/C	1	0.117	1.101	1.367965966
289	2020	2	30_60	R/C	1	0.087	0.742	1.596594997
290	2020	2	0_15	R/C	4	0.157	1.574	1.43684583
290	2020	2	15_30	R/C	4	0.122	1.176	1.367965966
290	2020	2	30_60	R/C	4	0.084	0.707	1.596594997
301	2022	3	0_15	DSB	4	0.14	1.46	1.38737936
301	2022	3	15_30	DSB	4	0.13	1.19	1.364429765
301	2022	3	30_60	DSB	4	0.12	0.9	1.568795013
302	2022	3	0_15	DSB	3	0.17	1.55	1.38737936
302	2022	3	15_30	DSB	3	0.13	1.17	1.364429765
302	2022	3	30_60	DSB	3	0.13	0.86	1.568795013
303	2022	3	0_15	DSB	2	0.16	1.57	1.38737936
303	2022	3	15_30	DSB	2	0.13	1.21	1.364429765
303	2022	3	30_60	DSB	2	0.11	0.84	1.568795013
304	2022	3	0_15	DSB	5	0.17	1.64	1.38737936
304	2022	3	15_30	DSB	5	0.13	1.2	1.364429765
304	2022	3	30_60	DSB	5	0.13	0.79	1.568795013
305	2022	3	0_15	DSB	1	0.17	1.5	1.38737936
305	2022	3	15_30	DSB	1	0.14	1.2	1.364429765
305	2022	3	30_60	DSB	1	0.12	0.78	1.568795013
306	2022	3	0_15	FTC	1	0.18	1.76	1.38737936
306	2022	3	15_30	FTC	1	0.14	1.11	1.364429765
306	2022	3	30_60	FTC	1	0.14	0.93	1.568795013
307	2022	3	0_15	FTC	2	0.18	1.75	1.38737936
307	2022	3	15_30	FTC	2	0.14	1.17	1.364429765
307	2022	3	30_60	FTC	2	0.14	0.96	1.568795013

308	2022	3	0_15	FTC	5	0.19	1.76	1.38737936
308	2022	3	15_30	FTC	5	0.14	1.24	1.364429765
308	2022	3	30_60	FTC	5	0.15	1.02	1.568795013
309	2022	3	0_15	FTC	4	0.18	1.76	1.38737936
309	2022	3	15_30	FTC	4	0.15	1.28	1.364429765
309	2022	3	30_60	FTC	4	0.13	1.05	1.568795013
310	2022	3	0_15	FTC	3	0.17	1.7	1.38737936
310	2022	3	15_30	FTC	3	0.16	1.37	1.364429765
310	2022	3	30_60	FTC	3	0.12	0.89	1.568795013
311	2022	3	0_15	CC	5	0.1703	1.6941	1.38737936
311	2022	3	15_30	CC	5	0.1119	1.1565	1.364429765
311	2022	3	30_60	CC	5	0.1104	0.9162	1.568795013
312	2022	3	0_15	CC	1	0.1534	1.529	1.38737936
312	2022	3	15_30	CC	1	0.1176	1.2244	1.364429765
312	2022	3	30_60	CC	1	0.1065	0.9697	1.568795013
313	2022	3	0_15	CC	4	0.1525	1.4974	1.38737936
313	2022	3	15_30	CC	4	0.1228	1.2609	1.364429765
313	2022	3	30_60	CC	4	0.1195	1.1092	1.568795013
314	2022	3	0_15	CC	3	0.1577	1.5704	1.38737936
314	2022	3	15_30	CC	3	0.1275	1.3262	1.364429765
314	2022	3	30_60	CC	3	0.1164	1.0561	1.568795013
315	2022	3	0_15	CC	2	0.1582	1.6003	1.38737936
315	2022	3	15_30	CC	2	0.1328	1.3422	1.364429765
315	2022	3	30_60	CC	2	0.1041	0.9291	1.568795013
316	2022	3	0_15	CR	2	0.1659	1.6724	1.38737936
316	2022	3	15_30	CR	2	0.1241	1.2844	1.364429765
316	2022	3	30_60	CR	2	0.1013	0.8927	1.568795013
317	2022	3	0_15	CR	1	0.1587	1.5503	1.38737936
317	2022	3	15_30	CR	1	0.1204	1.2494	1.364429765
317	2022	3	30_60	CR	1	0.1119	1.0206	1.568795013
318	2022	3	0_15	CR	5	0.1658	1.5944	1.38737936
318	2022	3	15_30	CR	5	0.1276	1.27	1.364429765
318	2022	3	30_60	CR	5	0.1089	0.9006	1.568795013
319	2022	3	0_15	CR	4	0.1702	1.6996	1.38737936
319	2022	3	15_30	CR	4	0.1419	1.4608	1.364429765
319	2022	3	30_60	CR	4	0.1195	1.0904	1.568795013
320	2022	3	0_15	CR	3	0.1723	1.7106	1.38737936
320	2022	3	15_30	CR	3	0.1355	1.3434	1.364429765

320	2022	3	30_60	CR	3	0.1025	0.8992	1.568795013
321	2022	3	0_15	CF	2	0.1461	1.4656	1.38737936
321	2022	3	15_30	CF	2	0.1195	1.172	1.364429765
321	2022	3	30_60	CF	2	0.094	0.7968	1.568795013
322	2022	3	0_15	CF	5	0.1555	1.5235	1.38737936
322	2022	3	15_30	CF	5	0.1144	1.1377	1.364429765
322	2022	3	30_60	CF	5	0.1041	0.9022	1.568795013
323	2022	3	0_15	CF	3	0.1572	1.5716	1.38737936
323	2022	3	15_30	CF	3	0.1269	1.24	1.364429765
323	2022	3	30_60	CF	3	0.1004	0.8297	1.568795013
324	2022	3	0_15	CF	4	0.1768	1.7617	1.38737936
324	2022	3	15_30	CF	4	0.1288	1.2533	1.364429765
324	2022	3	30_60	CF	4	0.1054	0.894	1.568795013
325	2022	3	0_15	CF	1	0.1666	1.69	1.38737936
325	2022	3	15_30	CF	1	0.1248	1.2501	1.364429765
325	2022	3	30_60	CF	1	0.1002	0.8693	1.568795013
326	2022	3	0_15	R/C	5	0.1662	1.5668	1.38737936
326	2022	3	15_30	R/C	5	0.1223	1.1143	1.364429765
326	2022	3	30_60	R/C	5	0.0976	0.7822	1.568795013
327	2022	3	0_15	R/C	1	0.1546	1.5032	1.38737936
327	2022	3	15_30	R/C	1	0.1148	1.1355	1.364429765
327	2022	3	30_60	R/C	1	0.0979	0.8151	1.568795013
328	2022	3	0_15	R/C	3	0.1623	1.5957	1.38737936
328	2022	3	15_30	R/C	3	0.1181	1.1306	1.364429765
328	2022	3	30_60	R/C	3	0.0991	0.814	1.568795013
329	2022	3	0_15	R/C	4	0.1514	1.4676	1.38737936
329	2022	3	15_30	R/C	4	0.1251	1.2031	1.364429765
329	2022	3	30_60	R/C	4	0.0979	0.798	1.568795013
330	2022	3	0_15	R/C	2	0.1649	1.6004	1.38737936
330	2022	3	15_30	R/C	2	0.1333	1.2663	1.364429765
330	2022	3	30_60	R/C	2	0.0977	0.8285	1.568795013
331	2020	3	0_15	CF	3	0.154	1.625	1.470222097
331	2020	3	15_30	CF	3	0.112	1.089	1.395076845
331	2020	3	30_60	CF	3	0.086	0.755	1.535663524
332	2020	3	0_15	CF	5	0.17	1.85	1.470222097
332	2020	3	15_30	CF	5	0.111	1.119	1.395076845
332	2020	3	30_60	CF	5	0.092	0.806	1.535663524
333	2020	3	0_15	CF	1	0.16	1.702	1.470222097
333	2020	3	15_30	CF	1	0.114	1.157	1.395076845

333	2020	3	30_60	CF	1	0.091	0.774	1.535663524
334	2020	3	0_15	CF	4	0.178	1.932	1.470222097
334	2020	3	15_30	CF	4	0.124	1.29	1.395076845
334	2020	3	30_60	CF	4	0.099	0.877	1.535663524
335	2020	3	0_15	CF	2	0.16	1.682	1.470222097
335	2020	3	15_30	CF	2	0.132	1.437	1.395076845
335	2020	3	30_60	CF	2	0.097	0.842	1.535663524
336	2020	3	0_15	CC	2	0.147	1.511	1.470222097
336	2020	3	15_30	CC	2	0.11	1.046	1.395076845
336	2020	3	30_60	CC	2	0.084	0.712	1.535663524
337	2020	3	0_15	CC	1	0.143	1.465	1.470222097
337	2020	3	15_30	CC	1	0.111	1.112	1.395076845
337	2020	3	30_60	CC	1	0.088	0.783	1.535663524
338	2020	3	0_15	CC	4	0.156	1.621	1.470222097
338	2020	3	15_30	CC	4	0.111	1.115	1.395076845
338	2020	3	30_60	CC	4	0.088	0.749	1.535663524
339	2020	3	0_15	CC	5	0.166	1.739	1.470222097
339	2020	3	15_30	CC	5	0.123	1.257	1.395076845
339	2020	3	30_60	CC	5	0.094	0.8	1.535663524
340	2020	3	0_15	CC	3	0.157	1.637	1.470222097
340	2020	3	15_30	CC	3	0.125	1.211	1.395076845
340	2020	3	30_60	CC	3	0.098	0.874	1.535663524
341	2020	3	0_15	FTC	4	0.17	1.68	1.470222097
341	2020	3	15_30	FTC	4	0.15	1.36	1.395076845
341	2020	3	30_60	FTC	4	0.11	0.62	1.535663524
342	2020	3	0_15	FTC	2	0.15	1.31	1.470222097
342	2020	3	15_30	FTC	2	0.13	0.87	1.395076845
342	2020	3	30_60	FTC	2	0.11	0.59	1.535663524
343	2020	3	0_15	FTC	1	0.14	1.17	1.470222097
343	2020	3	15_30	FTC	1	0.13	0.85	1.395076845
343	2020	3	30_60	FTC	1	0.1	0.47	1.535663524
344	2020	3	0_15	FTC	5	0.14	1.24	1.470222097
344	2020	3	15_30	FTC	5	0.12	0.82	1.395076845
344	2020	3	30_60	FTC	5	0.1	0.55	1.535663524
345	2020	3	0_15	FTC	3	0.14	1.31	1.470222097
345	2020	3	15_30	FTC	3	0.11	0.88	1.395076845
345	2020	3	30_60	FTC	3	0.1	0.55	1.535663524
346	2020	3	0_15	DSB	5	.	.	1.470222097

346	2020	3	15_30	DSB	5	.	.	1.395076845
346	2020	3	30_60	DSB	5	.	.	1.535663524
347	2020	3	0_15	DSB	2	.	.	1.470222097
347	2020	3	15_30	DSB	2	.	.	1.395076845
347	2020	3	30_60	DSB	2	.	.	1.535663524
348	2020	3	0_15	DSB	4	.	.	1.470222097
348	2020	3	15_30	DSB	4	.	.	1.395076845
348	2020	3	30_60	DSB	4	.	.	1.535663524
349	2020	3	0_15	DSB	3	.	.	1.470222097
349	2020	3	15_30	DSB	3	.	.	1.395076845
349	2020	3	30_60	DSB	3	.	.	1.535663524
350	2020	3	0_15	DSB	1	.	.	1.470222097
350	2020	3	15_30	DSB	1	.	.	1.395076845
350	2020	3	30_60	DSB	1	.	.	1.535663524
351	2020	3	0_15	CR	5	0.16	1.629	1.470222097
351	2020	3	15_30	CR	5	0.101	0.942	1.395076845
351	2020	3	30_60	CR	5	0.078	0.654	1.535663524
352	2020	3	0_15	CR	4	0.141	1.439	1.470222097
352	2020	3	15_30	CR	4	0.104	1.004	1.395076845
352	2020	3	30_60	CR	4	0.087	0.747	1.535663524
353	2020	3	0_15	CR	2	0.147	1.519	1.470222097
353	2020	3	15_30	CR	2	0.112	1.1	1.395076845
353	2020	3	30_60	CR	2	0.085	0.712	1.535663524
354	2020	3	0_15	CR	1	0.159	1.668	1.470222097
354	2020	3	15_30	CR	1	0.113	1.117	1.395076845
354	2020	3	30_60	CR	1	0.081	0.682	1.535663524
355	2020	3	0_15	CR	3	0.165	1.713	1.470222097
355	2020	3	15_30	CR	3	0.115	1.104	1.395076845
355	2020	3	30_60	CR	3	0.083	0.696	1.535663524
356	2020	3	0_15	R/C	4	0.169	1.7	1.470222097
356	2020	3	15_30	R/C	4	0.106	1.001	1.395076845
356	2020	3	30_60	R/C	4	0.08	0.671	1.535663524
357	2020	3	0_15	R/C	3	0.156	1.636	1.470222097
357	2020	3	15_30	R/C	3	0.104	0.991	1.395076845
357	2020	3	30_60	R/C	3	0.084	0.708	1.535663524
358	2020	3	0_15	R/C	5	0.151	1.55	1.470222097
358	2020	3	15_30	R/C	5	0.109	1.043	1.395076845
358	2020	3	30_60	R/C	5	0.088	0.758	1.535663524
359	2020	3	0_15	R/C	2	0.164	1.703	1.470222097

359	2020	3	15_30	R/C	2	0.118	1.188	1.395076845
359	2020	3	30_60	R/C	2	0.084	0.7	1.535663524
360	2020	3	0_15	R/C	1	0.158	1.618	1.470222097
360	2020	3	15_30	R/C	1	0.11	1.046	1.395076845
360	2020	3	30_60	R/C	1	0.087	0.757	1.535663524
361	2021	3	0_15	CC	4	0.1614	1.5793	1.380042463
361	2021	3	15_30	CC	4	0.1003	0.9224	1.435607155
361	2021	3	30_60	CC	4	0.0764	0.6391	1.533269788
362	2021	3	0_15	CC	2	0.1748	1.6964	1.380042463
362	2021	3	15_30	CC	2	0.1104	1.0023	1.435607155
362	2021	3	30_60	CC	2	0.0843	0.7083	1.533269788
363	2021	3	0_15	CC	1	0.1764	1.7683	1.380042463
363	2021	3	15_30	CC	1	0.1137	1.0606	1.435607155
363	2021	3	30_60	CC	1	0.0877	0.7669	1.533269788
364	2021	3	0_15	CC	5	0.1714	1.7586	1.380042463
364	2021	3	15_30	CC	5	0.1157	1.1282	1.435607155
364	2021	3	30_60	CC	5	0.083	0.6982	1.533269788
365	2021	3	0_15	CC	3	0.1823	1.7681	1.380042463
365	2021	3	15_30	CC	3	0.122	1.1394	1.435607155
365	2021	3	30_60	CC	3	0.0852	0.707	1.533269788
366	2021	3	0_15	DSB	3	0.17	1.63	1.380042463
366	2021	3	15_30	DSB	3	0.14	1.01	1.435607155
366	2021	2	30_60	DSB	3	0.13	0.65	1.533269788
367	2021	3	0_15	DSB	4	0.17	1.6	1.380042463
367	2021	3	15_30	DSB	4	0.14	1	1.435607155
367	2021	3	30_60	DSB	4	0.13	0.68	1.533269788
368	2021	3	0_15	DSB	2	0.19	1.67	1.380042463
368	2021	3	15_30	DSB	2	0.13	1.07	1.435607155
368	2021	3	30_60	DSB	2	0.13	0.69	1.533269788
369	2021	3	0_15	DSB	5	0.17	1.67	1.380042463
369	2021	3	15_30	DSB	5	0.14	1.13	1.435607155
369	2021	3	30_60	DSB	5	0.12	0.7	1.533269788
370	2021	3	0_15	DSB	1	0.18	1.73	1.380042463
370	2021	3	15_30	DSB	1	0.14	1.06	1.435607155
370	2021	3	30_60	DSB	1	0.11	0.67	1.533269788
371	2021	3	0_15	R/C	5	0.1618	1.5738	1.380042463
371	2021	3	15_30	R/C	5	0.1068	1.0055	1.435607155
371	2021	3	30_60	R/C	5	0.0805	0.6945	1.533269788
372	2021	3	0_15	R/C	4	0.1694	1.6134	1.380042463

372	2021	3	15_30	R/C	4	0.1118	1.0286	1.435607155
372	2021	3	30_60	R/C	4	0.0783	0.6564	1.533269788
373	2021	3	0_15	R/C	3	0.1862	1.8391	1.380042463
373	2021	3	15_30	R/C	3	0.1137	1.0413	1.435607155
373	2021	3	30_60	R/C	3	0.0811	0.6717	1.533269788
374	2021	3	0_15	R/C	2	0.1814	1.806	1.380042463
374	2021	3	15_30	R/C	2	0.1207	1.1388	1.435607155
374	2021	3	30_60	R/C	2	0.0825	0.7031	1.533269788
375	2021	3	0_15	R/C	1	0.1702	1.6885	1.380042463
375	2021	3	15_30	R/C	1	0.1171	1.0757	1.435607155
375	2021	3	30_60	R/C	1	0.0822	0.694	1.533269788
376	2021	3	0_15	CR	1	0.1675	1.6409	1.380042463
376	2021	3	15_30	CR	1	0.1089	1.0423	1.435607155
376	2021	3	30_60	CR	1	0.0817	0.7069	1.533269788
377	2021	3	0_15	CR	2	0.1722	1.7073	1.380042463
377	2021	3	15_30	CR	2	0.1121	1.0518	1.435607155
377	2021	3	30_60	CR	2	0.0832	0.6962	1.533269788
378	2021	3	0_15	CR	3	0.1649	1.6111	1.380042463
378	2021	3	15_30	CR	3	0.1078	1.0059	1.435607155
378	2021	3	30_60	CR	3	0.0892	0.7868	1.533269788
379	2021	3	0_15	CR	5	0.1772	1.8458	1.380042463
379	2021	3	15_30	CR	5	0.1087	0.9844	1.435607155
379	2021	3	30_60	CR	5	0.0657	0.5285	1.533269788
380	2021	3	0_15	CR	4	0.172	1.7214	1.380042463
380	2021	3	15_30	CR	4	0.1123	1.0657	1.435607155
380	2021	3	30_60	CR	4	0.082	0.6926	1.533269788
381	2021	3	0_15	FTC	1	0.17	1.6	1.380042463
381	2021	3	15_30	FTC	1	0.13	0.97	1.435607155
381	2021	3	30_60	FTC	1	0.12	0.66	1.533269788
382	2021	3	0_15	FTC	3	0.16	1.62	1.380042463
382	2021	3	15_30	FTC	3	0.13	1.05	1.435607155
382	2021	3	30_60	FTC	3	0.12	0.72	1.533269788
383	2021	3	0_15	FTC	4	0.17	1.68	1.380042463
383	2021	3	15_30	FTC	4	0.14	0.99	1.435607155
383	2021	3	30_60	FTC	4	0.11	0.69	1.533269788
384	2021	3	0_15	FTC	5	0.17	1.57	1.380042463
384	2021	3	15_30	FTC	5	0.14	0.95	1.435607155
384	2021	3	30_60	FTC	5	0.12	0.7	1.533269788

385	2021	3	0_15	FTC	2	0.18	1.83	1.380042463
385	2021	3	15_30	FTC	2	0.14	1.1	1.435607155
385	2021	3	30_60	FTC	2	0.13	0.73	1.533269788
386	2021	3	0_15	CF	4	0.1491	1.4826	1.380042463
386	2021	3	15_30	CF	4	0.1072	1.0342	1.435607155
386	2021	3	30_60	CF	4	0.0784	0.6722	1.533269788
387	2021	3	0_15	CF	5	0.1572	1.6071	1.380042463
387	2021	3	15_30	CF	5	0.1073	1.0421	1.435607155
387	2021	3	30_60	CF	5	0.0824	0.7063	1.533269788
388	2021	3	0_15	CF	1	0.1699	1.7637	1.380042463
388	2021	3	15_30	CF	1	0.1126	1.0341	1.435607155
388	2021	3	30_60	CF	1	0.0745	0.6217	1.533269788
389	2021	3	0_15	CF	3	0.1564	1.4904	1.380042463
389	2021	3	15_30	CF	3	0.1068	0.9542	1.435607155
389	2021	3	30_60	CF	3	0.0754	0.613	1.533269788
390	2021	3	0_15	CF	2	0.1603	1.5691	1.380042463
390	2021	3	15_30	CF	2	0.1083	0.9852	1.435607155
390	2021	3	30_60	CF	2	0.0809	0.6813	1.533269788
401	2021	4	0_15	CR	3	0.1552	1.5598	1.426725127
401	2021	4	15_30	CR	3	0.108	1.0347	1.428897439
401	2021	4	30_60	CR	3	0.0761	0.6331	1.541058498
402	2021	4	0_15	CR	2	0.1518	1.5126	1.426725127
402	2021	4	15_30	CR	2	0.1069	1.0356	1.428897439
402	2021	4	30_60	CR	2	0.0824	0.7026	1.541058498
403	2021	4	0_15	CR	5	0.1494	1.5104	1.426725127
403	2021	4	15_30	CR	5	0.1076	1.0241	1.428897439
403	2021	4	30_60	CR	5	0.0778	0.6589	1.541058498
404	2021	4	0_15	CR	4	0.1708	1.7183	1.426725127
404	2021	4	15_30	CR	4	0.1115	1.0551	1.428897439
404	2021	4	30_60	CR	4	0.0768	0.6481	1.541058498
405	2021	4	0_15	CR	1	0.1697	1.7194	1.426725127
405	2021	4	15_30	CR	1	0.1123	1.0706	1.428897439
405	2021	4	30_60	CR	1	0.0824	0.7226	1.541058498
406	2021	4	0_15	CF	4	0.1606	1.6015	1.426725127
406	2021	4	15_30	CF	4	0.1059	1.0332	1.428897439
406	2021	4	30_60	CF	4	0.0792	0.6862	1.541058498
407	2021	4	0_15	CF	5	0.15	1.5214	1.426725127
407	2021	4	15_30	CF	5	0.1031	0.9878	1.428897439
407	2021	4	30_60	CF	5	0.0755	0.635	1.541058498

408	2021	4	0_15	CF	1	0.1592	1.5947	1.426725127
408	2021	4	15_30	CF	1	0.1057	0.974	1.428897439
408	2021	4	30_60	CF	1	0.0807	0.6801	1.541058498
409	2021	4	0_15	CF	3	0.1614	1.6033	1.426725127
409	2021	4	15_30	CF	3	0.1093	1.0248	1.428897439
409	2021	4	30_60	CF	3	0.0787	0.6493	1.541058498
410	2021	4	0_15	CF	2	0.1551	1.5808	1.426725127
410	2021	4	15_30	CF	2	0.1083	1.0299	1.428897439
410	2021	4	30_60	CF	2	0.0794	0.6748	1.541058498
411	2021	4	0_15	DSB	2	0.17	1.68	1.426725127
411	2021	4	15_30	DSB	2	0.13	0.94	1.428897439
411	2021	3	30_60	DSB	2	0.11	0.61	1.541058498
412	2021	4	0_15	DSB	1	0.16	1.39	1.426725127
412	2021	4	15_30	DSB	1	0.14	0.97	1.428897439
412	2021	4	30_60	DSB	1	0.12	0.64	1.541058498
413	2021	4	0_15	DSB	4	0.17	1.5	1.426725127
413	2021	4	15_30	DSB	4	0.13	0.89	1.428897439
413	2021	4	30_60	DSB	4	0.12	0.67	1.541058498
414	2021	4	0_15	DSB	3	0.16	1.67	1.426725127
414	2021	4	15_30	DSB	3	0.14	1.11	1.428897439
414	2021	4	30_60	DSB	3	0.12	0.69	1.541058498
415	2021	4	0_15	DSB	5	0.17	1.63	1.426725127
415	2021	4	15_30	DSB	5	0.14	1.02	1.428897439
415	2021	4	30_60	DSB	5	0.12	0.68	1.541058498
416	2021	4	0_15	FTC	1	0.17	1.63	1.426725127
416	2021	4	15_30	FTC	1	0.15	1.01	1.428897439
416	2021	4	30_60	FTC	1	0.12	0.64	1.541058498
417	2021	4	0_15	FTC	2	0.16	1.52	1.426725127
417	2021	4	15_30	FTC	2	0.14	1.02	1.428897439
417	2021	4	30_60	FTC	2	0.12	0.68	1.541058498
418	2021	4	0_15	FTC	4	0.17	1.55	1.426725127
418	2021	4	15_30	FTC	4	0.13	1	1.428897439
418	2021	4	30_60	FTC	4	0.12	0.7	1.541058498
419	2021	4	0_15	FTC	5	0.18	1.65	1.426725127
419	2021	4	15_30	FTC	5	0.14	1.1	1.428897439
419	2021	4	30_60	FTC	5	0.12	0.67	1.541058498
420	2021	4	0_15	FTC	3	0.17	1.63	1.426725127
420	2021	4	15_30	FTC	3	0.14	1.03	1.428897439

420	2021	4	30_60	FTC	3	0.12	0.64	1.541058498
421	2021	4	0_15	CC	1	0.1614	1.6216	1.426725127
421	2021	4	15_30	CC	1	0.1069	1.0177	1.428897439
421	2021	4	30_60	CC	1	0.0756	0.6401	1.541058498
422	2021	4	0_15	CC	2	0.1597	1.6108	1.426725127
422	2021	4	15_30	CC	2	0.1051	1.0047	1.428897439
422	2021	4	30_60	CC	2	0.081	0.6946	1.541058498
423	2021	4	0_15	CC	5	0.155	1.5407	1.426725127
423	2021	4	15_30	CC	5	0.1042	0.9463	1.428897439
423	2021	4	30_60	CC	5	0.0775	0.651	1.541058498
424	2021	4	0_15	CC	3	0.1951	1.9831	1.426725127
424	2021	4	15_30	CC	3	0.1292	1.264	1.428897439
424	2021	4	30_60	CC	3	0.08	0.6735	1.541058498
425	2021	4	0_15	CC	4	0.1696	1.6856	1.426725127
425	2021	4	15_30	CC	4	0.1142	1.0797	1.428897439
425	2021	4	30_60	CC	4	0.0797	0.677	1.541058498
426	2021	4	0_15	R/C	4	0.1565	1.5424	1.426725127
426	2021	4	15_30	R/C	4	0.1056	1.0883	1.428897439
426	2021	4	30_60	R/C	4	0.0776	0.6669	1.541058498
427	2021	4	0_15	R/C	5	0.1636	1.6468	1.426725127
427	2021	4	15_30	R/C	5	0.1025	0.9561	1.428897439
427	2021	4	30_60	R/C	5	0.079	0.6883	1.541058498
428	2021	4	0_15	R/C	2	0.1741	1.7525	1.426725127
428	2021	4	15_30	R/C	2	0.1005	0.9064	1.428897439
428	2021	4	30_60	R/C	2	0.0782	0.6568	1.541058498
429	2021	4	0_15	R/C	1	0.1844	1.8693	1.426725127
429	2021	4	15_30	R/C	1	0.1174	1.1165	1.428897439
429	2021	4	30_60	R/C	1	0.0826	0.693	1.541058498
430	2021	4	0_15	R/C	3	0.1752	1.7423	1.426725127
430	2021	4	15_30	R/C	3	0.1156	1.0973	1.428897439
430	2021	4	30_60	R/C	3	0.0827	0.6997	1.541058498
431	2022	4	0_15	CC	1	0.1768	1.69	1.356017432
431	2022	4	15_30	CC	1	0.1114	0.9375	1.470896633
431	2022	4	30_60	CC	1	0.084	0.6715	1.553979235
432	2022	4	0_15	CC	5	0.1623	1.4521	1.356017432
432	2022	4	15_30	CC	5	0.1093	0.9363	1.470896633
432	2022	4	30_60	CC	5	0.0836	0.6749	1.553979235
433	2022	4	0_15	CC	2	0.1725	1.6254	1.356017432
433	2022	4	15_30	CC	2	0.1095	0.9553	1.470896633

433	2022	4	30_60	CC	2	0.0857	0.6832	1.553979235
434	2022	4	0_15	CC	4	0.1984	1.8288	1.356017432
434	2022	4	15_30	CC	4	0.1265	1.1155	1.470896633
434	2022	4	30_60	CC	4	0.0867	0.6875	1.553979235
435	2022	4	0_15	CC	3	0.1793	1.6443	1.356017432
435	2022	4	15_30	CC	3	0.1198	1.07	1.470896633
435	2022	4	30_60	CC	3	0.0849	0.6742	1.553979235
436	2022	4	0_15	FTC	4	0.17	1.53	1.356017432
436	2022	4	15_30	FTC	4	0.13	1.01	1.470896633
436	2022	4	30_60	FTC	4	0.11	0.63	1.553979235
437	2022	4	0_15	FTC	3	0.18	1.54	1.356017432
437	2022	4	15_30	FTC	3	0.13	0.95	1.470896633
437	2022	4	30_60	FTC	3	0.12	0.66	1.553979235
438	2022	4	0_15	FTC	1	0.17	1.53	1.356017432
438	2022	4	15_30	FTC	1	0.13	1.01	1.470896633
438	2022	4	30_60	FTC	1	0.11	0.71	1.553979235
439	2022	4	0_15	FTC	2	0.18	1.74	1.356017432
439	2022	4	15_30	FTC	2	0.15	1.1	1.470896633
439	2022	4	30_60	FTC	2	0.12	0.75	1.553979235
440	2022	4	0_15	FTC	5	0.19	1.83	1.356017432
440	2022	4	15_30	FTC	5	0.14	1.13	1.470896633
440	2022	4	30_60	FTC	5	0.12	0.72	1.553979235
441	2022	4	0_15	R/C	4	0.1582	1.3988	1.356017432
441	2022	4	15_30	R/C	4	0.116	0.974	1.470896633
441	2022	4	30_60	R/C	4	0.0834	0.6702	1.553979235
442	2022	4	0_15	R/C	3	0.192	1.7071	1.356017432
442	2022	4	15_30	R/C	3	0.1086	0.9109	1.470896633
442	2022	4	30_60	R/C	3	0.0824	0.6493	1.553979235
443	2022	4	0_15	R/C	5	0.1649	1.4566	1.356017432
443	2022	4	15_30	R/C	5	0.1112	0.9349	1.470896633
443	2022	4	30_60	R/C	5	0.0869	0.6993	1.553979235
444	2022	4	0_15	R/C	1	0.1632	1.5691	1.356017432
444	2022	4	15_30	R/C	1	0.1188	1.0237	1.470896633
444	2022	4	30_60	R/C	1	0.0916	0.6874	1.553979235
445	2022	4	0_15	R/C	2	0.1722	1.6501	1.356017432
445	2022	4	15_30	R/C	2	0.109	0.9384	1.470896633
445	2022	4	30_60	R/C	2	0.082	0.6369	1.553979235
446	2022	4	0_15	CR	2	0.1449	1.2787	1.356017432

446	2022	4	15_30	CR	2	0.1015	0.8604	1.470896633
446	2022	4	30_60	CR	2	0.0822	0.6564	1.553979235
447	2022	4	0_15	CR	4	0.1573	1.3617	1.356017432
447	2022	4	15_30	CR	4	0.1123	0.9323	1.470896633
447	2022	4	30_60	CR	4	0.0887	0.7022	1.553979235
448	2022	4	0_15	CR	3	0.162	1.4566	1.356017432
448	2022	4	15_30	CR	3	0.1094	0.9389	1.470896633
448	2022	4	30_60	CR	3	0.0869	0.6802	1.553979235
449	2022	4	0_15	CR	5	0.1782	1.6112	1.356017432
449	2022	4	15_30	CR	5	0.1171	0.9585	1.470896633
449	2022	4	30_60	CR	5	0.0839	0.6458	1.553979235
450	2022	4	0_15	CR	1	0.1753	1.6378	1.356017432
450	2022	4	15_30	CR	1	0.1236	1.0331	1.470896633
450	2022	4	30_60	CR	1	0.0918	0.7106	1.553979235
451	2022	4	0_15	CF	2	0.146	1.3068	1.356017432
451	2022	4	15_30	CF	2	0.1051	0.8234	1.470896633
451	2022	4	30_60	CF	2	0.0819	0.6136	1.553979235
452	2022	4	0_15	CF	3	0.1508	1.3543	1.356017432
452	2022	4	15_30	CF	3	0.1049	0.8944	1.470896633
452	2022	4	30_60	CF	3	0.0859	0.7087	1.553979235
453	2022	4	0_15	CF	5	0.1632	1.4611	1.356017432
453	2022	4	15_30	CF	5	0.1081	0.9113	1.470896633
453	2022	4	30_60	CF	5	0.0843	0.6809	1.553979235
454	2022	4	0_15	CF	1	0.1473	1.3655	1.356017432
454	2022	4	15_30	CF	1	0.1062	0.8835	1.470896633
454	2022	4	30_60	CF	1	0.083	0.6497	1.553979235
455	2022	4	0_15	CF	4	0.1608	1.4844	1.356017432
455	2022	4	15_30	CF	4	0.1183	1.0118	1.470896633
455	2022	4	30_60	CF	4	0.0852	0.6694	1.553979235
456	2022	4	0_15	DSB	2	0.17	1.41	1.356017432
456	2022	4	15_30	DSB	2	0.13	0.91	1.470896633
456	2022	4	30_60	DSB	2	0.11	0.68	1.553979235
457	2022	4	0_15	DSB	5	0.17	1.48	1.356017432
457	2022	4	15_30	DSB	5	0.13	0.95	1.470896633
457	2022	4	30_60	DSB	5	0.11	0.7	1.553979235
458	2022	4	0_15	DSB	1	0.16	1.36	1.356017432
458	2022	4	15_30	DSB	1	0.12	0.91	1.470896633
458	2022	4	30_60	DSB	1	0.11	0.66	1.553979235
459	2022	4	0_15	DSB	4	0.18	1.5	1.356017432

459	2022	4	15_30	DSB	4	0.15	0.98	1.470896633
459	2022	4	30_60	DSB	4	0.12	0.69	1.553979235
460	2022	4	0_15	DSB	3	0.18	1.51	1.356017432
460	2022	4	15_30	DSB	3	0.14	1.02	1.470896633
460	2022	4	30_60	DSB	3	0.12	0.74	1.553979235
461	2020	4	0_15	CC	4	0.173	1.71	1.455018987
461	2020	4	15_30	CC	4	0.105	0.931	1.360984235
461	2020	4	30_60	CC	4	0.083	0.7	1.546226793
462	2020	4	0_15	CC	5	0.163	1.589	1.455018987
462	2020	4	15_30	CC	5	0.105	0.957	1.360984235
462	2020	4	30_60	CC	5	0.08	0.668	1.546226793
463	2020	4	0_15	CC	2	0.155	1.574	1.455018987
463	2020	4	15_30	CC	2	0.103	0.956	1.360984235
463	2020	4	30_60	CC	2	0.084	0.703	1.546226793
464	2020	4	0_15	CC	3	0.173	1.731	1.455018987
464	2020	4	15_30	CC	3	0.112	1.043	1.360984235
464	2020	4	30_60	CC	3	0.088	0.743	1.546226793
465	2020	4	0_15	CC	1	0.179	1.902	1.455018987
465	2020	4	15_30	CC	1	0.114	1.076	1.360984235
465	2020	4	30_60	CC	1	0.089	0.778	1.546226793
466	2020	4	0_15	DSB	4	.	.	1.455018987
466	2020	4	15_30	DSB	4	.	.	1.360984235
466	2020	4	30_60	DSB	4	.	.	1.546226793
467	2020	4	0_15	DSB	2	.	.	1.455018987
467	2020	4	15_30	DSB	2	.	.	1.360984235
467	2020	4	30_60	DSB	2	.	.	1.546226793
468	2020	4	0_15	DSB	1	.	.	1.455018987
468	2020	4	15_30	DSB	1	.	.	1.360984235
468	2020	4	30_60	DSB	1	.	.	1.546226793
469	2020	4	0_15	DSB	5	.	.	1.455018987
469	2020	4	15_30	DSB	5	.	.	1.360984235
469	2020	4	30_60	DSB	5	.	.	1.546226793
470	2020	4	0_15	DSB	3	.	.	1.455018987
470	2020	4	15_30	DSB	3	.	.	1.360984235
470	2020	4	30_60	DSB	3	.	.	1.546226793
471	2020	4	0_15	CF	5	0.149	1.429	1.455018987
471	2020	4	15_30	CF	5	0.114	1.018	1.360984235
471	2020	4	30_60	CF	5	0.085	0.706	1.546226793
472	2020	4	0_15	CF	3	0.151	1.451	1.455018987

472	2020	4	15_30	CF	3	0.107	0.962	1.360984235
472	2020	4	30_60	CF	3	0.083	0.695	1.546226793
473	2020	4	0_15	CF	1	0.157	1.621	1.455018987
473	2020	4	15_30	CF	1	0.11	1.008	1.360984235
473	2020	4	30_60	CF	1	0.082	0.689	1.546226793
474	2020	4	0_15	CF	4	0.154	1.521	1.455018987
474	2020	4	15_30	CF	4	0.109	0.981	1.360984235
474	2020	4	30_60	CF	4	0.082	0.698	1.546226793
475	2020	4	0_15	CF	2	0.147	1.484	1.455018987
475	2020	4	15_30	CF	2	0.114	1.055	1.360984235
475	2020	4	30_60	CF	2	0.09	0.781	1.546226793
476	2020	4	0_15	FTC	4	0.17	1.71	1.455018987
476	2020	4	15_30	FTC	4	0.13	0.96	1.360984235
476	2020	4	30_60	FTC	4	0.11	0.71	1.546226793
477	2020	4	0_15	FTC	5	0.17	1.75	1.455018987
477	2020	4	15_30	FTC	5	0.13	0.96	1.360984235
477	2020	4	30_60	FTC	5	0.11	0.71	1.546226793
478	2020	4	0_15	FTC	1	0.18	1.76	1.455018987
478	2020	4	15_30	FTC	1	0.13	0.98	1.360984235
478	2020	4	30_60	FTC	1	0.12	0.66	1.546226793
479	2020	4	0_15	FTC	3	0.18	1.82	1.455018987
479	2020	4	15_30	FTC	3	0.14	0.96	1.360984235
480	2020	4	0_15	FTC	2	0.18	1.84	1.455018987
480	2020	4	15_30	FTC	2	0.14	1.09	1.360984235
480	2020	4	30_60	FTC	2	0.13	0.77	1.546226793
481	2020	4	0_15	R/C	4	0.155	1.531	1.455018987
481	2020	4	15_30	R/C	4	0.109	0.974	1.360984235
481	2020	4	30_60	R/C	4	0.084	0.695	1.546226793
482	2020	4	0_15	R/C	5	0.156	1.539	1.455018987
482	2020	4	15_30	R/C	5	0.112	1.005	1.360984235
482	2020	4	30_60	R/C	5	0.087	0.755	1.546226793
483	2020	4	0_15	R/C	2	0.168	1.726	1.455018987
483	2020	4	15_30	R/C	2	0.107	0.951	1.360984235
483	2020	4	30_60	R/C	2	0.079	0.655	1.546226793
484	2020	4	0_15	R/C	3	0.171	1.73	1.455018987
484	2020	4	15_30	R/C	3	0.108	0.991	1.360984235
484	2020	4	30_60	R/C	3	0.088	0.793	1.546226793
485	2020	4	0_15	R/C	1	0.174	1.807	1.455018987
485	2020	4	15_30	R/C	1	0.116	1.142	1.360984235
485	2020	4	30_60	R/C	1	0.092	0.81	1.546226793

486	2020	4	0_15	CR	4	0.155	1.525	1.455018987
486	2020	4	15_30	CR	4	0.112	0.996	1.360984235
486	2020	4	30_60	CR	4	0.086	0.723	1.546226793
487	2020	4	0_15	CR	2	0.167	1.697	1.455018987
487	2020	4	15_30	CR	2	0.11	1.01	1.360984235
487	2020	4	30_60	CR	2	0.085	0.734	1.546226793
488	2020	4	0_15	CR	1	0.165	1.682	1.455018987
488	2020	4	15_30	CR	1	0.109	1.007	1.360984235
488	2020	4	30_60	CR	1	0.081	0.685	1.546226793
489	2020	4	0_15	CR	3	0.167	1.659	1.455018987
489	2020	4	15_30	CR	3	0.11	1.022	1.360984235
489	2020	4	30_60	CR	3	0.085	0.732	1.546226793
490	2020	4	0_15	CR	5	0.139	1.401	1.455018987
490	2020	4	15_30	CR	5	0.146	1.44	1.360984235
490	2020	4	30_60	CR	5	0.096	0.883	1.546226793

Profile Nitrogen pre cover crops and post corn harvest

plot	Year	Rep	Depth (cm)	Cover	N rate level	post soil N Mgha	pre 0-60 N Mgha	post 0-60 N Mgha
101	2022	1	0_15	FTC	4	0.24	0.56	0.55
101	2022	1	15_30	FTC	4	0.16		
101	2022	1	30_60	FTC	4	0.14		
102	2022	1	0_15	FTC	2	0.21	0.56	0.61
102	2022	1	15_30	FTC	2	0.18		
102	2022	1	30_60	FTC	2	0.22		
103	2022	1	0_15	FTC	5	0.19	0.58	0.54
103	2022	1	15_30	FTC	5	0.16		
103	2022	1	30_60	FTC	5	0.18		
104	2022	1	0_15	FTC	1	0.22	0.56	0.55
104	2022	1	15_30	FTC	1	0.16		
104	2022	1	30_60	FTC	1	0.17		
105	2022	1	0_15	FTC	3	0.24	0.60	0.59
105	2022	1	15_30	FTC	3	0.16		
105	2022	1	30_60	FTC	3	0.18		
106	2022	1	0_15	CF	3	0.20	0.47	0.51
106	2022	1	15_30	CF	3	0.15		
106	2022	1	30_60	CF	3	0.15		
107	2022	1	0_15	CF	2	0.18	0.50	0.51

107	2022	1	15_30	CF	2	0.16		
107	2022	1	30_60	CF	2	0.17		
108	2022	1	0_15	CF	4	0.18	0.49	0.52
108	2022	1	15_30	CF	4	0.15		
108	2022	1	30_60	CF	4	0.18		
109	2022	1	0_15	CF	1	0.22	0.51	0.55
109	2022	1	15_30	CF	1	0.16		
109	2022	1	30_60	CF	1	0.17		
110	2022	1	0_15	CF	5	0.19	0.50	0.55
110	2022	1	15_30	CF	5	0.19		
110	2022	1	30_60	CF	5	0.17		
111	2022	1	0_15	DSB	3	0.18	0.51	0.51
111	2022	1	15_30	DSB	3	0.16		
111	2022	1	30_60	DSB	3	0.17		
112	2022	1	0_15	DSB	4	0.16	0.56	0.47
112	2022	1	15_30	DSB	4	0.14		
112	2022	1	30_60	DSB	4	0.17		
113	2022	1	0_15	DSB	5	0.16	0.58	0.50
113	2022	1	15_30	DSB	5	0.15		
113	2022	1	30_60	DSB	5	0.18		
114	2022	1	0_15	DSB	2	0.20	0.58	0.53
114	2022	1	15_30	DSB	2	0.16		
114	2022	1	30_60	DSB	2	0.17		
115	2022	1	0_15	DSB	1	0.19	0.56	0.51
115	2022	1	15_30	DSB	1	0.15		
115	2022	1	30_60	DSB	1	0.17		
116	2022	1	0_15	R/C	5	0.20	0.49	0.49
116	2022	1	15_30	R/C	5	0.12		
116	2022	1	30_60	R/C	5	0.17		
117	2022	1	0_15	R/C	4	0.20	0.51	0.50
117	2022	1	15_30	R/C	4	0.12		
117	2022	1	30_60	R/C	4	0.18		
118	2022	1	0_15	R/C	3	0.21	0.50	0.55
118	2022	1	15_30	R/C	3	0.15		
118	2022	1	30_60	R/C	3	0.20		
119	2022	1	0_15	R/C	2	0.20	0.51	0.52
119	2022	1	15_30	R/C	2	0.14		
119	2022	1	30_60	R/C	2	0.18		
120	2022	1	0_15	R/C	1	0.21	0.52	0.50
120	2022	1	15_30	R/C	1	0.12		
120	2022	1	30_60	R/C	1	0.17		
121	2022	1	0_15	CC	3	0.20	0.50	0.49
121	2022	1	15_30	CC	3	0.12		

121	2022	1	30_60	CC	3	0.17		
122	2022	1	0_15	CC	2	0.21	0.49	0.52
122	2022	1	15_30	CC	2	0.14		
122	2022	1	30_60	CC	2	0.17		
123	2022	1	0_15	CC	1	0.23	0.53	0.53
123	2022	1	15_30	CC	1	0.14		
123	2022	1	30_60	CC	1	0.17		
124	2022	1	0_15	CC	5	0.22	0.52	0.51
124	2022	1	15_30	CC	5	0.12		
124	2022	1	30_60	CC	5	0.17		
125	2022	1	0_15	CC	4	0.24	0.49	0.49
125	2022	1	15_30	CC	4	0.12		
125	2022	1	30_60	CC	4	0.13		
126	2022	1	0_15	CR	4	0.18	0.50	0.49
126	2022	1	15_30	CR	4	0.14		
126	2022	1	30_60	CR	4	0.17		
127	2022	1	0_15	CR	1	0.22	0.51	0.51
127	2022	1	15_30	CR	1	0.12		
127	2022	1	30_60	CR	1	0.17		
128	2022	1	0_15	CR	2	0.22	0.50	0.51
128	2022	1	15_30	CR	2	0.14		
128	2022	1	30_60	CR	2	0.15		
129	2022	1	0_15	CR	3	0.22	0.51	0.49
129	2022	1	15_30	CR	3	0.12		
129	2022	1	30_60	CR	3	0.15		
130	2022	1	0_15	CR	5	0.23	0.48	0.49
130	2022	1	15_30	CR	5	0.12		
130	2022	1	30_60	CR	5	0.14		
131	2020	1	0_15	FTC	1	0.22	0.60	0.46
131	2020	1	15_30	FTC	1	0.13		
131	2020	1	30_60	FTC	1	0.11		
132	2020	1	0_15	FTC	3	0.22	0.64	0.49
132	2020	1	15_30	FTC	3	0.15		
132	2020	1	30_60	FTC	3	0.13		
133	2020	1	0_15	FTC	2	0.21	0.61	0.49
133	2020	1	15_30	FTC	2	0.15		
133	2020	1	30_60	FTC	2	0.13		
134	2020	1	0_15	FTC	4	0.21	0.58	0.47
134	2020	1	15_30	FTC	4	0.15		
134	2020	1	30_60	FTC	4	0.11		
135	2020	1	0_15	FTC	5	0.21	0.58	0.47
135	2020	1	15_30	FTC	5	0.15		
135	2020	1	30_60	FTC	5	0.11		

136	2020	1	0_15	CC	3	0.20	0.52	0.49
136	2020	1	15_30	CC	3	0.15		
136	2020	1	30_60	CC	3	0.14		
137	2020	1	0_15	CC	2	0.20	0.51	0.49
137	2020	1	15_30	CC	2	0.15		
137	2020	1	30_60	CC	2	0.14		
138	2020	1	0_15	CC	4	0.22	0.53	0.49
138	2020	1	15_30	CC	4	0.16		
138	2020	1	30_60	CC	4	0.11		
139	2020	1	0_15	CC	1	0.23	0.52	0.49
139	2020	1	15_30	CC	1	0.15		
139	2020	1	30_60	CC	1	0.11		
140	2020	1	0_15	CC	5	0.22	0.52	0.46
140	2020	1	15_30	CC	5	0.13		
140	2020	1	30_60	CC	5	0.11		
141	2020	1	0_15	CF	5	0.20	0.53	0.49
141	2020	1	15_30	CF	5	0.15		
141	2020	1	30_60	CF	5	0.14		
142	2020	1	0_15	CF	3	0.20	0.53	0.47
142	2020	1	15_30	CF	3	0.15		
142	2020	1	30_60	CF	3	0.13		
143	2020	1	0_15	CF	4	0.20	0.50	0.48
143	2020	1	15_30	CF	4	0.15		
143	2020	1	30_60	CF	4	0.13		
144	2020	1	0_15	CF	2	0.20	0.48	0.46
144	2020	1	15_30	CF	2	0.15		
144	2020	1	30_60	CF	2	0.11		
145	2020	1	0_15	CF	1	0.19	0.51	0.47
145	2020	1	15_30	CF	1	0.15		
145	2020	1	30_60	CF	1	0.13		
146	2020	1	0_15	DSB	2	0.20	.	0.49
146	2020	1	15_30	DSB	2	0.15		
146	2020	1	30_60	DSB	2	0.14		
147	2020	1	0_15	DSB	3	0.21	.	0.50
147	2020	1	15_30	DSB	3	0.16		
147	2020	1	30_60	DSB	3	0.13		
148	2020	1	0_15	DSB	5	0.20	.	0.48
148	2020	1	15_30	DSB	5	0.15		
148	2020	1	30_60	DSB	5	0.13		
149	2020	1	0_15	DSB	4	0.21	.	0.50
149	2020	1	15_30	DSB	4	0.16		
149	2020	1	30_60	DSB	4	0.13		
150	2020	1	0_15	DSB	1	0.21	.	0.48

150	2020	1	15_30	DSB	1	0.15		
150	2020	1	30_60	DSB	1	0.13		
151	2020	1	0_15	R/C	5	0.21	0.57	0.52
151	2020	1	15_30	R/C	5	0.16		
151	2020	1	30_60	R/C	5	0.15		
152	2020	1	0_15	R/C	2	0.22	0.55	0.51
152	2020	1	15_30	R/C	2	0.15		
152	2020	1	30_60	R/C	2	0.14		
153	2020	1	0_15	R/C	4	0.22	0.59	0.51
153	2020	1	15_30	R/C	4	0.16		
153	2020	1	30_60	R/C	4	0.13		
154	2020	1	0_15	R/C	1	0.22	0.56	0.52
154	2020	1	15_30	R/C	1	0.16		
154	2020	1	30_60	R/C	1	0.14		
155	2020	1	0_15	R/C	3	0.21	0.54	0.51
155	2020	1	15_30	R/C	3	0.16		
155	2020	1	30_60	R/C	3	0.14		
156	2020	1	0_15	CR	5	0.22	0.57	0.55
156	2020	1	15_30	CR	5	0.16		
156	2020	1	30_60	CR	5	0.17		
157	2020	1	0_15	CR	2	0.21	0.54	0.51
157	2020	1	15_30	CR	2	0.16		
157	2020	1	30_60	CR	2	0.14		
158	2020	1	0_15	CR	4	0.22	0.55	0.53
158	2020	1	15_30	CR	4	0.16		
158	2020	1	30_60	CR	4	0.15		
159	2020	1	0_15	CR	3	0.20	0.57	0.51
159	2020	1	15_30	CR	3	0.16		
159	2020	1	30_60	CR	3	0.14		
160	2020	1	0_15	CR	1	0.20	0.55	0.49
160	2020	1	15_30	CR	1	0.16		
160	2020	1	30_60	CR	1	0.13		
161	2021	1	0_15	R/C	4	0.22	0.57	0.61
161	2021	1	15_30	R/C	4	0.18		
161	2021	1	30_60	R/C	4	0.21		
162	2021	1	0_15	R/C	1	0.23	0.58	0.65
162	2021	1	15_30	R/C	1	0.21		
162	2021	1	30_60	R/C	1	0.21		
163	2021	1	0_15	R/C	3	0.24	0.59	0.62
163	2021	1	15_30	R/C	3	0.18		
163	2021	1	30_60	R/C	3	0.21		
164	2021	1	0_15	R/C	5	0.23	0.58	0.62
164	2021	1	15_30	R/C	5	0.19		

164	2021	1	30_60	R/C	5	0.20		
165	2021	1	0_15	R/C	2	0.22	0.56	0.59
165	2021	1	15_30	R/C	2	0.19		
165	2021	1	30_60	R/C	2	0.18		
166	2021	4	0_15	FTC	5	0.20	0.66	0.62
166	2021	1	15_30	FTC	5	0.21		
166	2021	1	30_60	FTC	5	0.21		
167	2021	1	0_15	FTC	3	0.22	0.63	0.61
167	2021	1	15_30	FTC	3	0.18		
167	2021	1	30_60	FTC	3	0.21		
168	2021	1	0_15	FTC	4	0.22	0.60	0.64
168	2021	1	15_30	FTC	4	0.18		
168	2021	1	30_60	FTC	4	0.24		
169	2021	1	0_15	FTC	2	0.24	0.62	0.64
169	2021	1	15_30	FTC	2	0.19		
169	2021	1	30_60	FTC	2	0.21		
170	2021	1	0_15	FTC	1	0.24	0.62	0.61
170	2021	1	15_30	FTC	1	0.21		
170	2021	1	30_60	FTC	1	0.17		
171	2021	1	0_15	DSB	4	0.23	0.63	0.69
171	2021	1	15_30	DSB	4	0.23		
171	2021	1	30_60	DSB	4	0.23		
172	2021	1	0_15	DSB	2	0.23	0.62	0.61
172	2021	1	15_30	DSB	2	0.19		
172	2021	1	30_60	DSB	2	0.20		
173	2021	1	0_15	DSB	3	0.23	0.62	0.63
173	2021	1	15_30	DSB	3	0.21		
173	2021	1	30_60	DSB	3	0.20		
174	2021	1	0_15	DSB	1	0.23	0.63	0.61
174	2021	1	15_30	DSB	1	0.21		
174	2021	1	30_60	DSB	1	0.18		
175	2021	1	0_15	DSB	5	0.23	0.62	0.65
175	2021	1	15_30	DSB	5	0.22		
175	2021	1	30_60	DSB	5	0.20		
176	2021	1	0_15	CF	5	0.23	0.57	0.61
176	2021	1	15_30	CF	5	0.19		
176	2021	1	30_60	CF	5	0.20		
177	2021	1	0_15	CF	3	0.23	0.57	0.63
177	2021	1	15_30	CF	3	0.21		
177	2021	1	30_60	CF	3	0.20		
178	2021	1	0_15	CF	1	0.22	0.56	0.57
178	2021	1	15_30	CF	1	0.19		
178	2021	1	30_60	CF	1	0.17		

179	2021	1	0_15	CF	4	0.21	0.54	0.60
179	2021	1	15_30	CF	4	0.21		
179	2021	1	30_60	CF	4	0.18		
180	2021	1	0_15	CF	2	0.22	0.53	0.60
180	2021	1	15_30	CF	2	0.21		
180	2021	1	30_60	CF	2	0.18		
181	2021	1	0_15	CR	5	0.22	0.59	0.59
181	2021	1	15_30	CR	5	0.19		
181	2021	1	30_60	CR	5	0.18		
182	2021	1	0_15	CR	4	0.22	0.55	0.58
182	2021	1	15_30	CR	4	0.19		
182	2021	1	30_60	CR	4	0.17		
183	2021	1	0_15	CR	1	0.23	0.57	0.57
183	2021	1	15_30	CR	1	0.19		
183	2021	1	30_60	CR	1	0.15		
184	2021	1	0_15	CR	3	0.21	0.56	0.57
184	2021	1	15_30	CR	3	0.19		
184	2021	1	30_60	CR	3	0.17		
185	2021	1	0_15	CR	2	0.24	0.56	0.62
185	2021	1	15_30	CR	2	0.21		
185	2021	1	30_60	CR	2	0.17		
186	2021	1	0_15	CC	1	0.21	0.59	0.58
186	2021	1	15_30	CC	1	0.21		
186	2021	1	30_60	CC	1	0.17		
187	2021	1	0_15	CC	5	0.21	0.59	0.60
187	2021	1	15_30	CC	5	0.21		
187	2021	1	30_60	CC	5	0.18		
188	2021	1	0_15	CC	3	0.21	0.54	0.59
188	2021	1	15_30	CC	3	0.22		
188	2021	1	30_60	CC	3	0.17		
189	2021	1	0_15	CC	4	0.24	0.54	0.64
189	2021	1	15_30	CC	4	0.21		
189	2021	1	30_60	CC	4	0.20		
190	2021	1	0_15	CC	2	0.22	0.52	0.59
190	2021	1	15_30	CC	2	0.19		
190	2021	1	30_60	CC	2	0.18		
201	2021	1	0_15	DSB	2	0.23	.	.
201	2021	2	15_30	DSB	2	0.18		
202	2021	2	0_15	DSB	5	0.24	0.64	0.61
202	2021	2	15_30	DSB	5	0.17		
202	2021	2	30_60	DSB	5	0.20		
203	2021	2	0_15	DSB	1	0.24	0.61	0.59
203	2021	2	15_30	DSB	1	0.17		

203	2021	2	30_60	DSB	1	0.18		
204	2021	2	0_15	DSB	3	0.24	0.61	0.62
204	2021	2	15_30	DSB	3	0.18		
204	2021	2	30_60	DSB	3	0.20		
205	2021	2	0_15	DSB	4	0.24	0.59	0.58
205	2021	2	15_30	DSB	4	0.18		
205	2021	2	30_60	DSB	4	0.17		
206	2021	2	0_15	CR	1	0.21	0.58	0.59
206	2021	2	15_30	CR	1	0.19		
206	2021	2	30_60	CR	1	0.18		
207	2021	2	0_15	CR	5	0.24	0.59	0.61
207	2021	2	15_30	CR	5	0.18		
207	2021	2	30_60	CR	5	0.18		
208	2021	2	0_15	CR	3	0.23	0.53	0.61
208	2021	2	15_30	CR	3	0.18		
208	2021	2	30_60	CR	3	0.20		
209	2021	2	0_15	CR	2	0.23	0.55	0.56
209	2021	2	15_30	CR	2	0.17		
209	2021	2	30_60	CR	2	0.17		
210	2021	2	0_15	CR	4	0.22	0.55	0.60
210	2021	2	15_30	CR	4	0.19		
210	2021	2	30_60	CR	4	0.18		
211	2021	2	0_15	CC	2	0.24	0.58	0.60
211	2021	2	15_30	CC	2	0.18		
211	2021	2	30_60	CC	2	0.18		
212	2021	2	0_15	CC	4	0.23	0.57	0.59
212	2021	2	15_30	CC	4	0.19		
212	2021	2	30_60	CC	4	0.17		
213	2021	2	0_15	CC	5	0.24	0.58	0.64
213	2021	2	15_30	CC	5	0.21		
213	2021	2	30_60	CC	5	0.20		
214	2021	2	0_15	CC	3	0.23	0.55	0.59
214	2021	2	15_30	CC	3	0.19		
214	2021	2	30_60	CC	3	0.17		
215	2021	2	0_15	CC	1	0.23	0.56	0.61
215	2021	2	15_30	CC	1	0.18		
215	2021	2	30_60	CC	1	0.20		
216	2021	2	0_15	R/C	1	0.24	0.58	0.64
216	2021	2	15_30	R/C	1	0.21		
216	2021	2	30_60	R/C	1	0.20		
217	2021	2	0_15	R/C	2	0.25	0.56	0.60
217	2021	2	15_30	R/C	2	0.19		
217	2021	2	30_60	R/C	2	0.15		

218	2021	2	0_15	R/C	4	0.24	0.55	0.64
218	2021	2	15_30	R/C	4	0.22		
218	2021	2	30_60	R/C	4	0.18		
219	2021	2	0_15	R/C	3	0.24	0.60	0.60
219	2021	2	15_30	R/C	3	0.18		
219	2021	2	30_60	R/C	3	0.18		
220	2021	2	0_15	R/C	5	0.24	0.60	0.57
220	2021	2	15_30	R/C	5	0.18		
220	2021	2	30_60	R/C	5	0.15		
221	2021	2	0_15	FTC	1	0.23	0.59	0.60
221	2021	2	15_30	FTC	1	0.19		
221	2021	2	30_60	FTC	1	0.18		
222	2021	2	0_15	FTC	2	0.22	0.61	0.59
222	2021	2	15_30	FTC	2	0.19		
222	2021	2	30_60	FTC	2	0.18		
223	2021	2	0_15	FTC	3	0.23	0.65	0.63
223	2021	2	15_30	FTC	3	0.18		
223	2021	2	30_60	FTC	3	0.22		
224	2021	2	0_15	FTC	5	0.24	0.65	0.60
224	2021	2	15_30	FTC	5	0.18		
224	2021	2	30_60	FTC	5	0.18		
225	2021	2	0_15	FTC	4	0.24	0.65	0.57
225	2021	2	15_30	FTC	4	0.18		
225	2021	2	30_60	FTC	4	0.15		
226	2021	2	0_15	CF	2	0.20	0.49	0.57
226	2021	2	15_30	CF	2	0.18		
226	2021	2	30_60	CF	2	0.18		
227	2021	2	0_15	CF	4	0.23	0.55	0.57
227	2021	2	15_30	CF	4	0.17		
227	2021	2	30_60	CF	4	0.17		
228	2021	2	0_15	CF	5	0.22	0.63	0.60
228	2021	2	15_30	CF	5	0.18		
228	2021	2	30_60	CF	5	0.20		
229	2021	2	0_15	CF	3	0.22	0.54	0.57
229	2021	2	15_30	CF	3	0.18		
229	2021	2	30_60	CF	3	0.17		
230	2021	2	0_15	CF	1	0.23	0.54	0.59
230	2021	2	15_30	CF	1	0.19		
230	2021	2	30_60	CF	1	0.17		
231	2022	2	0_15	CR	4	0.21	0.55	0.52
231	2022	2	15_30	CR	4	0.10		
231	2022	2	30_60	CR	4	0.20		
232	2022	2	0_15	CR	3	0.21	0.54	0.49

232	2022	2	15_30	CR	3	0.09		
232	2022	2	30_60	CR	3	0.20		
233	2022	2	0_15	CR	2	0.21	0.52	0.50
233	2022	2	15_30	CR	2	0.13		
233	2022	2	30_60	CR	2	0.17		
234	2022	2	0_15	CR	5	0.23	0.57	0.55
234	2022	2	15_30	CR	5	0.10		
234	2022	2	30_60	CR	5	0.22		
235	2022	2	0_15	CR	1	0.24	0.56	0.55
235	2022	2	15_30	CR	1	0.14		
235	2022	2	30_60	CR	1	0.17		
236	2022	2	0_15	R/C	3	0.21	0.54	0.57
236	2022	2	15_30	R/C	3	0.19		
236	2022	2	30_60	R/C	3	0.17		
237	2022	2	0_15	R/C	1	0.22	0.55	0.54
237	2022	2	15_30	R/C	1	0.14		
237	2022	2	30_60	R/C	1	0.17		
238	2022	2	0_15	R/C	2	0.24	0.55	0.55
238	2022	2	15_30	R/C	2	0.14		
238	2022	2	30_60	R/C	2	0.17		
239	2022	2	0_15	R/C	5	0.24	0.56	0.55
239	2022	2	15_30	R/C	5	0.14		
239	2022	2	30_60	R/C	5	0.17		
240	2022	2	0_15	R/C	4	0.24	0.54	0.57
240	2022	2	15_30	R/C	4	0.16		
240	2022	2	30_60	R/C	4	0.17		
241	2022	2	0_15	CC	3	0.21	0.54	0.53
241	2022	2	15_30	CC	3	0.13		
241	2022	2	30_60	CC	3	0.19		
242	2022	2	0_15	CC	1	0.22	0.55	0.52
242	2022	2	15_30	CC	1	0.13		
242	2022	2	30_60	CC	1	0.17		
243	2022	2	0_15	CC	2	0.22	0.57	0.57
243	2022	2	15_30	CC	2	0.17		
243	2022	2	30_60	CC	2	0.17		
244	2022	2	0_15	CC	4	0.22	0.54	0.52
244	2022	2	15_30	CC	4	0.13		
244	2022	2	30_60	CC	4	0.17		
245	2022	2	0_15	CC	5	0.21	0.55	0.51
245	2022	2	15_30	CC	5	0.14		
245	2022	2	30_60	CC	5	0.16		
246	2022	2	0_15	CF	3	0.21	0.51	0.54
246	2022	2	15_30	CF	3	0.14		

246	2022	2	30_60	CF	3	0.19		
247	2022	2	0_15	CF	1	0.23	0.56	0.55
247	2022	2	15_30	CF	1	0.14		
247	2022	2	30_60	CF	1	0.17		
248	2022	2	0_15	CF	4	0.21	0.55	0.51
248	2022	2	15_30	CF	4	0.13		
248	2022	2	30_60	CF	4	0.17		
249	2022	2	0_15	CF	5	0.23	0.54	0.54
249	2022	2	15_30	CF	5	0.13		
249	2022	2	30_60	CF	5	0.19		
250	2022	2	0_15	CF	2	0.21	0.51	0.52
250	2022	2	15_30	CF	2	0.14		
250	2022	2	30_60	CF	2	0.17		
251	2022	2	0_15	DSB	2	0.22	0.62	0.52
251	2022	2	15_30	DSB	2	0.13		
251	2022	2	30_60	DSB	2	0.17		
252	2022	2	0_15	DSB	1	0.23	0.61	0.55
252	2022	2	15_30	DSB	1	0.14		
252	2022	2	30_60	DSB	1	0.17		
253	2022	2	0_15	DSB	5	0.22	0.61	0.55
253	2022	2	15_30	DSB	5	0.16		
253	2022	2	30_60	DSB	5	0.17		
254	2022	2	0_15	DSB	3	0.21	0.60	0.54
254	2022	2	15_30	DSB	3	0.14		
254	2022	2	30_60	DSB	3	0.19		
255	2022	2	0_15	DSB	4	0.22	0.60	0.54
255	2022	2	15_30	DSB	4	0.14		
255	2022	2	30_60	DSB	4	0.17		
256	2022	2	0_15	FTC	4	0.21	0.60	0.53
256	2022	2	15_30	FTC	4	0.13		
256	2022	2	30_60	FTC	4	0.19		
257	2022	2	0_15	FTC	1	0.21	0.62	0.51
257	2022	2	15_30	FTC	1	0.13		
257	2022	2	30_60	FTC	1	0.17		
258	2022	2	0_15	FTC	5	0.23	0.63	0.63
258	2022	2	15_30	FTC	5	0.21		
258	2022	2	30_60	FTC	5	0.19		
259	2022	2	0_15	FTC	2	0.23	0.66	0.55
259	2022	2	15_30	FTC	2	0.14		
259	2022	2	30_60	FTC	2	0.17		
260	2022	2	0_15	FTC	3	0.24	0.62	0.52
260	2022	2	15_30	FTC	3	0.13		
260	2022	2	30_60	FTC	3	0.16		

261	2020	2	0_15	CC	3	0.21	0.51	0.47
261	2020	2	15_30	CC	3	0.14		
261	2020	2	30_60	CC	3	0.13		
262	2020	2	0_15	CC	2	0.23	0.51	0.53
262	2020	2	15_30	CC	2	0.16		
262	2020	2	30_60	CC	2	0.14		
263	2020	2	0_15	CC	5	0.22	0.56	0.52
263	2020	2	15_30	CC	5	0.16		
263	2020	2	30_60	CC	5	0.14		
264	2020	2	0_15	CC	4	0.23	0.52	0.52
264	2020	2	15_30	CC	4	0.16		
264	2020	2	30_60	CC	4	0.13		
265	2020	2	0_15	CC	1	0.24	0.50	0.54
265	2020	2	15_30	CC	1	0.16		
265	2020	2	30_60	CC	1	0.13		
266	2020	2	0_15	CF	5	0.19	0.51	0.46
266	2020	2	15_30	CF	5	0.15		
266	2020	2	30_60	CF	5	0.13		
267	2020	2	0_15	CF	4	0.20	0.52	0.48
267	2020	2	15_30	CF	4	0.14		
267	2020	2	30_60	CF	4	0.14		
268	2020	2	0_15	CF	3	0.19	0.55	0.47
268	2020	2	15_30	CF	3	0.15		
268	2020	2	30_60	CF	3	0.13		
269	2020	2	0_15	CF	2	0.20	0.48	0.48
269	2020	2	15_30	CF	2	0.14		
269	2020	2	30_60	CF	2	0.14		
270	2020	2	0_15	CF	1	0.19	0.51	0.46
270	2020	2	15_30	CF	1	0.15		
270	2020	2	30_60	CF	1	0.13		
271	2020	2	0_15	FTC	4	0.20	0.66	0.45
271	2020	2	15_30	FTC	4	0.12		
271	2020	2	30_60	FTC	4	0.13		
272	2020	2	0_15	FTC	3	0.20	0.64	0.45
272	2020	2	15_30	FTC	3	0.14		
272	2020	2	30_60	FTC	3	0.11		
273	2020	2	0_15	FTC	1	0.21	0.64	0.49
273	2020	2	15_30	FTC	1	0.15		
273	2020	2	30_60	FTC	1	0.13		
274	2020	2	0_15	FTC	5	0.23	0.66	0.53
274	2020	2	15_30	FTC	5	0.16		
274	2020	2	30_60	FTC	5	0.14		
275	2020	2	0_15	FTC	2	0.22	0.64	0.51

275	2020	2	15_30	FTC	2	0.15		
275	2020	2	30_60	FTC	2	0.14		
276	2020	2	0_15	CR	5	0.21	0.50	0.47
276	2020	2	15_30	CR	5	0.14		
276	2020	2	30_60	CR	5	0.13		
277	2020	2	0_15	CR	4	0.22	0.48	0.48
277	2020	2	15_30	CR	4	0.14		
277	2020	2	30_60	CR	4	0.13		
278	2020	2	0_15	CR	2	0.23	0.50	0.50
278	2020	2	15_30	CR	2	0.14		
278	2020	2	30_60	CR	2	0.13		
279	2020	2	0_15	CR	3	0.22	0.50	0.49
279	2020	2	15_30	CR	3	0.15		
279	2020	2	30_60	CR	3	0.13		
280	2020	2	0_15	CR	1	0.20	0.52	0.50
280	2020	2	15_30	CR	1	0.15		
280	2020	2	30_60	CR	1	0.14		
281	2020	2	0_15	DSB	3	0.22	#####	0.48
281	2020	2	15_30	DSB	3	0.14		
281	2020	2	30_60	DSB	3	0.13		
282	2020	2	0_15	DSB	5	0.20	#####	0.47
282	2020	2	15_30	DSB	5	0.15		
282	2020	2	30_60	DSB	5	0.13		
283	2020	2	0_15	DSB	1	0.21	#####	0.48
283	2020	2	15_30	DSB	1	0.15		
283	2020	2	30_60	DSB	1	0.13		
284	2020	2	0_15	DSB	4	0.20	#####	0.48
284	2020	2	15_30	DSB	4	0.15		
284	2020	2	30_60	DSB	4	0.13		
285	2020	2	0_15	DSB	2	0.23	#####	0.52
285	2020	2	15_30	DSB	2	0.16		
285	2020	2	30_60	DSB	2	0.13		
286	2020	2	0_15	R/C	2	0.20	0.52	0.48
286	2020	2	15_30	R/C	2	0.14		
286	2020	2	30_60	R/C	2	0.14		
287	2020	2	0_15	R/C	5	0.20	0.54	0.51
287	2020	2	15_30	R/C	5	0.16		
287	2020	2	30_60	R/C	5	0.14		
288	2020	2	0_15	R/C	3	0.20	0.54	0.50
288	2020	2	15_30	R/C	3	0.15		
288	2020	2	30_60	R/C	3	0.14		
289	2020	2	0_15	R/C	1	0.20	0.52	0.50
289	2020	2	15_30	R/C	1	0.15		

289	2020	2	30_60	R/C	1	0.14		
290	2020	2	0_15	R/C	4	0.22	0.53	0.50
290	2020	2	15_30	R/C	4	0.15		
290	2020	2	30_60	R/C	4	0.13		
301	2022	3	0_15	DSB	4	0.23	0.56	0.53
301	2022	3	15_30	DSB	4	0.12		
301	2022	3	30_60	DSB	4	0.17		
302	2022	3	0_15	DSB	3	0.24	0.62	0.55
302	2022	3	15_30	DSB	3	0.12		
302	2022	3	30_60	DSB	3	0.19		
303	2022	3	0_15	DSB	2	0.21	0.57	0.51
303	2022	3	15_30	DSB	2	0.12		
303	2022	3	30_60	DSB	2	0.17		
304	2022	3	0_15	DSB	5	0.25	0.62	0.55
304	2022	3	15_30	DSB	5	0.14		
304	2022	3	30_60	DSB	5	0.17		
305	2022	3	0_15	DSB	1	0.23	0.62	0.57
305	2022	3	15_30	DSB	1	0.16		
305	2022	3	30_60	DSB	1	0.17		
306	2022	3	0_15	FTC	1	0.25	0.66	0.56
306	2022	3	15_30	FTC	1	0.12		
306	2022	3	30_60	FTC	1	0.19		
307	2022	3	0_15	FTC	2	0.20	0.66	0.53
307	2022	3	15_30	FTC	2	0.14		
307	2022	3	30_60	FTC	2	0.19		
308	2022	3	0_15	FTC	5	0.21	0.69	0.59
308	2022	3	15_30	FTC	5	0.18		
308	2022	3	30_60	FTC	5	0.20		
309	2022	3	0_15	FTC	4	0.21	0.66	0.54
309	2022	3	15_30	FTC	4	0.14		
309	2022	3	30_60	FTC	4	0.19		
310	2022	3	0_15	FTC	3	0.21	0.64	0.58
310	2022	3	15_30	FTC	3	0.18		
310	2022	3	30_60	FTC	3	0.19		
311	2022	3	0_15	CC	5	0.21	0.56	0.56
311	2022	3	15_30	CC	5	0.16		
311	2022	3	30_60	CC	5	0.19		
312	2022	3	0_15	CC	1	0.21	0.54	0.58
312	2022	3	15_30	CC	1	0.16		
312	2022	3	30_60	CC	1	0.20		
313	2022	3	0_15	CC	4	0.21	0.57	0.58
313	2022	3	15_30	CC	4	0.16		
313	2022	3	30_60	CC	4	0.20		

314	2022	3	0_15	CC	3	0.22	0.58	0.60
314	2022	3	15_30	CC	3	0.18		
314	2022	3	30_60	CC	3	0.20		
315	2022	3	0_15	CC	2	0.22	0.56	0.57
315	2022	3	15_30	CC	2	0.16		
315	2022	3	30_60	CC	2	0.19		
316	2022	3	0_15	CR	2	0.21	0.56	0.57
316	2022	3	15_30	CR	2	0.18		
316	2022	3	30_60	CR	2	0.19		
317	2022	3	0_15	CR	1	0.19	0.56	0.56
317	2022	3	15_30	CR	1	0.16		
317	2022	3	30_60	CR	1	0.20		
318	2022	3	0_15	CR	5	0.22	0.57	0.57
318	2022	3	15_30	CR	5	0.16		
318	2022	3	30_60	CR	5	0.19		
319	2022	3	0_15	CR	4	0.22	0.62	0.60
319	2022	3	15_30	CR	4	0.18		
319	2022	3	30_60	CR	4	0.20		
320	2022	3	0_15	CR	3	0.21	0.58	0.56
320	2022	3	15_30	CR	3	0.18		
320	2022	3	30_60	CR	3	0.17		
321	2022	3	0_15	CF	2	0.20	0.51	0.52
321	2022	3	15_30	CF	2	0.15		
321	2022	3	30_60	CF	2	0.17		
322	2022	3	0_15	CF	5	0.18	0.54	0.50
322	2022	3	15_30	CF	5	0.15		
322	2022	3	30_60	CF	5	0.17		
323	2022	3	0_15	CF	3	0.20	0.55	0.51
323	2022	3	15_30	CF	3	0.15		
323	2022	3	30_60	CF	3	0.16		
324	2022	3	0_15	CF	4	0.20	0.59	0.54
324	2022	3	15_30	CF	4	0.16		
324	2022	3	30_60	CF	4	0.17		
325	2022	3	0_15	CF	1	0.22	0.56	0.54
325	2022	3	15_30	CF	1	0.15		
325	2022	3	30_60	CF	1	0.17		
326	2022	3	0_15	R/C	5	0.20	0.55	0.50
326	2022	3	15_30	R/C	5	0.14		
326	2022	3	30_60	R/C	5	0.16		
327	2022	3	0_15	R/C	1	0.23	0.52	0.52
327	2022	3	15_30	R/C	1	0.14		
327	2022	3	30_60	R/C	1	0.16		
328	2022	3	0_15	R/C	3	0.23	0.54	0.55

328	2022	3	15_30	R/C	3	0.15		
328	2022	3	30_60	R/C	3	0.17		
329	2022	3	0_15	R/C	4	0.21	0.53	0.54
329	2022	3	15_30	R/C	4	0.15		
329	2022	3	30_60	R/C	4	0.17		
330	2022	3	0_15	R/C	2	0.23	0.56	0.59
330	2022	3	15_30	R/C	2	0.19		
330	2022	3	30_60	R/C	2	0.17		
331	2020	3	0_15	CF	3	0.19	0.51	0.44
331	2020	3	15_30	CF	3	0.13		
331	2020	3	30_60	CF	3	0.12		
332	2020	3	0_15	CF	5	0.16	0.55	0.45
332	2020	3	15_30	CF	5	0.15		
332	2020	3	30_60	CF	5	0.14		
333	2020	3	0_15	CF	1	0.18	0.53	0.50
333	2020	3	15_30	CF	1	0.18		
333	2020	3	30_60	CF	1	0.14		
334	2020	3	0_15	CF	4	0.19	0.59	0.56
334	2020	3	15_30	CF	4	0.18		
334	2020	3	30_60	CF	4	0.18		
335	2020	3	0_15	CF	2	0.22	0.57	0.54
335	2020	3	15_30	CF	2	0.15		
335	2020	3	30_60	CF	2	0.17		
336	2020	3	0_15	CC	2	0.21	0.50	0.49
336	2020	3	15_30	CC	2	0.15		
336	2020	3	30_60	CC	2	0.12		
337	2020	3	0_15	CC	1	0.19	0.50	0.48
337	2020	3	15_30	CC	1	0.15		
337	2020	3	30_60	CC	1	0.14		
338	2020	3	0_15	CC	4	0.23	0.52	0.53
338	2020	3	15_30	CC	4	0.17		
338	2020	3	30_60	CC	4	0.14		
339	2020	3	0_15	CC	5	0.23	0.56	0.53
339	2020	3	15_30	CC	5	0.17		
339	2020	3	30_60	CC	5	0.14		
340	2020	3	0_15	CC	3	0.24	0.56	0.58
340	2020	3	15_30	CC	3	0.17		
340	2020	3	30_60	CC	3	0.17		
341	2020	3	0_15	FTC	4	0.21	0.63	0.51
341	2020	3	15_30	FTC	4	0.17		
341	2020	3	30_60	FTC	4	0.14		
342	2020	3	0_15	FTC	2	0.21	0.57	0.50
342	2020	3	15_30	FTC	2	0.15		

342	2020	3	30_60	FTC	2	0.14		
343	2020	3	0_15	FTC	1	0.22	0.54	0.51
343	2020	3	15_30	FTC	1	0.15		
343	2020	3	30_60	FTC	1	0.14		
344	2020	3	0_15	FTC	5	0.24	0.53	0.56
344	2020	3	15_30	FTC	5	0.17		
344	2020	3	30_60	FTC	5	0.15		
345	2020	3	0_15	FTC	3	0.23	0.51	0.56
345	2020	3	15_30	FTC	3	0.20		
345	2020	3	30_60	FTC	3	0.14		
346	2020	3	0_15	DSB	5	0.20	#####	0.47
346	2020	3	15_30	DSB	5	0.15		
346	2020	3	30_60	DSB	5	0.12		
347	2020	3	0_15	DSB	2	0.20	#####	0.50
347	2020	3	15_30	DSB	2	0.15		
347	2020	3	30_60	DSB	2	0.15		
348	2020	3	0_15	DSB	4	0.21	#####	0.48
348	2020	3	15_30	DSB	4	0.15		
348	2020	3	30_60	DSB	4	0.12		
349	2020	3	0_15	DSB	3	0.21	#####	0.54
349	2020	3	15_30	DSB	3	0.18		
349	2020	3	30_60	DSB	3	0.15		
350	2020	3	0_15	DSB	1	0.23	#####	0.49
350	2020	3	15_30	DSB	1	0.15		
350	2020	3	30_60	DSB	1	0.11		
351	2020	3	0_15	CR	5	0.21	0.50	0.50
351	2020	3	15_30	CR	5	0.18		
351	2020	3	30_60	CR	5	0.11		
352	2020	3	0_15	CR	4	0.23	0.49	0.51
352	2020	3	15_30	CR	4	0.15		
352	2020	3	30_60	CR	4	0.12		
353	2020	3	0_15	CR	2	0.21	0.50	0.49
353	2020	3	15_30	CR	2	0.14		
353	2020	3	30_60	CR	2	0.14		
354	2020	3	0_15	CR	1	0.23	0.52	0.56
354	2020	3	15_30	CR	1	0.18		
354	2020	3	30_60	CR	1	0.15		
355	2020	3	0_15	CR	3	0.21	0.53	0.54
355	2020	3	15_30	CR	3	0.17		
355	2020	3	30_60	CR	3	0.17		
356	2020	3	0_15	R/C	4	0.22	0.52	0.49
356	2020	3	15_30	R/C	4	0.15		
356	2020	3	30_60	R/C	4	0.12		

357	2020	3	0_15	R/C	3	0.18	0.50	0.46
357	2020	3	15_30	R/C	3	0.14		
357	2020	3	30_60	R/C	3	0.14		
358	2020	3	0_15	R/C	5	0.20	0.51	0.50
358	2020	3	15_30	R/C	5	0.14		
358	2020	3	30_60	R/C	5	0.17		
359	2020	3	0_15	R/C	2	0.19	0.53	0.47
359	2020	3	15_30	R/C	2	0.14		
359	2020	3	30_60	R/C	2	0.14		
360	2020	3	0_15	R/C	1	0.20	0.52	0.46
360	2020	3	15_30	R/C	1	0.13		
360	2020	3	30_60	R/C	1	0.14		
361	2021	3	0_15	CC	4	0.24	0.48	0.56
361	2021	3	15_30	CC	4	0.17		
361	2021	3	30_60	CC	4	0.15		
362	2021	3	0_15	CC	2	0.21	0.53	0.55
362	2021	3	15_30	CC	2	0.16		
362	2021	3	30_60	CC	2	0.18		
363	2021	3	0_15	CC	1	0.24	0.54	0.55
363	2021	3	15_30	CC	1	0.14		
363	2021	3	30_60	CC	1	0.17		
364	2021	3	0_15	CC	5	0.23	0.53	0.58
364	2021	3	15_30	CC	5	0.17		
364	2021	3	30_60	CC	5	0.18		
365	2021	3	0_15	CC	3	0.23	0.56	0.60
365	2021	3	15_30	CC	3	0.19		
365	2021	3	30_60	CC	3	0.18		
366	2021	3	0_15	DSB	3	0.21	0.63	0.55
366	2021	3	15_30	DSB	3	0.16		
366	2021	2	30_60	DSB	3	0.18		
367	2021	3	0_15	DSB	4	0.23	0.63	0.58
367	2021	3	15_30	DSB	4	0.19		
367	2021	3	30_60	DSB	4	0.17		
368	2021	3	0_15	DSB	2	0.24	0.65	0.60
368	2021	3	15_30	DSB	2	0.17		
368	2021	3	30_60	DSB	2	0.18		
369	2021	3	0_15	DSB	5	0.23	0.62	0.56
369	2021	3	15_30	DSB	5	0.17		
369	2021	3	30_60	DSB	5	0.15		
370	2021	3	0_15	DSB	1	0.25	0.62	0.62
370	2021	3	15_30	DSB	1	0.17		
370	2021	3	30_60	DSB	1	0.20		
371	2021	3	0_15	R/C	5	0.23	0.50	0.59

371	2021	3	15_30	R/C	5	0.17		
371	2021	3	30_60	R/C	5	0.18		
372	2021	3	0_15	R/C	4	0.24	0.51	0.59
372	2021	3	15_30	R/C	4	0.16		
372	2021	3	30_60	R/C	4	0.18		
373	2021	3	0_15	R/C	3	0.20	0.54	0.54
373	2021	3	15_30	R/C	3	0.17		
373	2021	3	30_60	R/C	3	0.17		
374	2021	3	0_15	R/C	2	0.23	0.55	0.55
374	2021	3	15_30	R/C	2	0.16		
374	2021	3	30_60	R/C	2	0.17		
375	2021	3	0_15	R/C	1	0.22	0.53	0.56
375	2021	3	15_30	R/C	1	0.19		
375	2021	3	30_60	R/C	1	0.15		
376	2021	3	0_15	CR	1	0.22	0.51	0.56
376	2021	3	15_30	CR	1	0.17		
376	2021	3	30_60	CR	1	0.17		
377	2021	3	0_15	CR	2	0.23	0.53	0.58
377	2021	3	15_30	CR	2	0.19		
377	2021	3	30_60	CR	2	0.17		
378	2021	3	0_15	CR	3	0.25	0.52	0.53
378	2021	3	15_30	CR	3	0.14		
378	2021	3	30_60	CR	3	0.14		
379	2021	3	0_15	CR	5	0.22	0.50	0.53
379	2021	3	15_30	CR	5	0.16		
379	2021	3	30_60	CR	5	0.15		
380	2021	3	0_15	CR	4	0.22	0.52	0.56
380	2021	3	15_30	CR	4	0.19		
380	2021	3	30_60	CR	4	0.15		
381	2021	3	0_15	FTC	1	0.22	0.61	0.55
381	2021	3	15_30	FTC	1	0.16		
381	2021	3	30_60	FTC	1	0.17		
382	2021	3	0_15	FTC	3	0.21	0.59	0.52
382	2021	3	15_30	FTC	3	0.14		
382	2021	3	30_60	FTC	3	0.17		
383	2021	3	0_15	FTC	4	0.22	0.60	0.56
383	2021	3	15_30	FTC	4	0.16		
383	2021	3	30_60	FTC	4	0.18		
384	2021	3	0_15	FTC	5	0.23	0.62	0.55
384	2021	3	15_30	FTC	5	0.17		
384	2021	3	30_60	FTC	5	0.15		
385	2021	3	0_15	FTC	2	0.22	0.65	0.59
385	2021	3	15_30	FTC	2	0.19		

385	2021	3	30_60	FTC	2	0.18		
386	2021	3	0_15	CF	4	0.23	0.48	0.54
386	2021	3	15_30	CF	4	0.14		
386	2021	3	30_60	CF	4	0.17		
387	2021	3	0_15	CF	5	0.21	0.50	0.53
387	2021	3	15_30	CF	5	0.17		
387	2021	3	30_60	CF	5	0.15		
388	2021	3	0_15	CF	1	0.23	0.51	0.57
388	2021	3	15_30	CF	1	0.17		
388	2021	3	30_60	CF	1	0.17		
389	2021	3	0_15	CF	3	0.21	0.48	0.53
389	2021	3	15_30	CF	3	0.17		
389	2021	3	30_60	CF	3	0.15		
390	2021	3	0_15	CF	2	0.20	0.50	0.54
390	2021	3	15_30	CF	2	0.16		
390	2021	3	30_60	CF	2	0.18		
401	2021	4	0_15	CR	3	0.24	0.49	0.61
401	2021	4	15_30	CR	3	0.19		
401	2021	4	30_60	CR	3	0.18		
402	2021	4	0_15	CR	2	0.21	0.50	0.54
402	2021	4	15_30	CR	2	0.16		
402	2021	4	30_60	CR	2	0.17		
403	2021	4	0_15	CR	5	0.23	0.49	0.55
403	2021	4	15_30	CR	5	0.14		
403	2021	4	30_60	CR	5	0.17		
404	2021	4	0_15	CR	4	0.23	0.52	0.56
404	2021	4	15_30	CR	4	0.16		
404	2021	4	30_60	CR	4	0.17		
405	2021	4	0_15	CR	1	0.24	0.53	0.61
405	2021	4	15_30	CR	1	0.20		
405	2021	4	30_60	CR	1	0.17		
406	2021	4	0_15	CF	4	0.20	0.50	0.52
406	2021	4	15_30	CF	4	0.16		
406	2021	4	30_60	CF	4	0.15		
407	2021	4	0_15	CF	5	0.21	0.48	0.58
407	2021	4	15_30	CF	5	0.20		
407	2021	4	30_60	CF	5	0.17		
408	2021	4	0_15	CF	1	0.22	0.50	0.57
408	2021	4	15_30	CF	1	0.19		
408	2021	4	30_60	CF	1	0.17		
409	2021	4	0_15	CF	3	0.23	0.51	0.60
409	2021	4	15_30	CF	3	0.20		
409	2021	4	30_60	CF	3	0.17		

410	2021	4	0_15	CF	2	0.22	0.50	0.54
410	2021	4	15_30	CF	2	0.17		
410	2021	4	30_60	CF	2	0.15		
411	2021	4	0_15	DSB	2	0.19	0.60	0.52
411	2021	4	15_30	DSB	2	0.17		
411	2021	3	30_60	DSB	2	0.15		
412	2021	4	0_15	DSB	1	0.22	0.61	0.58
412	2021	4	15_30	DSB	1	0.19		
412	2021	4	30_60	DSB	1	0.17		
413	2021	4	0_15	DSB	4	0.21	0.61	0.60
413	2021	4	15_30	DSB	4	0.21		
413	2021	4	30_60	DSB	4	0.17		
414	2021	4	0_15	DSB	3	0.22	0.61	0.59
414	2021	4	15_30	DSB	3	0.20		
414	2021	4	30_60	DSB	3	0.17		
415	2021	4	0_15	DSB	5	0.22	0.63	0.60
415	2021	4	15_30	DSB	5	0.21		
415	2021	4	30_60	DSB	5	0.17		
416	2021	4	0_15	FTC	1	0.23	0.64	0.63
416	2021	4	15_30	FTC	1	0.24		
416	2021	4	30_60	FTC	1	0.15		
417	2021	4	0_15	FTC	2	0.23	0.61	0.64
417	2021	4	15_30	FTC	2	0.26		
417	2021	4	30_60	FTC	2	0.15		
418	2021	4	0_15	FTC	4	0.23	0.61	0.64
418	2021	4	15_30	FTC	4	0.26		
418	2021	4	30_60	FTC	4	0.15		
419	2021	4	0_15	FTC	5	0.24	0.64	0.74
419	2021	4	15_30	FTC	5	0.31		
419	2021	4	30_60	FTC	5	0.18		
420	2021	4	0_15	FTC	3	0.24	0.63	0.74
420	2021	4	15_30	FTC	3	0.33		
420	2021	4	30_60	FTC	3	0.17		
421	2021	4	0_15	CC	1	0.23	0.50	0.76
421	2021	4	15_30	CC	1	0.36		
421	2021	4	30_60	CC	1	0.17		
422	2021	4	0_15	CC	2	0.22	0.50	0.74
422	2021	4	15_30	CC	2	0.39		
422	2021	4	30_60	CC	2	0.14		
423	2021	4	0_15	CC	5	0.22	0.49	0.81
423	2021	4	15_30	CC	5	0.43		
423	2021	4	30_60	CC	5	0.15		
424	2021	4	0_15	CC	3	0.24	0.59	0.96

424	2021	4	15_30	CC	3	0.53		
424	2021	4	30_60	CC	3	0.18		
425	2021	4	0_15	CC	4	0.24	0.53	0.59
425	2021	4	15_30	CC	4	0.21		
425	2021	4	30_60	CC	4	0.14		
426	2021	4	0_15	R/C	4	0.24	0.49	0.65
426	2021	4	15_30	R/C	4	0.24		
426	2021	4	30_60	R/C	4	0.17		
427	2021	4	0_15	R/C	5	0.21	0.50	0.55
427	2021	4	15_30	R/C	5	0.19		
427	2021	4	30_60	R/C	5	0.15		
428	2021	4	0_15	R/C	2	0.23	0.51	0.57
428	2021	4	15_30	R/C	2	0.17		
428	2021	4	30_60	R/C	2	0.17		
429	2021	4	0_15	R/C	1	0.24	0.56	0.60
429	2021	4	15_30	R/C	1	0.20		
429	2021	4	30_60	R/C	1	0.15		
430	2021	4	0_15	R/C	3	0.24	0.54	0.62
430	2021	4	15_30	R/C	3	0.24		
430	2021	4	30_60	R/C	3	0.14		
431	2022	4	0_15	CC	1	0.23	0.53	0.59
431	2022	4	15_30	CC	1	0.21		
431	2022	4	30_60	CC	1	0.16		
432	2022	4	0_15	CC	5	0.22	0.51	0.51
432	2022	4	15_30	CC	5	0.13		
432	2022	4	30_60	CC	5	0.16		
433	2022	4	0_15	CC	2	0.22	0.53	0.51
433	2022	4	15_30	CC	2	0.15		
433	2022	4	30_60	CC	2	0.14		
434	2022	4	0_15	CC	4	0.24	0.59	0.52
434	2022	4	15_30	CC	4	0.15		
434	2022	4	30_60	CC	4	0.14		
435	2022	4	0_15	CC	3	0.25	0.55	0.55
435	2022	4	15_30	CC	3	0.16		
435	2022	4	30_60	CC	3	0.14		
436	2022	4	0_15	FTC	4	0.20	0.59	0.49
436	2022	4	15_30	FTC	4	0.15		
436	2022	4	30_60	FTC	4	0.14		
437	2022	4	0_15	FTC	3	0.20	0.62	0.49
437	2022	4	15_30	FTC	3	0.13		
437	2022	4	30_60	FTC	3	0.16		
438	2022	4	0_15	FTC	1	0.21	0.59	0.51
438	2022	4	15_30	FTC	1	0.15		

438	2022	4	30_60	FTC	1	0.16		
439	2022	4	0_15	FTC	2	0.20	0.65	0.51
439	2022	4	15_30	FTC	2	0.16		
439	2022	4	30_60	FTC	2	0.14		
440	2022	4	0_15	FTC	5	0.21	0.65	0.54
440	2022	4	15_30	FTC	5	0.18		
440	2022	4	30_60	FTC	5	0.16		
441	2022	4	0_15	R/C	4	0.20	0.51	0.51
441	2022	4	15_30	R/C	4	0.15		
441	2022	4	30_60	R/C	4	0.16		
442	2022	4	0_15	R/C	3	0.21	0.55	0.57
442	2022	4	15_30	R/C	3	0.21		
442	2022	4	30_60	R/C	3	0.16		
443	2022	4	0_15	R/C	5	0.23	0.52	0.60
443	2022	4	15_30	R/C	5	0.21		
443	2022	4	30_60	R/C	5	0.17		
444	2022	4	0_15	R/C	1	0.21	0.54	0.56
444	2022	4	15_30	R/C	1	0.19		
444	2022	4	30_60	R/C	1	0.16		
445	2022	4	0_15	R/C	2	0.21	0.52	0.52
445	2022	4	15_30	R/C	2	0.18		
445	2022	4	30_60	R/C	2	0.14		
446	2022	4	0_15	CR	2	0.19	0.47	0.49
446	2022	4	15_30	CR	2	0.16		
446	2022	4	30_60	CR	2	0.14		
447	2022	4	0_15	CR	4	0.22	0.52	0.50
447	2022	4	15_30	CR	4	0.15		
447	2022	4	30_60	CR	4	0.14		
448	2022	4	0_15	CR	3	0.20	0.52	0.52
448	2022	4	15_30	CR	3	0.16		
448	2022	4	30_60	CR	3	0.16		
449	2022	4	0_15	CR	5	0.21	0.54	0.53
449	2022	4	15_30	CR	5	0.16		
449	2022	4	30_60	CR	5	0.16		
450	2022	4	0_15	CR	1	0.21	0.56	0.51
450	2022	4	15_30	CR	1	0.15		
450	2022	4	30_60	CR	1	0.16		
451	2022	4	0_15	CF	2	0.21	0.48	0.45
451	2022	4	15_30	CF	2	0.12		
451	2022	4	30_60	CF	2	0.12		
452	2022	4	0_15	CF	3	0.22	0.49	0.53
452	2022	4	15_30	CF	3	0.16		
452	2022	4	30_60	CF	3	0.16		

453	2022	4	0_15	CF	5	0.20	0.51	0.52
453	2022	4	15_30	CF	5	0.16		
453	2022	4	30_60	CF	5	0.16		
454	2022	4	0_15	CF	1	0.22	0.48	0.52
454	2022	4	15_30	CF	1	0.15		
454	2022	4	30_60	CF	1	0.16		
455	2022	4	0_15	CF	4	0.22	0.52	0.57
455	2022	4	15_30	CF	4	0.18		
455	2022	4	30_60	CF	4	0.17		
456	2022	4	0_15	DSB	2	0.23	0.59	0.56
456	2022	4	15_30	DSB	2	0.16		
456	2022	4	30_60	DSB	2	0.17		
457	2022	4	0_15	DSB	5	0.23	0.59	0.56
457	2022	4	15_30	DSB	5	0.16		
457	2022	4	30_60	DSB	5	0.17		
458	2022	4	0_15	DSB	1	0.21	0.56	0.51
458	2022	4	15_30	DSB	1	0.15		
458	2022	4	30_60	DSB	1	0.16		
459	2022	4	0_15	DSB	4	0.24	0.65	0.55
459	2022	4	15_30	DSB	4	0.16		
459	2022	4	30_60	DSB	4	0.16		
460	2022	4	0_15	DSB	3	0.24	0.64	0.58
460	2022	4	15_30	DSB	3	0.18		
460	2022	4	30_60	DSB	3	0.16		
461	2020	4	0_15	CC	4	0.19	0.52	0.45
461	2020	4	15_30	CC	4	0.14		
461	2020	4	30_60	CC	4	0.12		
462	2020	4	0_15	CC	5	0.19	0.50	0.46
462	2020	4	15_30	CC	5	0.12		
462	2020	4	30_60	CC	5	0.14		
463	2020	4	0_15	CC	2	0.19	0.50	0.49
463	2020	4	15_30	CC	2	0.16		
463	2020	4	30_60	CC	2	0.14		
464	2020	4	0_15	CC	3	0.18	0.54	0.44
464	2020	4	15_30	CC	3	0.12		
464	2020	4	30_60	CC	3	0.14		
465	2020	4	0_15	CC	1	0.24	0.55	0.54
465	2020	4	15_30	CC	1	0.16		
465	2020	4	30_60	CC	1	0.14		
466	2020	4	0_15	DSB	4	0.22	#####	0.52
466	2020	4	15_30	DSB	4	0.14		
466	2020	4	30_60	DSB	4	0.17		
467	2020	4	0_15	DSB	2	0.21	#####	0.45

467	2020	4	15_30	DSB	2	0.12		
467	2020	4	30_60	DSB	2	0.12		
468	2020	4	0_15	DSB	1	0.20	#####	0.46
468	2020	4	15_30	DSB	1	0.12		
468	2020	4	30_60	DSB	1	0.14		
469	2020	4	0_15	DSB	5	0.19	#####	0.48
469	2020	4	15_30	DSB	5	0.14		
469	2020	4	30_60	DSB	5	0.15		
470	2020	4	0_15	DSB	3	0.19	#####	0.50
470	2020	4	15_30	DSB	3	0.15		
470	2020	4	30_60	DSB	3	0.15		
471	2020	4	0_15	CF	5	0.19	0.50	0.44
471	2020	4	15_30	CF	5	0.12		
471	2020	4	30_60	CF	5	0.12		
472	2020	4	0_15	CF	3	0.18	0.49	0.41
472	2020	4	15_30	CF	3	0.12		
472	2020	4	30_60	CF	3	0.11		
473	2020	4	0_15	CF	1	0.21	0.50	0.47
473	2020	4	15_30	CF	1	0.14		
473	2020	4	30_60	CF	1	0.12		
474	2020	4	0_15	CF	4	0.19	0.50	0.49
474	2020	4	15_30	CF	4	0.12		
474	2020	4	30_60	CF	4	0.17		
475	2020	4	0_15	CF	2	0.20	0.51	0.48
475	2020	4	15_30	CF	2	0.14		
475	2020	4	30_60	CF	2	0.14		
476	2020	4	0_15	FTC	4	0.20	0.59	0.45
476	2020	4	15_30	FTC	4	0.12		
476	2020	4	30_60	FTC	4	0.12		
477	2020	4	0_15	FTC	5	0.20	0.59	0.47
477	2020	4	15_30	FTC	5	0.12		
477	2020	4	30_60	FTC	5	0.14		
478	2020	4	0_15	FTC	1	0.20	0.62	0.48
478	2020	4	15_30	FTC	1	0.14		
478	2020	4	30_60	FTC	1	0.14		
479	2020	4	0_15	FTC	3	0.21	0.71	0.55
479	2020	4	15_30	FTC	3	0.14		
480	2020	4	0_15	FTC	2	0.20	0.65	0.46
480	2020	4	15_30	FTC	2	0.14		
480	2020	4	30_60	FTC	2	0.12		
481	2020	4	0_15	R/C	4	0.20	0.50	0.45
481	2020	4	15_30	R/C	4	0.11		
481	2020	4	30_60	R/C	4	0.14		

482	2020	4	0_15	R/C	5	0.19	0.51	0.44
482	2020	4	15_30	R/C	5	0.14		
482	2020	4	30_60	R/C	5	0.11		
483	2020	4	0_15	R/C	2	0.19	0.51	0.41
483	2020	4	15_30	R/C	2	0.11		
483	2020	4	30_60	R/C	2	0.11		
484	2020	4	0_15	R/C	3	0.18	0.53	0.44
484	2020	4	15_30	R/C	3	0.12		
484	2020	4	30_60	R/C	3	0.14		
485	2020	4	0_15	R/C	1	0.24	0.55	0.54
485	2020	4	15_30	R/C	1	0.15		
485	2020	4	30_60	R/C	1	0.15		
486	2020	4	0_15	CR	4	0.21	0.51	0.46
486	2020	4	15_30	CR	4	0.11		
486	2020	4	30_60	CR	4	0.14		
487	2020	4	0_15	CR	2	0.18	0.52	0.44
487	2020	4	15_30	CR	2	0.15		
487	2020	4	30_60	CR	2	0.11		
488	2020	4	0_15	CR	1	0.19	0.51	0.48
488	2020	4	15_30	CR	1	0.14		
488	2020	4	30_60	CR	1	0.15		
489	2020	4	0_15	CR	3	0.21	0.52	0.50
489	2020	4	15_30	CR	3	0.14		
489	2020	4	30_60	CR	3	0.15		
490	2020	4	0_15	CR	5	0.20	0.55	0.49
490	2020	4	15_30	CR	5	0.16		
490	2020	4	30_60	CR	5	0.12		

Soil Nitrogen Balance

	Cover	N	Δ soil N	Cover Crop Biomass N kgha	grain N removed	N losses	N inputs kgha	N outputs kgha	N Balance kgha
101	FTC	4	-8.7	11.8	182.1	3.6	191.8	185.7	14.8
102	FTC	2	51.4	13.2	106.9	0.9	58.2	107.8	-101.0
103	FTC	5	-45.9	15.5	179.1	5.4	285.5	184.5	146.9
104	FTC	1	-3.7	19.7	46.7	0.0	19.7	46.7	-23.3
105	FTC	3	-13.6	22.5	129.4	1.8	112.5	131.2	-5.2
106	CF	3	39.6	1.2	183.0	1.8	91.2	184.8	-133.2
107	CF	2	10.3	3.8	160.4	0.9	48.8	161.3	-122.8
108	CF	4	25.0	0.8	180.7	3.6	180.8	184.3	-28.5

109	CF	1	42.1	5.2	142.9	0.0	5.2	142.9	-179.9
110	CF	5	49.8	15.4	183.9	5.4	285.4	189.3	46.3
111	DSB	3	-4.8	0.0	146.5	1.8	90.0	148.3	-53.5
112	DSB	4	-87.9	0.0	168.9	3.6	180.0	172.5	95.3
113	DSB	5	-88.3	0.0	158.6	5.4	270.0	164.0	194.3
114	DSB	2	-55.8	0.0	133.2	0.9	45.0	134.1	-33.3
115	DSB	1	-45.9	0.0	88.9	0.0	0.0	88.9	-43.0
116	R/C	5	7.3	22.6	163.1	5.4	292.6	168.5	116.8
117	R/C	4	-3.3	17.5	162.7	3.6	197.5	166.3	34.5
118	R/C	3	48.0	13.7	123.5	1.8	103.7	125.3	-69.6
119	R/C	2	6.3	16.9	66.3	0.9	61.9	67.2	-11.5
120	R/C	1	-19.8	14.0	31.7	0.0	14.0	31.7	2.1
121	CC	3	-6.2	8.1	155.8	1.8	98.1	157.6	-53.3
122	CC	2	25.6	4.9	125.8	0.9	49.9	126.7	-102.4
123	CC	1	1.7	17.1	103.4	0.0	17.1	103.4	-88.1
124	CC	5	-10.4	11.1	167.0	5.4	281.1	172.4	119.1
125	CC	4	-0.6	19.7	168.0	3.6	199.7	171.6	28.7
126	CR	4	-9.0	21.3	161.3	3.6	201.3	164.9	45.5
127	CR	1	-5.5	19.3	42.4	0.0	19.3	42.4	-17.6
128	CR	2	12.7	23.7	50.0	0.9	68.7	50.9	5.1
129	CR	3	-14.2	14.2	88.8	1.8	104.2	90.6	27.9
130	CR	5	11.5	12.4	146.3	5.4	282.4	151.7	119.2
131	FTC	1	-	8.0	50.1	0.0	8.0	50.1	91.1
132	FTC	3	-	11.4	115.6	1.8	101.4	117.4	131.6
133	FTC	2	-	22.4	57.0	0.9	67.4	57.9	134.5
134	FTC	4	-	10.6	146.1	3.6	190.6	149.7	152.3
135	FTC	5	-	13.8	150.1	5.4	283.8	155.5	239.7
136	CC	3	-36.4	21.6	149.2	1.8	111.6	151.0	-3.1
137	CC	2	-20.3	41.8	107.6	0.9	86.8	108.5	-1.4
138	CC	4	-36.5	45.4	159.0	3.6	225.4	162.6	99.3
139	CC	1	-27.9	33.8	65.0	0.0	33.8	65.0	-3.3
140	CC	5	-52.0	56.7	151.3	5.4	326.7	156.7	221.9
141	CF	5	-37.2	0.0	184.5	5.4	270.0	189.9	117.3
142	CF	3	-54.5	0.0	188.9	1.8	90.0	190.7	-46.2
143	CF	4	-23.1	0.0	176.6	3.6	180.0	180.2	22.9
144	CF	2	-25.3	0.0	118.1	0.9	45.0	119.0	-48.7
145	CF	1	-37.9	0.0	91.8	0.0	0.0	91.8	-53.8
151	R/C	5	-45.7	25.3	157.0	5.4	295.3	162.4	178.6
152	R/C	2	-46.8	22.3	63.5	0.9	67.3	64.4	49.6

153	R/C	4	-77.5	18.9	157.6	3.6	198.9	161.2	115.2
154	R/C	1	-36.6	26.8	34.9	0.0	26.8	34.9	28.5
155	R/C	3	-29.4	27.1	95.4	1.8	117.1	97.2	49.3
156	CR	5	-19.2	31.3	191.2	5.4	301.3	196.6	123.9
157	CR	2	-29.6	27.2	59.2	0.9	72.2	60.1	41.7
158	CR	4	-18.8	26.7	157.9	3.6	206.7	161.5	64.0
159	CR	3	-60.1	30.2	85.3	1.8	120.2	87.1	93.1
160	CR	1	-63.1	26.8	28.4	0.0	26.8	28.4	61.5
161	R/C	4	37.2	32.7	119.1	3.6	212.7	122.7	52.7
162	R/C	1	67.0	33.0	49.8	0.0	33.0	49.8	-83.9
163	R/C	3	34.4	50.0	80.0	1.8	140.0	81.8	23.7
164	R/C	5	40.6	45.5	116.0	5.4	315.5	121.4	153.5
165	R/C	2	25.6	31.1	60.9	0.9	76.1	61.8	-11.3
166	FTC	5	-45.2	25.0	148.7	5.4	295.0	154.1	186.2
167	FTC	3	-27.2	22.3	125.8	1.8	112.3	127.6	12.0
168	FTC	4	36.2	23.9	150.7	3.6	203.9	154.3	13.4
169	FTC	2	25.5	21.0	77.3	0.9	66.0	78.2	-37.7
170	FTC	1	-10.6	27.4	43.8	0.0	27.4	43.8	-5.8
171	DSB	4	56.1	0.0	192.7	3.6	180.0	196.3	-72.5
172	DSB	2	-4.6	0.0	161.1	0.9	45.0	162.0	-112.4
173	DSB	3	13.7	0.0	169.4	1.8	90.0	171.2	-94.8
174	DSB	1	-19.6	0.0	93.5	0.0	0.0	93.5	-73.8
175	DSB	5	28.8	0.0	162.6	5.4	270.0	168.0	73.2
176	CF	5	44.4	0.0	174.9	5.4	270.0	180.3	45.3
177	CF	3	54.3	0.0	159.3	1.8	90.0	161.1	-125.4
178	CF	1	15.1	0.0	101.1	0.0	0.0	101.1	-116.2
179	CF	4	60.4	0.0	194.4	3.6	180.0	198.0	-78.4
180	CF	2	73.0	0.0	109.2	0.9	45.0	110.1	-138.1
181	CR	5	7.7	26.3	113.4	5.4	296.3	118.8	169.8
182	CR	4	26.1	36.7	121.6	3.6	216.7	125.2	65.4
183	CR	1	3.4	23.1	24.9	0.0	23.1	24.9	-5.2
184	CR	3	14.1	25.4	71.7	1.8	115.4	73.5	27.8
185	CR	2	53.1	22.8	30.0	0.9	67.8	30.9	-16.2
186	CC	1	-8.5	34.4	89.4	0.0	34.4	89.4	-46.5
187	CC	5	5.6	16.9	172.4	5.4	286.9	177.8	103.4
188	CC	3	50.9	12.9	160.7	1.8	102.9	162.5	-110.5
189	CC	4	95.2	26.9	158.2	3.6	206.9	161.8	-50.0
190	CC	2	74.0	46.2	107.5	0.9	91.2	108.4	-91.2
202	DSB	5	-32.4	0.0	178.5	5.4	270.0	183.9	118.5
203	DSB	1	-24.9	0.0	94.9	0.0	0.0	94.9	-70.1
204	DSB	3	10.6	0.0	150.5	1.8	90.0	152.3	-72.9
205	DSB	4	-9.3	0.0	141.2	3.6	180.0	144.8	44.5
206	CR	1	6.0	45.9	8.5	0.0	45.9	8.5	31.4

207	CR	5	21.3	45.9	116.0	5.4	315.9	121.4	173.2
208	CR	3	75.5	35.2	82.1	1.8	125.2	83.9	-34.1
209	CR	2	8.8	37.7	36.0	0.9	82.7	36.9	37.0
210	CR	4	46.2	45.3	125.1	3.6	225.3	128.7	50.4
211	CC	2	26.5	30.3	121.6	0.9	75.3	122.5	-73.8
212	CC	4	23.8	39.2	169.8	3.6	219.2	173.4	22.1
213	CC	5	65.7	40.8	152.1	5.4	310.8	157.5	87.6
214	CC	3	39.2	44.0	147.2	1.8	134.0	149.0	-54.2
215	CC	1	53.2	44.6	66.0	0.0	44.6	66.0	-74.6
216	R/C	1	65.2	38.5	10.6	0.0	38.5	10.6	-37.4
217	R/C	2	32.0	37.2	67.5	0.9	82.2	68.4	-18.3
218	R/C	4	89.5	33.2	110.8	3.6	213.2	114.4	9.2
219	R/C	3	2.3	38.2	93.2	1.8	128.2	95.0	30.8
220	R/C	5	-23.8	58.2	130.1	5.4	328.2	135.5	216.5
221	FTC	1	9.0	26.5	32.1	0.0	26.5	32.1	-14.7
222	FTC	2	-12.0	40.9	75.3	0.9	85.9	76.2	21.7
223	FTC	3	-25.8	31.0	100.5	1.8	121.0	102.3	44.5
224	FTC	5	-47.5	33.6	159.3	5.4	303.6	164.7	186.4
225	FTC	4	-76.4	31.6	113.7	3.6	211.6	117.3	170.8
226	CF	2	79.4	0.0	121.1	0.9	45.0	122.0	-156.4
227	CF	4	20.3	0.0	178.2	3.6	180.0	181.8	-22.1
228	CF	5	-26.4	0.0	168.9	5.4	270.0	174.3	122.0
229	CF	3	32.2	0.0	156.3	1.8	90.0	158.1	-100.4
230	CF	1	51.7	0.0	91.5	0.0	0.0	91.5	-143.3
231	CR	4	-34.6	14.3	154.6	3.6	194.3	158.2	70.6
232	CR	3	-45.4	10.4	127.9	1.8	100.4	129.7	16.1
233	CR	2	-19.8	10.3	94.0	0.9	55.3	94.9	-19.8
234	CR	5	-21.9	11.6	168.2	5.4	281.6	173.6	129.9
235	CR	1	-8.1	12.2	25.6	0.0	12.2	25.6	-5.4
236	R/C	3	29.4	14.7	126.7	1.8	104.7	128.5	-53.2
237	R/C	1	-9.6	17.4	34.3	0.0	17.4	34.3	-7.2
238	R/C	2	2.2	11.9	75.5	0.9	56.9	76.4	-21.7
239	R/C	5	-9.9	17.4	161.0	5.4	287.4	166.4	131.0
240	R/C	4	21.8	10.9	175.7	3.6	190.9	179.3	-10.1
241	CC	3	-7.4	14.2	158.9	1.8	104.2	160.7	-49.1
242	CC	1	-26.0	11.5	119.5	0.0	11.5	119.5	-81.9
243	CC	2	-2.1	11.7	171.3	0.9	56.7	172.2	-113.4
244	CC	4	-23.9	17.2	192.6	3.6	197.2	196.2	24.9
245	CC	5	-37.1	11.5	176.9	5.4	281.5	182.3	136.3
246	CF	3	28.0	2.4	165.3	1.8	92.4	167.1	-102.7
247	CF	1	-14.1	1.2	127.4	0.0	1.2	127.4	-112.1
248	CF	4	-38.7	2.0	197.2	3.6	182.0	200.8	19.9
249	CF	5	4.4	2.0	161.3	5.4	272.0	166.7	100.9

250	CF	2	9.5	1.3	183.0	0.9	46.3	183.9	-147.1
251	DSB	2	-96.0	0.0	110.4	0.9	45.0	111.3	29.8
252	DSB	1	-60.7	0.0	82.1	0.0	0.0	82.1	-21.4
253	DSB	5	-55.6	0.0	164.9	5.4	270.0	170.3	155.3
254	DSB	3	-60.4	0.0	163.3	1.8	90.0	165.1	-14.7
255	DSB	4	-66.8	0.0	169.1	3.6	180.0	172.7	74.1
256	FTC	4	-75.4	14.8	161.1	3.6	194.8	164.7	105.5
257	FTC	1	-	109.7	10.6	58.6	0.0	10.6	58.6
258	FTC	5	-5.2	15.0	161.9	5.4	285.0	167.3	123.0
259	FTC	2	-	116.1	9.3	100.4	0.9	54.3	101.3
260	FTC	3	-99.7	7.2	153.9	1.8	97.2	155.7	41.1
261	CC	3	-35.8	44.3	96.9	1.8	134.3	98.7	71.4
262	CC	2	21.2	40.6	75.4	0.9	85.6	76.3	-11.9
263	CC	5	-32.4	53.4	134.9	5.4	323.4	140.3	215.5
264	CC	4	-2.8	50.1	107.1	3.6	230.1	110.7	122.2
265	CC	1	35.1	37.9	39.9	0.0	37.9	39.9	-37.0
266	CF	5	-41.6	0.0	164.4	5.4	270.0	169.8	141.8
267	CF	4	-42.9	0.0	196.8	3.6	180.0	200.4	22.6
268	CF	3	-81.1	0.0	145.1	1.8	90.0	146.9	24.2
269	CF	2	-0.8	0.0	101.3	0.9	45.0	102.2	-56.4
270	CF	1	-48.9	0.0	91.5	0.0	0.0	91.5	-42.7
271	FTC	4	-	207.3	14.7	154.9	3.6	194.7	158.5
272	FTC	3	-	192.9	15.5	89.8	1.8	105.5	91.6
273	FTC	1	-	154.4	12.2	50.3	0.0	12.2	50.3
274	FTC	5	-	124.1	18.6	174.6	5.4	288.6	180.0
275	FTC	2	-	126.6	12.8	43.6	0.9	57.8	44.5
276	CR	5	-26.4	10.4	188.9	5.4	280.4	194.3	112.5
277	CR	4	0.9	7.6	146.3	3.6	187.6	149.9	36.8
278	CR	2	1.6	13.7	46.8	0.9	58.7	47.7	9.4
279	CR	3	-6.9	15.8	87.8	1.8	105.8	89.6	23.1
280	CR	1	-25.7	21.8	31.9	0.0	21.8	31.9	15.6
286	R/C	2	-38.9	4.5	47.9	0.9	49.5	48.8	39.6
287	R/C	5	-35.7	3.1	153.4	5.4	273.1	158.8	150.0
288	R/C	3	-48.4	0.0	87.5	1.8	90.0	89.3	49.1
289	R/C	1	-27.8	4.5	34.7	0.0	4.5	34.7	-2.4
290	R/C	4	-28.1	0.5	136.3	3.6	180.5	139.9	68.7
301	DSB	4	-33.3	0.0	134.9	3.6	180.0	138.5	74.7

302	DSB	3	-65.6	0.0	118.6	1.8	90.0	120.4	35.2
303	DSB	2	-63.8	0.0	92.4	0.9	45.0	93.3	15.5
304	DSB	5	-63.1	0.0	130.6	5.4	270.0	136.0	197.1
305	DSB	1	-47.6	0.0	89.1	0.0	0.0	89.1	-41.5
306	FTC	1	-	104.2	10.9	51.3	0.0	10.9	51.3
307	FTC	2	-	132.2	5.2	70.4	0.9	50.2	71.3
308	FTC	5	-95.9	10.5	124.0	5.4	280.5	129.4	247.0
309	FTC	4	-	120.9	10.7	144.2	3.6	190.7	147.8
310	FTC	3	-64.1	14.9	109.2	1.8	104.9	111.0	58.0
311	CC	5	-2.1	7.9	122.3	5.4	277.9	127.7	152.3
312	CC	1	35.4	4.1	85.7	0.0	4.1	85.7	-117.0
313	CC	4	9.2	6.5	142.9	3.6	186.5	146.5	30.8
314	CC	3	27.9	10.2	156.0	1.8	100.2	157.8	-85.5
315	CC	2	10.0	2.7	124.3	0.9	47.7	125.2	-87.5
316	CR	2	15.3	15.0	65.4	0.9	60.0	66.3	-21.6
317	CR	1	1.9	21.0	35.6	0.0	21.0	35.6	-16.5
318	CR	5	-1.0	23.5	123.9	5.4	293.5	129.3	165.2
319	CR	4	-18.5	18.6	170.8	3.6	198.6	174.4	42.7
320	CR	3	-26.7	22.8	97.9	1.8	112.8	99.7	39.8
321	CF	2	8.3	2.7	142.9	0.9	47.7	143.8	-104.5
322	CF	5	-32.1	0.8	156.5	5.4	270.8	161.9	141.0
323	CF	3	-38.3	2.2	177.2	1.8	92.2	179.0	-48.5
324	CF	4	-46.6	1.4	158.9	3.6	181.4	162.5	65.6
325	CF	1	-18.6	1.3	125.2	0.0	1.3	125.2	-105.3
326	R/C	5	-53.8	22.3	117.0	5.4	292.3	122.4	223.6
327	R/C	1	-4.8	13.7	43.2	0.0	13.7	43.2	-24.7
328	R/C	3	7.5	16.0	97.4	1.8	106.0	99.2	-0.7
329	R/C	4	1.1	17.7	166.2	3.6	197.7	169.8	26.9
330	R/C	2	26.3	15.1	59.4	0.9	60.1	60.3	-26.5
331	CF	3	-75.2	0.0	184.5	1.8	90.0	186.3	-21.1
332	CF	5	-92.7	0.0	179.4	5.4	270.0	184.8	177.9
333	CF	1	-33.1	0.0	86.9	0.0	0.0	86.9	-53.8
334	CF	4	-30.0	0.0	201.8	3.6	180.0	205.4	4.6
335	CF	2	-30.3	0.0	127.4	0.9	45.0	128.3	-52.9
336	CC	2	-11.5	39.0	79.0	0.9	84.0	79.9	15.6
337	CC	1	-17.4	48.1	75.6	0.0	48.1	75.6	-10.1
338	CC	4	11.7	52.2	122.4	3.6	232.2	126.0	94.5
339	CC	5	-29.0	44.2	172.6	5.4	314.2	178.0	165.2
340	CC	3	20.8	48.4	133.2	1.8	138.4	135.0	-17.4
341	FTC	4	-	116.7	20.2	144.7	3.6	200.2	148.3

342	FTC	2	-68.4	8.8	76.7	0.9	53.8	77.6	44.7
343	FTC	1	-28.6	14.0	42.2	0.0	14.0	42.2	0.4
344	FTC	5	34.3	21.3	205.4	5.4	291.3	210.8	46.2
345	FTC	3	46.1	16.4	100.5	1.8	106.4	102.3	-42.0
351	CR	5	3.7	14.0	163.7	5.4	284.0	169.1	111.2
352	CR	4	20.7	8.4	144.6	3.6	188.4	148.2	19.6
353	CR	2	-14.5	17.0	39.3	0.9	62.0	40.2	36.2
354	CR	1	44.6	16.2	28.8	0.0	16.2	28.8	-57.2
355	CR	3	11.7	14.5	76.9	1.8	104.5	78.7	14.1
356	R/C	4	-27.3	23.0	139.3	3.6	203.0	142.9	87.3
357	R/C	3	-44.4	27.9	101.9	1.8	117.9	103.7	58.6
358	R/C	5	-4.7	23.6	162.6	5.4	293.6	168.0	130.4
359	R/C	2	-65.9	19.2	63.4	0.9	64.2	64.3	65.8
360	R/C	1	-59.6	30.2	42.4	0.0	30.2	42.4	47.4
361	CC	4	80.9	26.2	128.8	3.6	206.2	132.4	-7.1
362	CC	2	19.9	26.7	66.4	0.9	71.7	67.3	-15.5
363	CC	1	10.3	41.5	57.0	0.0	41.5	57.0	-25.7
364	CC	5	51.8	36.5	129.7	5.4	306.5	135.1	119.6
365	CC	3	38.7	16.4	103.5	1.8	106.4	105.3	-37.6
366	DSB	3	-81.4	0.0	144.4	1.8	90.0	146.2	25.2
367	DSB	4	-54.2	0.0	142.9	3.6	180.0	146.5	87.7
368	DSB	2	-52.7	0.0	114.4	0.9	45.0	115.3	-17.6
369	DSB	5	-59.4	0.0	134.4	5.4	270.0	139.8	189.6
370	DSB	1	6.6	0.0	73.0	0.0	0.0	73.0	-79.6
371	R/C	5	86.2	43.1	99.0	5.4	313.1	104.4	122.5
372	R/C	4	71.4	36.2	113.7	3.6	216.2	117.3	27.5
373	R/C	3	-5.8	35.2	74.3	1.8	125.2	76.1	54.9
374	R/C	2	1.9	32.8	50.6	0.9	77.8	51.5	24.4
375	R/C	1	31.7	32.7	22.6	0.0	32.7	22.6	-21.6
376	CR	1	49.0	43.8	13.0	0.0	43.8	13.0	-18.2
377	CR	2	54.6	34.3	49.3	0.9	79.3	50.2	-25.4
378	CR	3	10.9	45.8	72.9	1.8	135.8	74.7	50.2
379	CR	5	26.1	50.9	115.3	5.4	320.9	120.7	174.1
380	CR	4	31.8	40.1	97.7	3.6	220.1	101.3	86.9
381	FTC	1	-57.8	20.9	41.0	0.0	20.9	41.0	37.7
382	FTC	3	-72.2	15.1	99.8	1.8	105.1	101.6	75.7
383	FTC	4	-41.5	22.4	114.4	3.6	202.4	118.0	125.9
384	FTC	5	-68.6	22.1	141.7	5.4	292.1	147.1	213.6
385	FTC	2	-57.3	33.2	69.2	0.9	78.2	70.1	65.4
386	CF	4	57.8	0.0	133.7	3.6	180.0	137.3	-15.1
387	CF	5	35.3	0.0	163.1	5.4	270.0	168.5	66.2
388	CF	1	56.0	0.0	78.7	0.0	0.0	78.7	-134.7
389	CF	3	47.8	0.0	145.9	1.8	90.0	147.7	-105.6

390	CF	2	43.6	0.0	109.3	0.9	45.0	110.2	-108.7
401	CR	3	115.4	30.2	61.7	1.8	120.2	63.5	-58.8
402	CR	2	44.4	30.9	55.9	0.9	75.9	56.8	-25.3
403	CR	5	58.6	9.4	125.1	5.4	279.4	130.5	90.3
404	CR	4	38.4	24.7	130.6	3.6	204.7	134.2	32.2
405	CR	1	77.8	28.9	24.2	0.0	28.9	24.2	-73.2
406	CF	4	13.3	0.0	136.5	3.6	180.0	140.1	26.6
407	CF	5	105.9	0.0	157.7	5.4	270.0	163.1	1.0
408	CF	1	71.5	0.0	99.7	0.0	0.0	99.7	-171.2
409	CF	3	94.9	0.0	141.5	1.8	90.0	143.3	-148.1
410	CF	2	45.9	0.0	130.7	0.9	45.0	131.6	-132.6
411	DSB	2	-77.3	0.0	118.2	0.9	45.0	119.1	3.1
412	DSB	1	-34.5	0.0	83.8	0.0	0.0	83.8	-49.4
413	DSB	4	-15.4	0.0	119.4	3.6	180.0	123.0	72.4
414	DSB	3	-20.2	0.0	131.5	1.8	90.0	133.3	-23.2
415	DSB	5	-24.9	0.0	148.4	5.4	270.0	153.8	141.1
416	FTC	1	-11.8	25.3	28.7	0.0	25.3	28.7	8.3
417	FTC	2	31.1	32.1	57.3	0.9	77.1	58.2	-12.2
418	FTC	4	26.4	24.6	109.5	3.6	204.6	113.1	65.1
419	FTC	5	95.3	29.5	120.0	5.4	299.5	125.4	78.8
420	FTC	3	108.4	38.6	97.4	1.8	128.6	99.2	-79.0
421	CC	1	260.2	36.8	58.1	0.0	36.8	58.1	-281.5
422	CC	2	240.4	38.8	127.0	0.9	83.8	127.9	-284.5
423	CC	5	316.8	30.0	106.7	5.4	300.0	112.1	-129.0
424	CC	3	369.9	43.0	113.0	1.8	133.0	114.8	-351.8
425	CC	4	62.8	31.2	109.4	3.6	211.2	113.0	35.3
426	R/C	4	161.2	43.1	95.9	3.6	223.1	99.5	-37.5
427	R/C	5	47.5	32.0	93.4	5.4	302.0	98.8	155.8
428	R/C	2	61.5	35.6	29.1	0.9	80.6	30.0	-10.8
429	R/C	1	38.6	46.9	32.9	0.0	46.9	32.9	-24.6
430	R/C	3	81.6	61.2	70.3	1.8	151.2	72.1	-2.4
431	CC	1	57.7	3.1	84.5	0.0	3.1	84.5	-139.1
432	CC	5	-1.5	2.1	142.1	5.4	272.1	147.5	126.0
433	CC	2	-19.7	3.0	121.5	0.9	48.0	122.4	-54.7
434	CC	4	-67.8	6.7	158.4	3.6	186.7	162.0	92.5
435	CC	3	-1.0	10.7	142.3	1.8	100.7	144.1	-42.3
436	FTC	4	-	8.2	127.1	3.6	188.2	130.7	159.9
437	FTC	3	-	4.1	116.9	1.8	94.1	118.7	110.6
438	FTC	1	-82.3	4.8	55.4	0.0	4.8	55.4	31.7
439	FTC	2	-	7.4	85.2	0.9	52.4	86.1	112.4

440	FTC	5	-	110.2	5.9	138.4	5.4	275.9	143.8	242.4
441	R/C	4	-8.9	19.2	95.3	3.6	199.2	98.9	109.1	
442	R/C	3	21.1	16.6	90.5	1.8	106.6	92.3	-6.8	
443	R/C	5	80.7	19.7	110.1	5.4	289.7	115.5	93.5	
444	R/C	1	20.7	19.7	34.9	0.0	19.7	34.9	-35.9	
445	R/C	2	3.0	15.5	63.0	0.9	60.5	63.9	-6.4	
446	CR	2	18.0	17.4	43.3	0.9	62.4	44.2	0.2	
447	CR	4	-12.4	14.3	115.8	3.6	194.3	119.4	87.4	
448	CR	3	5.0	13.3	73.5	1.8	103.3	75.3	23.0	
449	CR	5	-19.1	17.6	113.5	5.4	287.6	118.9	187.8	
450	CR	1	-51.8	14.8	26.0	0.0	14.8	26.0	40.6	
451	CF	2	-29.9	0.9	97.0	0.9	45.9	97.9	-22.1	
452	CF	3	41.9	0.9	124.4	1.8	90.9	126.2	-77.2	
453	CF	5	9.3	1.2	120.9	5.4	271.2	126.3	135.7	
454	CF	1	34.5	0.7	103.7	0.0	0.7	103.7	-137.4	
455	CF	4	44.5	0.0	139.9	3.6	180.0	143.5	-7.9	
456	DSB	2	-29.4	0.0	79.4	0.9	45.0	80.3	-5.9	
457	DSB	5	-29.4	0.0	113.7	5.4	270.0	119.1	180.4	
458	DSB	1	-49.5	0.0	62.2	0.0	0.0	62.2	-12.8	
459	DSB	4	-99.0	0.0	112.4	3.6	180.0	116.0	162.9	
460	DSB	3	-60.5	0.0	136.0	1.8	90.0	137.8	12.7	
461	CC	4	-74.0	29.9	124.4	3.6	209.9	128.0	155.9	
462	CC	5	-48.1	22.2	143.5	5.4	292.2	148.9	191.4	
463	CC	2	-4.0	23.1	42.3	0.9	68.1	43.2	28.9	
464	CC	3	-99.1	29.3	72.9	1.8	119.3	74.7	143.7	
465	CC	1	-13.1	22.5	32.3	0.0	22.5	32.3	3.3	
471	CF	5	-63.2	0.0	176.7	5.4	270.0	182.1	151.1	
472	CF	3	-83.5	0.0	170.5	1.8	90.0	172.3	1.2	
473	CF	1	-36.6	0.0	93.6	0.0	0.0	93.6	-57.0	
474	CF	4	-12.6	0.0	181.2	3.6	180.0	184.8	7.9	
475	CF	2	-29.2	0.0	99.9	0.9	45.0	100.8	-26.6	
476	FTC	4	-	144.5	8.7	157.6	3.6	188.7	161.2	172.0
477	FTC	5	-	129.0	9.7	159.7	5.4	279.7	165.1	243.5
478	FTC	1	-	145.4	11.5	40.7	0.0	11.5	40.7	116.2
479	FTC	3	-	166.0	10.3	85.8	1.8	100.3	87.6	178.7
480	FTC	2	-	190.0	6.5	44.9	0.9	51.5	45.8	195.6
481	R/C	4	-56.9	30.8	117.0	3.6	210.8	120.6	147.1	
482	R/C	5	-75.6	24.6	132.3	5.4	294.6	137.7	232.5	

483	R/C	2	-	101.1	15.3	49.3	0.9	60.3	50.2	111.3
484	R/C	3	-90.8	26.4	84.4	1.8	116.4	86.2	121.0	
485	R/C	1	-11.3	21.5	37.5	0.0	21.5	37.5	-4.7	
486	CR	4	-54.3	17.3	130.6	3.6	197.3	134.2	117.4	
487	CR	2	-81.9	12.0	38.3	0.9	57.0	39.2	99.7	
488	CR	1	-28.9	9.1	24.7	0.0	9.1	24.7	13.4	
489	CR	3	-24.9	8.9	69.2	1.8	98.9	71.0	52.8	
490	CR	5	-63.5	11.2	146.1	5.4	281.2	151.5	193.2	

Cover crops and weeds biomass

Biomass was taken from 0.5-m² quadrat

year	block	Plot	trt	g_rye	g_legume	g_weeds	g_ftc
2023	1	101	FTC				30.0
2023	1	102	FTC				33.4
2023	1	103	FTC				39.3
2023	1	104	FTC				50.1
2023	1	105	FTC				57.0
2023	1	106	CF			2.4	
2023	1	107	CF			7.8	
2023	1	108	CF			1.6	
2023	1	109	CF			10.5	
2023	1	110	CF			31.2	
2023	1	111	DSB				
2023	1	112	DSB				
2023	1	113	DSB				
2023	1	114	DSB				
2023	1	115	DSB				
2023	1	116	R/C	52.9			
2023	1	117	R/C	40.9			
2023	1	118	R/C	32.0			
2023	1	119	R/C	39.6			
2023	1	120	R/C	32.7			
2023	1	121	CC		9.9		
2023	1	122	CC		6.0		
2023	1	123	CC		20.9		
2023	1	124	CC		13.6		
2023	1	125	CC		24.2		
2023	1	126	CR	61.7			
2023	1	127	CR	55.7			
2023	1	128	CR	68.4			

2023	1	129	CR	41.1			
2023	1	130	CR	35.9			
2021	1	131	FTC				19.9
2021	1	132	FTC				28.3
2021	1	133	FTC				55.7
2021	1	134	FTC				26.4
2021	1	135	FTC				34.3
2021	1	136	CC		22.0	13.4	
2021	1	137	CC		48.9	16.5	
2021	1	138	CC		61.0	6.3	
2021	1	139	CC		37.5	16.4	
2021	1	140	CC		66.0	22.9	
2021	1	141	CF				
2021	1	142	CF				
2021	1	143	CF				
2021	1	144	CF				
2021	1	145	CF				
2021	1	146	DSB				
2021	1	147	DSB				
2021	1	148	DSB				
2021	1	149	DSB				
2021	1	150	DSB				
2021	1	151	R/C	65.2	1.5		
2021	1	152	R/C	59.2			
2021	1	153	R/C	49.7	0.4		
2021	1	154	R/C	69.2	1.4		
2021	1	155	R/C	71.2	0.6		
2021	1	156	CR	84.7			
2021	1	157	CR	73.5			
2021	1	158	CR	72.1			
2021	1	159	CR	81.5			
2021	1	160	CR	72.5			
2022	1	161	R/C	121.6	2.2		
2022	1	162	R/C	113.8	5.5		
2022	1	163	R/C	193.7	0.6		
2022	1	164	R/C	175.4	0.9		
2022	1	165	R/C	121.4			
2022	1	166	FTC				75.3
2022	1	167	FTC				67.3
2022	1	168	FTC				72.1
2022	1	169	FTC				63.3
2022	1	170	FTC				82.6
2022	1	171	DSB				

2022	1	172	DSB				
2022	1	173	DSB				
2022	1	174	DSB				
2022	1	175	DSB				
2022	1	176	CF				
2022	1	177	CF				
2022	1	178	CF				
2022	1	179	CF				
2022	1	180	CF				
2022	1	181	CR	126.6			
2022	1	182	CR	176.5			
2022	1	183	CR	111.2			
2022	1	184	CR	121.9			
2022	1	185	CR	109.4			
2022	1	186	CC		46.6	4.9	
2022	1	187	CC		20.8	7.9	
2022	1	188	CC		14.7	8.8	
2022	1	189	CC		29.3	21.6	
2022	1	190	CC		65.0	2.4	
2022	2	201	DSB				
2022	2	202	DSB				
2022	2	203	DSB				
2022	2	204	DSB				
2022	2	205	DSB				
2022	2	206	CR	117.2			
2022	2	207	CR	117.1			
2022	2	208	CR	89.9			
2022	2	209	CR	96.3			
2022	2	210	CR	115.6			
2022	2	211	CC		39.7		
2022	2	212	CC		51.5		
2022	2	213	CC		53.6	2.0	
2022	2	214	CC		57.5	0.5	
2022	2	215	CC		58.3	0.5	
2022	2	216	R/C	96.4	6.8		
2022	2	217	R/C	93.9	6.2		
2022	2	218	R/C	81.0	7.1		
2022	2	219	R/C	105.5	1.3		
2022	2	220	R/C	153.1	6.2		
2022	2	221	FTC				78.9
2022	2	222	FTC				121.8
2022	2	223	FTC				92.2
2022	2	224	FTC				100.1

2022	2	225	FTC				94.0
2022	2	226	CF				
2022	2	227	CF				
2022	2	228	CF				
2022	2	229	CF				
2022	2	230	CF				
2023	2	231	CR	37.6			
2023	2	232	CR	27.3			
2023	2	233	CR	27.1			
2023	2	234	CR	30.5			
2023	2	235	CR	32.0			
2023	2	236	R/C	34.9			
2023	2	237	R/C	41.3			
2023	2	238	R/C	28.3			
2023	2	239	R/C	41.3			
2023	2	240	R/C	25.9			
2023	2	241	CC		18.8		
2023	2	242	CC		15.3		
2023	2	243	CC		15.5		
2023	2	244	CC		22.8		
2023	2	245	CC		15.2		
2023	2	246	CF			4.9	
2023	2	247	CF			2.4	
2023	2	248	CF			4.1	
2023	2	249	CF			4.0	
2023	2	250	CF			2.6	
2023	2	251	DSB				
2023	2	252	DSB				
2023	2	253	DSB				
2023	2	254	DSB				
2023	2	255	DSB				
2023	3	256	FTC				36.0
2023	3	257	FTC				25.7
2023	3	258	FTC				36.5
2023	3	259	FTC				22.6
2023	3	260	FTC				17.5
2021	2	261	CC		60.4	13.3	
2021	2	262	CC		49.3	21.4	
2021	2	263	CC		52.5	46.9	
2021	2	264	CC		31.6	70.9	
2021	2	265	CC		37.4	33.1	
2021	2	266	CF				
2021	2	267	CF				

2021	2	268	CF				
2021	2	269	CF				
2021	2	270	CF				
2021	2	271	FTC				41.9
2021	2	272	FTC				44.1
2021	2	273	FTC				34.6
2021	2	274	FTC				52.9
2021	2	275	FTC				36.3
2021	2	276	CR	40.1			
2021	2	277	CR	29.2			
2021	2	278	CR	52.8			
2021	2	279	CR	60.8			
2021	2	280	CR	83.7			
2021	2	281	DSB				
2021	2	282	DSB				
2021	2	283	DSB				
2021	2	284	DSB				
2021	2	285	DSB				
2021	2	286	R/C		8.1		59.7
2021	2	287	R/C		5.5		76.8
2021	2	288	R/C			0.1	65.0
2021	2	289	R/C		8.1	0.1	68.1
2021	2	290	R/C		0.9		67.4
2023	3	301	DSB				
2023	3	302	DSB				
2023	3	303	DSB				
2023	3	304	DSB				
2023	3	305	DSB				
2023	3	306	FTC				24.8
2023	3	307	FTC				11.8
2023	3	308	FTC				23.9
2023	3	309	FTC				24.3
2023	3	310	FTC				33.9
2023	3	311	CC		10.3		
2023	3	312	CC		5.3		
2023	3	313	CC		8.5		
2023	3	314	CC		13.3		
2023	3	315	CC		3.5		
2023	3	316	CR	34.3			
2023	3	317	CR	48.0			
2023	3	318	CR	53.6			
2023	3	319	CR	42.5			
2023	3	320	CR	52.1			

2023	3	321	CF			5.4	
2023	3	322	CF			1.5	
2023	3	323	CF			4.4	
2023	3	324	CF			2.9	
2023	3	325	CF			2.6	
2023	3	326	R/C	58.0			
2023	3	327	R/C	35.7			
2023	3	328	R/C	41.6			
2023	3	329	R/C	46.2			
2023	3	330	R/C	39.3			
2021	3	331	CF				
2021	3	332	CF				
2021	3	333	CF				
2021	3	334	CF				
2021	3	335	CF				
2021	3	336	CC		42.0	35.6	
2021	3	337	CC		72.9	8.0	
2021	3	338	CC		73.2	18.8	
2021	3	339	CC		62.6	14.9	
2021	3	340	CC		64.9	22.5	
2021	3	341	FTC				57.3
2021	3	342	FTC				25.1
2021	3	343	FTC				39.9
2021	3	344	FTC				60.5
2021	3	345	FTC				46.6
2021	3	346	DSB				
2021	3	347	DSB				
2021	3	348	DSB				
2021	3	349	DSB				
2021	3	350	DSB				
2021	3	351	CR	42.4			
2021	3	352	CR	25.5		0.1	
2021	3	353	CR	51.4			
2021	3	354	CR	49.1			
2021	3	355	CR	43.9			
2021	3	356	R/C	50.0	12.6		
2021	3	357	R/C	38.5	26.7		
2021	3	358	R/C	60.4	8.3		
2021	3	359	R/C	50.2	6.2		
2021	3	360	R/C	51.6	23.8		
2022	3	361	CC		37.2	1.3	
2022	3	362	CC		35.5	6.9	
2022	3	363	CC		54.9	11.6	

2022	3	364	CC		52.4	0.4	
2022	3	365	CC		20.0	8.5	
2022	3	366	DSB				
2022	3	367	DSB				
2022	3	368	DSB				
2022	3	369	DSB				
2022	3	370	DSB				
2022	3	371	R/C	150.6	7.2		
2022	3	372	R/C	122.0	7.9		
2022	3	373	R/C	120.9	6.7		
2022	3	374	R/C	122.9	1.9		
2022	3	375	R/C	106.0	9.0		
2022	3	376	CR	123.1			
2022	3	377	CR	96.4			
2022	3	378	CR	128.7			
2022	3	379	CR	142.9			
2022	3	380	CR	112.6			
2022	3	381	FTC				69.8
2022	3	382	FTC				50.4
2022	3	383	FTC				74.5
2022	3	384	FTC				73.8
2022	3	385	FTC				110.5
2022	3	386	CF				
2022	3	387	CF				
2022	3	388	CF				
2022	3	389	CF				
2022	3	390	CF				
2022	4	401	CR	130.0			
2022	4	402	CR	133.0			
2022	4	403	CR	40.6			
2022	4	404	CR	106.6			
2022	4	405	CR	124.4			
2022	4	406	CF				
2022	4	407	CF				
2022	4	408	CF				
2022	4	409	CF				
2022	4	410	CF				
2022	4	411	DSB				
2022	4	412	DSB				
2022	4	413	DSB				
2022	4	414	DSB				
2022	4	415	DSB				
2022	4	416	FTC				65.9

2022	4	417	FTC				83.6
2022	4	418	FTC				64.1
2022	4	419	FTC				76.8
2022	4	420	FTC				100.5
2022	4	421	CC		44.8	8.4	
2022	4	422	CC		46.7	10.2	
2022	4	423	CC		39.2		
2022	4	424	CC		56.1		
2022	4	425	CC		40.7		
2022	4	426	R/C	101.1	9.2		
2022	4	427	R/C	73.0	8.1		
2022	4	428	R/C	82.8	8.0		
2022	4	429	R/C	101.7	15.0		
2022	4	430	R/C	145.6	11.7		
2023	4	431	CC		4.4		
2023	4	432	CC		2.9		
2023	4	433	CC		4.2		
2023	4	434	CC		9.5		
2023	4	435	CC		15.1		
2023	4	436	FTC				18.4
2023	4	437	FTC				9.2
2023	4	438	FTC				10.8
2023	4	439	FTC				16.6
2023	4	440	FTC				13.2
2023	4	441	R/C	46.6	0.5		
2023	4	442	R/C	38.7	1.4		
2023	4	443	R/C	43.8	2.8		
2023	4	444	R/C	37.6	6.3		
2023	4	445	R/C	22.7	8.9		
2023	4	446	CR	39.9			
2023	4	447	CR	32.9			
2023	4	448	CR	30.6			
2023	4	449	CR	40.4			
2023	4	450	CR	33.9			
2023	4	451	CF			1.8	
2023	4	452	CF			1.9	
2023	4	453	CF			2.5	
2023	4	454	CF			1.5	
2023	4	455	CF				
2023	4	456	DSB				
2023	4	457	DSB				
2023	4	458	DSB				
2023	4	459	DSB				

2023	4	460	DSB				
2021	4	461	CC		35.4	28.6	
2021	4	462	CC		11.2	45.9	
2021	4	463	CC		26.3	23.8	
2021	4	464	CC		35.4	26.7	
2021	4	465	CC		19.4	33.2	
2021	4	466	DSB				
2021	4	467	DSB				
2021	4	468	DSB				
2021	4	469	DSB				
2021	4	470	DSB				
2021	4	471	CF				
2021	4	472	CF				
2021	4	473	CF				
2021	4	474	CF				
2021	4	475	CF				
2021	4	476	FTC				26
2021	4	477	FTC				28.9
2021	4	478	FTC				34.3
2021	4	479	FTC				30.9
2021	4	480	FTC				19.4
2021	4	481	R/C	65.4	8.1		
2021	4	482	R/C	49	8.8		
2021	4	483	R/C	24.2	9.9		
2021	4	484	R/C	41.8	17		
2021	4	485	R/C	43.2	7.3		
2021	4	486	CR	55.3			
2021	4	487	CR	38.5			
2021	4	488	CR	29.1			
2021	4	489	CR	28.5			
2021	4	490	CR	35.9			

Cover crops and weeds nitrogen content

Biomass was taken from 0.5-m² quadrat in each plot

year	block	Plot	trt	%N rye	gN rye	%N legume	gN legume	%N Weeds	gN weeds	%N ftc	gNftc	total N g
2023	1	101	FTC		0.0		0.0		0.0	2.0	0.6	0.6
2023	1	102	FTC		0.0		0.0		0.0	2.0	0.7	0.7
2023	1	103	FTC		0.0		0.0		0.0	2.0	0.8	0.8
2023	1	104	FTC		0.0		0.0		0.0	2.0	1.0	1.0
2023	1	105	FTC		0.0		0.0		0.0	2.0	1.1	1.1

2023	1	106	CF					2.5	0.1			0.1
2023	1	107	CF					2.5	0.2			0.2
2023	1	108	CF					2.5	0.0			0.0
2023	1	109	CF					2.5	0.3			0.3
2023	1	110	CF					2.5	0.8			0.8
2023	1	111	DSB									0.0
2023	1	112	DSB									0.0
2023	1	113	DSB									0.0
2023	1	114	DSB									0.0
2023	1	115	DSB									0.0
2023	1	116	R/C	2.1	1.1		0.0		0.0		0.0	1.1
2023	1	117	R/C	2.1	0.9		0.0		0.0		0.0	0.9
2023	1	118	R/C	2.1	0.7		0.0		0.0		0.0	0.7
2023	1	119	R/C	2.1	0.8		0.0		0.0		0.0	0.8
2023	1	120	R/C	2.1	0.7		0.0		0.0		0.0	0.7
2023	1	121	CC		0.0	4.1	0.4		0.0		0.0	0.4
2023	1	122	CC		0.0	4.1	0.2		0.0		0.0	0.2
2023	1	123	CC		0.0	4.1	0.9		0.0		0.0	0.9
2023	1	124	CC		0.0	4.1	0.6		0.0		0.0	0.6
2023	1	125	CC		0.0	4.1	1.0		0.0		0.0	1.0
2023	1	126	CR	1.7	1.1		0.0		0.0		0.0	1.1
2023	1	127	CR	1.7	1.0		0.0		0.0		0.0	1.0
2023	1	128	CR	1.7	1.2		0.0		0.0		0.0	1.2
2023	1	129	CR	1.7	0.7		0.0		0.0		0.0	0.7
2023	1	130	CR	1.7	0.6		0.0		0.0		0.0	0.6
2021	1	131	FTC		0.0		0.0		0.0	2.0	0.4	0.4
2021	1	132	FTC		0.0		0.0		0.0	2.0	0.6	0.6
2021	1	133	FTC		0.0		0.0		0.0	2.0	1.1	1.1
2021	1	134	FTC		0.0		0.0		0.0	2.0	0.5	0.5
2021	1	135	FTC		0.0		0.0		0.0	2.0	0.7	0.7
2021	1	136	CC		0.0	3.5	0.8	2.3	0.3		0.0	1.1
2021	1	137	CC		0.0	3.5	1.7	2.3	0.4		0.0	2.1
2021	1	138	CC		0.0	3.5	2.1	2.3	0.1		0.0	2.3
2021	1	139	CC		0.0	3.5	1.3	2.3	0.4		0.0	1.7
2021	1	140	CC		0.0	3.5	2.3	2.3	0.5		0.0	2.8
2021	1	141	CF									0.0
2021	1	142	CF									0.0
2021	1	143	CF									0.0
2021	1	144	CF									0.0
2021	1	145	CF									0.0
2021	1	146	DSB									0.0
2021	1	147	DSB									0.0
2021	1	148	DSB									0.0

2021	1	149	DSB									0.0
2021	1	150	DSB									0.0
2021	1	151	R/C	1.9	1.2	2.7	0.0		0.0		0.0	1.3
2021	1	152	R/C	1.9	1.1	2.7	0.0		0.0		0.0	1.1
2021	1	153	R/C	1.9	0.9	2.7	0.0		0.0		0.0	0.9
2021	1	154	R/C	1.9	1.3	2.7	0.0		0.0		0.0	1.3
2021	1	155	R/C	1.9	1.3	2.7	0.0		0.0		0.0	1.4
2021	1	156	CR	1.9	1.6		0.0		0.0		0.0	1.6
2021	1	157	CR	1.9	1.4		0.0		0.0		0.0	1.4
2021	1	158	CR	1.9	1.3		0.0		0.0		0.0	1.3
2021	1	159	CR	1.9	1.5		0.0		0.0		0.0	1.5
2021	1	160	CR	1.9	1.3		0.0		0.0		0.0	1.3
2022	1	161	R/C	1.3	1.6	3.5	0.1		0.0		0.0	1.6
2022	1	162	R/C	1.3	1.5	3.5	0.2		0.0		0.0	1.6
2022	1	163	R/C	1.3	2.5	3.5	0.0		0.0		0.0	2.5
2022	1	164	R/C	1.3	2.2	3.5	0.0		0.0		0.0	2.3
2022	1	165	R/C	1.3	1.6	3.5	0.0		0.0		0.0	1.6
2022	1	166	FTC		0.0		0.0		0.0	1.7	1.2	1.2
2022	1	167	FTC		0.0		0.0		0.0	1.7	1.1	1.1
2022	1	168	FTC		0.0		0.0		0.0	1.7	1.2	1.2
2022	1	169	FTC		0.0		0.0		0.0	1.7	1.1	1.1
2022	1	170	FTC		0.0		0.0		0.0	1.7	1.4	1.4
2022	1	171	DSB									0.0
2022	1	172	DSB									0.0
2022	1	173	DSB									0.0
2022	1	174	DSB									0.0
2022	1	175	DSB									0.0
2022	1	176	CF									0.0
2022	1	177	CF									0.0
2022	1	178	CF									0.0
2022	1	179	CF									0.0
2022	1	180	CF									0.0
2022	1	181	CR	1.0	1.3		0.0		0.0		0.0	1.3
2022	1	182	CR	1.0	1.8		0.0		0.0		0.0	1.8
2022	1	183	CR	1.0	1.2		0.0		0.0		0.0	1.2
2022	1	184	CR	1.0	1.3		0.0		0.0		0.0	1.3
2022	1	185	CR	1.0	1.1		0.0		0.0		0.0	1.1
2022	1	186	CC		0.0	3.5	1.6	1.8	0.1		0.0	1.7
2022	1	187	CC		0.0	3.5	0.7	1.5	0.1		0.0	0.8
2022	1	188	CC		0.0	3.5	0.5	1.5	0.1		0.0	0.6
2022	1	189	CC		0.0	3.5	1.0	1.5	0.3		0.0	1.3
2022	1	190	CC		0.0	3.5	2.3	1.5	0.0		0.0	2.3
2022	2	201	DSB									0.0

2022	2	202	DSB									0.0
2022	2	203	DSB									0.0
2022	2	204	DSB									0.0
2022	2	205	DSB									0.0
2022	2	206	CR	2.0	2.3		0.0		0.0		0.0	2.3
2022	2	207	CR	2.0	2.3		0.0		0.0		0.0	2.3
2022	2	208	CR	2.0	1.8		0.0		0.0		0.0	1.8
2022	2	209	CR	2.0	1.9		0.0		0.0		0.0	1.9
2022	2	210	CR	2.0	2.3		0.0		0.0		0.0	2.3
2022	2	211	CC		0.0	3.8	1.5	1.5	0.0		0.0	1.5
2022	2	212	CC		0.0	3.8	2.0		0.0		0.0	2.0
2022	2	213	CC		0.0	3.8	2.0		0.0		0.0	2.0
2022	2	214	CC		0.0	3.8	2.2	1.5	0.0		0.0	2.2
2022	2	215	CC		0.0	3.8	2.2	1.5	0.0		0.0	2.2
2022	2	216	R/C	1.8	1.7	3.2	0.2		0.0		0.0	1.9
2022	2	217	R/C	1.8	1.7	3.2	0.2		0.0		0.0	1.9
2022	2	218	R/C	1.8	1.4	3.2	0.2		0.0		0.0	1.7
2022	2	219	R/C	1.8	1.9	3.2	0.0		0.0		0.0	1.9
2022	2	220	R/C	1.8	2.7	3.2	0.2		0.0		0.0	2.9
2022	2	221	FTC		0.0		0.0		0.0	1.7	1.3	1.3
2022	2	222	FTC		0.0		0.0		0.0	1.7	2.0	2.0
2022	2	223	FTC		0.0		0.0		0.0	1.7	1.5	1.5
2022	2	224	FTC		0.0		0.0		0.0	1.7	1.7	1.7
2022	2	225	FTC		0.0		0.0		0.0	1.7	1.6	1.6
2022	2	226	CF									0.0
2022	2	227	CF									0.0
2022	2	228	CF									0.0
2022	2	229	CF									0.0
2022	2	230	CF									0.0
2023	2	231	CR	1.9	0.7		0.0		0.0		0.0	0.7
2023	2	232	CR	1.9	0.5		0.0		0.0		0.0	0.5
2023	2	233	CR	1.9	0.5		0.0		0.0		0.0	0.5
2023	2	234	CR	1.9	0.6		0.0		0.0		0.0	0.6
2023	2	235	CR	1.9	0.6		0.0		0.0		0.0	0.6
2023	2	236	R/C	2.1	0.7		0.0		0.0		0.0	0.7
2023	2	237	R/C	2.1	0.9		0.0		0.0		0.0	0.9
2023	2	238	R/C	2.1	0.6		0.0		0.0		0.0	0.6
2023	2	239	R/C	2.1	0.9		0.0		0.0		0.0	0.9
2023	2	240	R/C	2.1	0.5		0.0		0.0		0.0	0.5
2023	2	241	CC		0.0	3.8	0.7		0.0		0.0	0.7
2023	2	242	CC		0.0	3.8	0.6		0.0		0.0	0.6
2023	2	243	CC		0.0	3.8	0.6		0.0		0.0	0.6
2023	2	244	CC		0.0	3.8	0.9		0.0		0.0	0.9

2023	2	245	CC		0.0	3.8	0.6		0.0		0.0	0.6
2023	2	246	CF					2.5	0.1			0.1
2023	2	247	CF					2.5	0.1			0.1
2023	2	248	CF					2.5	0.1			0.1
2023	2	249	CF					2.5	0.1			0.1
2023	2	250	CF					2.5	0.1			0.1
2023	2	251	DSB									0.0
2023	2	252	DSB									0.0
2023	2	253	DSB									0.0
2023	2	254	DSB									0.0
2023	2	255	DSB									0.0
2023	3	256	FTC		0.0		0.0		0.0	2.1	0.7	0.7
2023	3	257	FTC		0.0		0.0		0.0	2.1	0.5	0.5
2023	3	258	FTC		0.0		0.0		0.0	2.1	0.8	0.8
2023	3	259	FTC		0.0		0.0		0.0	2.1	0.5	0.5
2023	3	260	FTC		0.0		0.0		0.0	2.1	0.4	0.4
2021	2	261	CC		0.0	3.2	1.9	2.1	0.3		0.0	2.2
2021	2	262	CC		0.0	3.2	1.6	2.1	0.5		0.0	2.0
2021	2	263	CC		0.0	3.2	1.7	2.1	1.0		0.0	2.7
2021	2	264	CC		0.0	3.2	1.0	2.1	1.5		0.0	2.5
2021	2	265	CC		0.0	3.2	1.2	2.1	0.7		0.0	1.9
2021	2	266	CF									0.0
2021	2	267	CF									0.0
2021	2	268	CF									0.0
2021	2	269	CF									0.0
2021	2	270	CF									0.0
2021	2	271	FTC		0.0		0.0		0.0	1.8	0.7	0.7
2021	2	272	FTC		0.0		0.0		0.0	1.8	0.8	0.8
2021	2	273	FTC		0.0		0.0		0.0	1.8	0.6	0.6
2021	2	274	FTC		0.0		0.0		0.0	1.8	0.9	0.9
2021	2	275	FTC		0.0		0.0		0.0	1.8	0.6	0.6
2021	2	276	CR	1.3	0.5		0.0		0.0		0.0	0.5
2021	2	277	CR	1.3	0.4		0.0		0.0		0.0	0.4
2021	2	278	CR	1.3	0.7		0.0		0.0		0.0	0.7
2021	2	279	CR	1.3	0.8		0.0		0.0		0.0	0.8
2021	2	280	CR	1.3	1.1		0.0		0.0		0.0	1.1
2021	2	281	DSB									0.0
2021	2	282	DSB									0.0
2021	2	283	DSB									0.0
2021	2	284	DSB									0.0
2021	2	285	DSB									0.0
2021	2	286	R/C	1.5	0.0	2.8	0.2		0.0		0.0	0.2
2021	2	287	R/C	1.5	0.0	2.8	0.2		0.0		0.0	0.2

2021	2	288	R/C	1.5	0.0	2.8	0.0		0.0		0.0	0.0
2021	2	289	R/C	1.5	0.0	2.8	0.2		0.0		0.0	0.2
2021	2	290	R/C	1.5	0.0	2.8	0.0		0.0		0.0	0.0
2023	3	301	DSB									0.0
2023	3	302	DSB									0.0
2023	3	303	DSB									0.0
2023	3	304	DSB									0.0
2023	3	305	DSB									0.0
2023	3	306	FTC		0.0		0.0		0.0	2.2	0.5	0.5
2023	3	307	FTC		0.0		0.0		0.0	2.2	0.3	0.3
2023	3	308	FTC		0.0		0.0		0.0	2.2	0.5	0.5
2023	3	309	FTC		0.0		0.0		0.0	2.2	0.5	0.5
2023	3	310	FTC		0.0		0.0		0.0	2.2	0.7	0.7
2023	3	311	CC		0.0	3.9	0.4		0.0		0.0	0.4
2023	3	312	CC		0.0	3.9	0.2		0.0		0.0	0.2
2023	3	313	CC		0.0	3.9	0.3		0.0		0.0	0.3
2023	3	314	CC		0.0	3.9	0.5		0.0		0.0	0.5
2023	3	315	CC		0.0	3.9	0.1		0.0		0.0	0.1
2023	3	316	CR	2.2	0.8		0.0		0.0		0.0	0.8
2023	3	317	CR	2.2	1.1		0.0		0.0		0.0	1.1
2023	3	318	CR	2.2	1.2		0.0		0.0		0.0	1.2
2023	3	319	CR	2.2	0.9		0.0		0.0		0.0	0.9
2023	3	320	CR	2.2	1.1		0.0		0.0		0.0	1.1
2023	3	321	CF					2.5	0.1			0.1
2023	3	322	CF					2.5	0.0			0.0
2023	3	323	CF					2.5	0.1			0.1
2023	3	324	CF					2.5	0.1			0.1
2023	3	325	CF					2.5	0.1			0.1
2023	3	326	R/C	1.9	1.1		0.0		0.0		0.0	1.1
2023	3	327	R/C	1.9	0.7		0.0		0.0		0.0	0.7
2023	3	328	R/C	1.9	0.8		0.0		0.0		0.0	0.8
2023	3	329	R/C	1.9	0.9		0.0		0.0		0.0	0.9
2023	3	330	R/C	1.9	0.8		0.0		0.0		0.0	0.8
2021	3	331	CF									0.0
2021	3	332	CF									0.0
2021	3	333	CF									0.0
2021	3	334	CF									0.0
2021	3	335	CF									0.0
2021	3	336	CC		0.0	3.1	1.3	1.8	0.6		0.0	1.9
2021	3	337	CC		0.0	3.1	2.3	1.8	0.1		0.0	2.4
2021	3	338	CC		0.0	3.1	2.3	1.8	0.3		0.0	2.6
2021	3	339	CC		0.0	3.1	1.9	1.8	0.3		0.0	2.2
2021	3	340	CC		0.0	3.1	2.0	1.8	0.4		0.0	2.4

2021	3	341	FTC		0.0		0.0		0.0	1.8	1.0	1.0
2021	3	342	FTC		0.0		0.0		0.0	1.8	0.4	0.4
2021	3	343	FTC		0.0		0.0		0.0	1.8	0.7	0.7
2021	3	344	FTC		0.0		0.0		0.0	1.8	1.1	1.1
2021	3	345	FTC		0.0		0.0		0.0	1.8	0.8	0.8
2021	3	346	DSB									0.0
2021	3	347	DSB									0.0
2021	3	348	DSB									0.0
2021	3	349	DSB									0.0
2021	3	350	DSB									0.0
2021	3	351	CR	1.7	0.7		0.0		0.0		0.0	0.7
2021	3	352	CR	1.7	0.4		0.0		0.0		0.0	0.4
2021	3	353	CR	1.7	0.8		0.0		0.0		0.0	0.8
2021	3	354	CR	1.7	0.8		0.0		0.0		0.0	0.8
2021	3	355	CR	1.7	0.7		0.0		0.0		0.0	0.7
2021	3	356	R/C	1.5	0.8	3.0	0.4		0.0		0.0	1.1
2021	3	357	R/C	1.5	0.6	3.0	0.8		0.0		0.0	1.4
2021	3	358	R/C	1.5	0.9	3.0	0.2		0.0		0.0	1.2
2021	3	359	R/C	1.5	0.8	3.0	0.2		0.0		0.0	1.0
2021	3	360	R/C	1.5	0.8	3.0	0.7		0.0		0.0	1.5
2022	3	361	CC		0.0	3.5	1.3	1.5	0.0		0.0	1.3
2022	3	362	CC		0.0	3.5	1.2	1.5	0.1		0.0	1.3
2022	3	363	CC		0.0	3.5	1.9	1.5	0.2		0.0	2.1
2022	3	364	CC		0.0	3.5	1.8	1.5	0.0		0.0	1.8
2022	3	365	CC		0.0	3.5	0.7	1.5	0.1		0.0	0.8
2022	3	366	DSB									0.0
2022	3	367	DSB									0.0
2022	3	368	DSB									0.0
2022	3	369	DSB									0.0
2022	3	370	DSB									0.0
2022	3	371	R/C	1.3	1.9	3.0	0.2		0.0		0.0	2.2
2022	3	372	R/C	1.3	1.6	3.0	0.2		0.0		0.0	1.8
2022	3	373	R/C	1.3	1.6	3.0	0.2		0.0		0.0	1.8
2022	3	374	R/C	1.3	1.6	3.0	0.1		0.0		0.0	1.6
2022	3	375	R/C	1.3	1.4	3.0	0.3		0.0		0.0	1.6
2022	3	376	CR	1.8	2.2		0.0		0.0		0.0	2.2
2022	3	377	CR	1.8	1.7		0.0		0.0		0.0	1.7
2022	3	378	CR	1.8	2.3		0.0		0.0		0.0	2.3
2022	3	379	CR	1.8	2.5		0.0		0.0		0.0	2.5
2022	3	380	CR	1.8	2.0		0.0		0.0		0.0	2.0
2022	3	381	FTC		0.0		0.0		0.0	1.5	1.0	1.0
2022	3	382	FTC		0.0		0.0		0.0	1.5	0.8	0.8
2022	3	383	FTC		0.0		0.0		0.0	1.5	1.1	1.1

2022	3	384	FTC		0.0		0.0		0.0	1.5	1.1	1.1
2022	3	385	FTC		0.0		0.0		0.0	1.5	1.7	1.7
2022	3	386	CF									0.0
2022	3	387	CF									0.0
2022	3	388	CF									0.0
2022	3	389	CF									0.0
2022	3	390	CF									0.0
2022	4	401	CR	1.2	1.5		0.0		0.0		0.0	1.5
2022	4	402	CR	1.2	1.5		0.0		0.0		0.0	1.5
2022	4	403	CR	1.2	0.5		0.0		0.0		0.0	0.5
2022	4	404	CR	1.2	1.2		0.0		0.0		0.0	1.2
2022	4	405	CR	1.2	1.4		0.0		0.0		0.0	1.4
2022	4	406	CF									0.0
2022	4	407	CF									0.0
2022	4	408	CF									0.0
2022	4	409	CF									0.0
2022	4	410	CF									0.0
2022	4	411	DSB									0.0
2022	4	412	DSB									0.0
2022	4	413	DSB									0.0
2022	4	414	DSB									0.0
2022	4	415	DSB									0.0
2022	4	416	FTC		0.0		0.0		0.0	1.9	1.3	1.3
2022	4	417	FTC		0.0		0.0		0.0	1.9	1.6	1.6
2022	4	418	FTC		0.0		0.0		0.0	1.9	1.2	1.2
2022	4	419	FTC		0.0		0.0		0.0	1.9	1.5	1.5
2022	4	420	FTC		0.0		0.0		0.0	1.9	1.9	1.9
2022	4	421	CC		0.0	3.8	1.7	1.5	0.1		0.0	1.8
2022	4	422	CC		0.0	3.8	1.8	1.5	0.2		0.0	1.9
2022	4	423	CC		0.0	3.8	1.5	1.5	0.0		0.0	1.5
2022	4	424	CC		0.0	3.8	2.1		0.0		0.0	2.1
2022	4	425	CC		0.0	3.8	1.6		0.0		0.0	1.6
2022	4	426	R/C	1.9	1.9	3.0	0.3		0.0		0.0	2.2
2022	4	427	R/C	1.9	1.4	3.0	0.2		0.0		0.0	1.6
2022	4	428	R/C	1.9	1.5	3.0	0.2		0.0		0.0	1.8
2022	4	429	R/C	1.9	1.9	3.0	0.5		0.0		0.0	2.3
2022	4	430	R/C	1.9	2.7	3.0	0.4		0.0		0.0	3.1
2023	4	431	CC		0.0	3.6	0.2		0.0		0.0	0.2
2023	4	432	CC		0.0	3.6	0.1		0.0		0.0	0.1
2023	4	433	CC		0.0	3.6	0.1		0.0		0.0	0.1
2023	4	434	CC		0.0	3.6	0.3		0.0		0.0	0.3
2023	4	435	CC		0.0	3.6	0.5		0.0		0.0	0.5
2023	4	436	FTC		0.0		0.0		0.0	2.2	0.4	0.4

2023	4	437	FTC		0.0		0.0		0.0	2.2	0.2	0.2
2023	4	438	FTC		0.0		0.0		0.0	2.2	0.2	0.2
2023	4	439	FTC		0.0		0.0		0.0	2.2	0.4	0.4
2023	4	440	FTC		0.0		0.0		0.0	2.2	0.3	0.3
2023	4	441	R/C	2.0	0.9	3.6	0.0		0.0		0.0	1.0
2023	4	442	R/C	2.0	0.8	3.6	0.0		0.0		0.0	0.8
2023	4	443	R/C	2.0	0.9	3.6	0.1		0.0		0.0	1.0
2023	4	444	R/C	2.0	0.8	3.6	0.2		0.0		0.0	1.0
2023	4	445	R/C	2.0	0.5	3.6	0.3		0.0		0.0	0.8
2023	4	446	CR	2.2	0.9		0.0		0.0		0.0	0.9
2023	4	447	CR	2.2	0.7		0.0		0.0		0.0	0.7
2023	4	448	CR	2.2	0.7		0.0		0.0		0.0	0.7
2023	4	449	CR	2.2	0.9		0.0		0.0		0.0	0.9
2023	4	450	CR	2.2	0.7		0.0		0.0		0.0	0.7
2023	4	451	CF					2.5	0.0			0.0
2023	4	452	CF					2.5	0.0			0.0
2023	4	453	CF					2.5	0.1			0.1
2023	4	454	CF					2.5	0.0			0.0
2023	4	455	CF									0.0
2023	4	456	DSB									0.0
2023	4	457	DSB									0.0
2023	4	458	DSB									0.0
2023	4	459	DSB									0.0
2023	4	460	DSB									0.0
2021	4	461	CC		0.0	2.8	1.0	1.7	0.5		0.0	1.5
2021	4	462	CC		0.0	2.8	0.3	1.7	0.8		0.0	1.1
2021	4	463	CC		0.0	2.8	0.7	1.7	0.4		0.0	1.2
2021	4	464	CC		0.0	2.8	1.0	1.7	0.5		0.0	1.5
2021	4	465	CC		0.0	2.8	0.5	1.7	0.6		0.0	1.1
2021	4	466	DSB									0.0
2021	4	467	DSB									0.0
2021	4	468	DSB									0.0
2021	4	469	DSB									0.0
2021	4	470	DSB									0.0
2021	4	471	CF									0.0
2021	4	472	CF									0.0
2021	4	473	CF									0.0
2021	4	474	CF									0.0
2021	4	475	CF									0.0
2021	4	476	FTC		0.0		0.0		0.0	1.7	0.4	0.4
2021	4	477	FTC		0.0		0.0		0.0	1.7	0.5	0.5
2021	4	478	FTC		0.0		0.0		0.0	1.7	0.6	0.6
2021	4	479	FTC		0.0		0.0		0.0	1.7	0.5	0.5

2021	4	480	FTC		0.0		0.0		0.0	1.7	0.3	0.3
2021	4	481	R/C	2.0	1.3	2.9	0.2		0.0		0.0	1.5
2021	4	482	R/C	2.0	1.0	2.9	0.3		0.0		0.0	1.2
2021	4	483	R/C	2.0	0.5	2.9	0.3		0.0		0.0	0.8
2021	4	484	R/C	2.0	0.8	2.9	0.5		0.0		0.0	1.3
2021	4	485	R/C	2.0	0.9	2.9	0.2		0.0		0.0	1.1
2021	4	486	CR	1.6	0.9		0.0		0.0		0.0	0.9
2021	4	487	CR	1.6	0.6		0.0		0.0		0.0	0.6
2021	4	488	CR	1.6	0.5		0.0		0.0		0.0	0.5
2021	4	489	CR	1.6	0.4		0.0		0.0		0.0	0.4
2021	4	490	CR	1.6	0.6		0.0		0.0		0.0	0.6

0N Corn Data

year	Plot	Cover	component	%C	%N	CN
2021	145	Fallow	Stover	42	0.47	89.3617
2021	145	Fallow	Cobs	44.2	0.58	76.2069
2021	145	Fallow	Kernels	42.9	1.07	40.09346
2021	160	Rye	Stover	41	0.35	117.1429
2021	160	Rye	Cobs	43.7	0.58	75.34483
2021	160	Rye	Kernels	42.5	0.98	43.36735
2021	139	Legume	Stover	41.9	0.37	113.2432
2021	139	Legume	Cobs	44.3	0.41	108.0488
2021	139	Legume	Kernels	42.7	1.05	40.66667
2021	154	Mix	Stover	40.9	0.33	123.9394
2021	154	Mix	Cobs	43.7	0.61	71.63934
2021	154	Mix	Kernels	42.5	0.99	42.92929
2021	270	Fallow	Stover	42	0.38	110.5263
2021	270	Fallow	Cobs	44	0.53	83.01887
2021	270	Fallow	Kernels	42.6	1.02	41.76471
2021	280	Rye	Stover	41.2	0.36	114.4444
2021	280	Rye	Cobs	43.8	0.54	81.11111
2021	280	Rye	Kernels	42.8	1.08	39.62963
2021	265	Legume	Stover	41.6	0.38	109.4737
2021	265	Legume	Cobs	43.8	0.67	65.37313
2021	265	Legume	Kernels	42.4	1.04	40.76923
2021	289	Mix	Stover	41	0.36	113.8889
2021	289	Mix	Cobs	43.9	0.55	79.81818
2021	289	Mix	Kernels	42.7	1	42.7
2021	333	Fallow	Stover	41.3	0.4	103.25
2021	333	Fallow	Cobs	44.2	0.67	65.97015
2021	333	Fallow	Kernels	42.5	1.03	41.26214

2021	354	Rye	Stover	40.6	0.35	116
2021	354	Rye	Cobs	43.7	0.42	104.0476
2021	354	Rye	Kernels	42.6	1.05	40.57143
2021	337	Legume	Stover	41.7	0.36	115.8333
2021	337	Legume	Cobs	43.3	0.64	67.65625
2021	337	Legume	Kernels	42.4	1.04	40.76923
2021	360	Mix	Stover	41.2	0.39	105.641
2021	360	Mix	Cobs	43.4	0.65	66.76923
2021	360	Mix	Kernels	42.5	1.04	40.86538
2021	473	Fallow	Stover	41.3	0.4	103.25
2021	473	Fallow	Cobs	43.6	0.66	66.06061
2021	473	Fallow	Kernels	42.5	0.96	44.27083
2021	488	Rye	Stover	41	0.34	120.5882
2021	488	Rye	Cobs	43	0.5	86
2021	488	Rye	Kernels	42.6	1.07	39.81308
2021	465	Legume	Stover	41.1	0.38	108.1579
2021	465	Legume	Cobs	42.8	0.73	58.63014
2021	465	Legume	Kernels	42.2	1.11	38.01802
2021	485	Mix	Stover	41	0.38	107.8947
2021	485	Mix	Cobs	43.1	0.59	73.05085
2021	485	Mix	Kernels	42.6	1.12	38.03571
2022	178	Fallow	Stover	41.5	0.43	96.51163
2022	178	Fallow	Cobs	44.4	0.5	88.8
2022	178	Fallow	Kernels	42.1	1.05	40.09524
2022	183	Rye	Stover	40.4	0.37	109.1892
2022	183	Rye	Cobs	43.7	0.72	60.69444
2022	183	Rye	Kernels	42.4	1.02	41.56863
2022	186	Legume	Stover	40.7	0.38	107.1053
2022	186	Legume	Cobs	44	0.49	89.79592
2022	186	Legume	Kernels	42.1	0.98	42.95918
2022	162	Mix	Stover	39.7	0.4	99.25
2022	162	Mix	Cobs	43.7	0.54	80.92593
2022	162	Mix	Kernels	41.8	0.93	44.94624
2022	230	Fallow	Stover	41.8	0.44	95
2022	230	Fallow	Cobs	44.2	0.45	98.22222
2022	230	Fallow	Kernels	41.8	0.99	42.22222
2022	206	Rye	Stover	40.5	0.48	84.375
2022	206	Rye	Cobs	43.7	0.72	60.69444
2022	206	Rye	Kernels	42.4	1.14	37.19298
2022	215	Legume	Stover	41.3	0.39	105.8974
2022	215	Legume	Cobs	43.3	0.68	63.67647
2022	215	Legume	Kernels	42.5	1.1	38.63636
2022	216	Mix	Stover	39.8	0.62	64.19355

2022	216	Mix	Cobs	42.4	0.86	49.30233
2022	216	Mix	Kernels	42.4	1.28	33.125
2022	388	Fallow	Stover	41.2	0.45	91.55556
2022	388	Fallow	Cobs	43.9	0.53	82.83019
2022	388	Fallow	Kernels	42.4	1.02	41.56863
2022	376	Rye	Stover	39.7	0.4	99.25
2022	376	Rye	Cobs	43.8	0.58	75.51724
2022	376	Rye	Kernels	42.5	1.01	42.07921
2022	363	Legume	Stover	41.3	0.41	100.7317
2022	363	Legume	Cobs	43.6	0.52	83.84615
2022	363	Legume	Kernels	42.8	1.05	40.7619
2022	375	Mix	Stover	40.4	0.47	85.95745
2022	375	Mix	Cobs	42.9	0.72	59.58333
2022	375	Mix	Kernels	42.1	1.19	35.37815
2022	408	Fallow	Stover	41.3	0.44	93.86364
2022	408	Fallow	Cobs	43.3	0.58	74.65517
2022	408	Fallow	Kernels	42.4	1.07	39.62617
2022	405	Rye	Stover	40.3	0.41	98.29268
2022	405	Rye	Cobs	42.6	0.96	44.375
2022	405	Rye	Kernels	42.2	1.25	33.76
2022	421	Legume	Stover	41	0.44	93.18182
2022	421	Legume	Cobs	44	0.43	102.3256
2022	421	Legume	Kernels	42.5	1.07	39.71963
2022	429	Mix	Stover	40.2	0.51	78.82353
2022	429	Mix	Cobs	44.3	0.62	71.45161
2022	429	Mix	Kernels	43	1.2	35.83333
2023	109	Fallow	Stover	41.9	0.29	144.4828
2023	109	Fallow	Cobs	43.5	0.62	70.16129
2023	109	Fallow	Kernels	42.2	0.97	43.50515
2023	127	Rye	Stover	39.4	0.36	109.4444
2023	127	Rye	Cobs	43	0.63	68.25397
2023	127	Rye	Kernels	42.4	1.08	39.25926
2023	123	Legume	Stover	40.9	0.37	110.5405
2023	123	Legume	Cobs	43.4	0.67	64.77612
2023	123	Legume	Kernels	41.9	0.96	43.64583
2023	120	Mix	Stover	39.7	0.33	120.303
2023	120	Mix	Cobs	43.1	0.55	78.36364
2023	120	Mix	Kernels	42.2	1.02	41.37255
2023	247	Fallow	Stover	40.7	0.47	86.59574
2023	247	Fallow	Cobs	43.8	0.53	82.64151
2023	247	Fallow	Kernels	42	1	42
2023	235	Rye	Stover	39.5	0.4	98.75
2023	235	Rye	Cobs	43	0.66	65.15152

2023	235	Rye	Kernels	42.1	1.12	37.58929
2023	242	Legume	Stover	40.9	0.43	95.11628
2023	242	Legume	Cobs	43.5	0.66	65.90909
2023	242	Legume	Kernels	42.1	1.13	37.25664
2023	237	Mix	Stover	40.2	0.37	108.6486
2023	237	Mix	Cobs	43	0.64	67.1875
2023	237	Mix	Kernels	42	1	42
2023	325	Fallow	Stover	42.1	0.43	97.90698
2023	325	Fallow	Cobs	43.5	0.68	63.97059
2023	325	Fallow	Kernels	42.5	1.06	40.09434
2023	317	Rye	Stover	39.6	0.42	94.28571
2023	317	Rye	Cobs	43.1	0.57	75.61404
2023	317	Rye	Kernels	42.8	1.14	37.54386
2023	312	Legume	Stover	41	0.4	102.5
2023	312	Legume	Cobs	43.7	0.63	69.36508
2023	312	Legume	Kernels	42.4	1.04	40.76923
2023	327	Mix	Stover	40	0.4	100
2023	327	Mix	Cobs	43.4	0.86	50.46512
2023	327	Mix	Kernels	42.7	1.13	37.78761
2023	454	Fallow	Stover	42	0.32	131.25
2023	454	Fallow	Cobs	43.3	0.56	77.32143
2023	454	Fallow	Kernels	42.5	1.04	40.86538
2023	450	Rye	Stover	39.4	0.44	89.54545
2023	450	Rye	Cobs	43.4	0.64	67.8125
2023	450	Rye	Kernels	42.5	1.05	40.47619
2023	431	Legume	Stover	40.7	0.48	84.79167
2023	431	Legume	Cobs	44.2	0.62	71.29032
2023	431	Legume	Kernels	42.6	1.06	40.18868
2023	444	Mix	Stover	39.8	0.42	94.7619
2023	444	Mix	Cobs	43.1	0.91	47.36264
2023	444	Mix	Kernels	42.6	1.03	41.35922
2022	170	FTC	Stover	40.4	0.36	112.2222
2022	170	FTC	Cobs	43.5	0.57	76.31579
2022	170	FTC	Kernels	41.9	1	41.9
2022	174	DSB	Stover	41.2	0.44	93.63636
2022	174	DSB	Cobs	43.8	0.51	85.88235
2022	174	DSB	Kernels	42.3	1	42.3
2022	203	DSB	Stover	40.7	0.39	104.359
2022	203	DSB	Cobs	43.2	0.62	69.67742
2022	203	DSB	Kernels	41.8	1.01	41.38614
2022	221	FTC	Stover	40.6	0.38	106.8421
2022	221	FTC	Cobs	42.9	0.74	57.97297
2022	221	FTC	Kernels	42	1.07	39.25234

2022	370	DSB	Stover	41.1	0.39	105.3846
2022	370	DSB	Cobs	43.7	0.48	91.04167
2022	370	DSB	Kernels	42.4	0.97	43.71134
2022	381	FTC	Stover	40.6	0.36	112.7778
2022	381	FTC	Cobs	43.4	0.57	76.14035
2022	381	FTC	Kernels	41.8	1.02	40.98039
2022	412	DSB	Stover	41.3	0.42	98.33333
2022	412	DSB	Cobs	43.3	0.64	67.65625
2022	412	DSB	Kernels	41.7	1.05	39.71429
2022	416	FTC	Stover	40.5	0.47	86.17021
2022	416	FTC	Cobs	43	0.68	63.23529
2022	416	FTC	Kernels	42	1.15	36.52174
2021	150	DSB	Kernels	42.04	1.08	38.92593
2021	150	DSB	Cob	43.88	0.81	54.17284
2021	150	DSB	Stover	42.72	0.43	99.34884
2021	283	DSB	Kernels	41.83	1.02	41.0098
2021	283	DSB	Cob	44.16	0.65	67.93846
2021	283	DSB	Stover	42.1	0.5	84.2
2021	350	DSB	Kernels	41.7	1.06	39.33962
2021	350	DSB	Cob	44.02	0.78	56.4359
2021	350	DSB	Stover	42.63	0.51	83.58824
2021	468	DSB	Kernels	42.13	1.06	39.74528
2021	468	DSB	Cob	44.07	0.69	63.86957
2021	468	DSB	Stover	42.15	0.43	98.02326
2023	104	FTC	Kernels	42.8	0.89	48.08989
2023	104	FTC	Cob	43.62	0.95	45.91579
2023	104	FTC	Stover	41.45	0.36	115.1389
2023	257	FTC	Kernels	42.75	0.99	43.18182
2023	257	FTC	Cob	43.51	0.94	46.28723
2023	257	FTC	Stover	41.38	0.48	86.20833
2023	306	FTC	Kernels	42.86	1.05	40.81905
2023	306	FTC	Cob	43.84	0.77	56.93506
2023	306	FTC	Stover	40.91	0.45	90.91111
2023	438	FTC	Kernels	42.98	1.16	37.05172
2023	438	FTC	Cob	43.77	0.76	57.59211
2023	438	FTC	Stover	41.83	0.54	77.46296
2023	115	DSB	Kernels	42.89	0.96	44.67708
2023	115	DSB	Cob	44.23	0.87	50.83908
2023	115	DSB	Stover	42	0.52	80.76923
2023	252	DSB	Kernels	42.89	1.02	42.04902
2023	252	DSB	Cob	44.09	0.82	53.76829
2023	252	DSB	Stover	41.53	0.54	76.90741
2023	305	DSB	Kernels	42.87	1.06	40.4434

2023	305	DSB	Cob	43.76	0.79	55.39241
2023	305	DSB	Stover	41.74	0.49	85.18367
2023	458	DSB	Kernels	42.78	0.93	46
2023	458	DSB	Cob	43.51	0.98	44.39796
2023	458	DSB	Stover	42.34	0.51	83.01961

Appendix B - Chapter 3 Raw Data

Corn yield data

year	plot	trt	hhgrain1	hhgrain2	mois1	mois2	yield1bu	yield2bu
2021	101	green	4940	4250	18.2	16.6	187	164
2021	102	late	4910	5040	15.6	16.3	192	196
2021	103	early	6270	6020	17.2	14.9	241	238
2021	104	check	6410	5800	15.2	16.5	252	225
2021	201	early	5770	5690	17.7	18.5	220	215
2021	202	check	5680	6120	18.3	19.5	215	229
2021	203	green	5700	5250	19.5	20.8	213	193
2021	204	late	5480	5340	19	19.9	206	198
2021	301	check	5190	5590	16.4	18.2	201	212
2021	302	early	6190	5380	18	16.9	235	207
2021	303	late	6020	6270	19.7	19.8	224	233
2021	304	green	.	5100	.	19.9	.	189
2021	401	green	5370	4960	15.4	16.7	211	192
2021	402	late	3990	3350	18.5	18.9	151	126
2021	403	check	.	5720	.	16.3	.	222
2021	404	early	5830	5960	18	18	222	227
2022	101	late	1660	2550	17.8	17.4	63	98
2022	102	green	270	1070	16.1	16.8	11	41
2022	103	early	3480	2600	16.6	16.2	135	101
2022	104	check	3660	3610	15.2	15.3	144	142
2022	201	early	3100	3120	17.4	17.4	119	120
2022	202	check	2920	4210	17.6	17	112	162
2022	203	green	1760	2540	18.5	18.5	67	96
2022	204	late	2080	2860	16.7	17.1	80	110
2022	301	check	1550	3590	16.9	17.4	60	138
2022	302	early	2710	3860	16.5	17.4	105	148
2022	303	late	2800	2560	17.4	16.9	107	99
2022	304	green	1090	2010	18.3	17.9	41	77
2022	401	green	990	1590	17.1	20.4	38	59

2022	402	late	2800	2830	17.5	17.2	107	109
2022	403	check	3730	3080	16.5	16.7	144	119
2022	404	early	2980	2910	15.9	17.2	116	112
2023	101	late	2560	3120	15	12.7	101	126
2023	102	green	4160	4580	14.2	15.2	166	180
2023	103	early	3060	4460	13.9	13.7	122	179
2023	104	check	4150	4330	12.6	12.3	168	176
2023	201	early	3710	3340	15.5	14.6	145	132
2023	202	check	4250	4520	16.2	13.4	165	182
2023	203	green	3970	3570	13.5	14.9	159	141
2023	204	late	3460	4090	12.8	12.9	140	165
2023	301	check	2760	4340	12.6	13.7	112	174
2023	302	early	3500	4840	13.9	14.7	140	192
2023	303	late	3930	3050	13.9	13.3	157	123
2023	304	green	3480	3570	12.6	13.1	141	144
2023	401	green	2710	3170	10.8	11.7	112	130
2023	402	late	4190	5150	13.4	15.4	168	202
2023	403	check	4060	2870	13.7	13.4	163	115
2023	404	early	4060	3780	12.6	14.2	165	150

Cereal rye biomass

Cover crop plots only: b – brown; gb – late termination; gr – planting green

year	trt	plot	avg CC biomass 0.25m2	g per m2	Mg ha	ton/ac
2023	b	103	19.3	38.55	0.39	0.17
2023	b	201	15.2	30.4	0.30	0.14
2023	b	302	21.3	42.65	0.43	0.19
2023	b	404	18.4	36.75	0.37	0.16
2023	gb	101	29.4	58.85	0.59	0.26
2023	gb	204	30.4	60.8	0.61	0.27
2023	gb	303	28.4	56.7	0.57	0.25
2023	gb	402	33.7	67.45	0.67	0.30
2023	gr	102	43.3	86.5	0.87	0.39
2023	gr	203	47.7	95.45	0.95	0.43
2023	gr	304	44.6	89.25	0.89	0.40
2023	gr	401	44.6	89.2	0.89	0.40

2022	b	103	30.4	60.75	0.61	0.27
2022	b	201	23.7	47.45	0.47	0.21
2022	b	302	22.8	45.6	0.46	0.20
2022	b	404	22.3	44.6	0.45	0.20
2022	gb	101	38.2	76.45	0.76	0.34
2022	gb	204	55.4	110.85	1.11	0.49
2022	gb	303	50.1	100.1333	1.00	0.45
2022	gb	402	48.9	97.85	0.98	0.44
2022	gr	102	83.6	167.25	1.67	0.75
2022	gr	203	108.1	216.1	2.16	0.96
2022	gr	304	97.1	194.15	1.94	0.87
2022	gr	401	112.6	225.25	2.25	1.00
2021	b	103	116.2	232.35	2.32	1.04
2021	b	201	96.0	192	1.92	0.86
2021	b	302	125.0	249.95	2.50	1.12
2021	b	404	120.5	241	2.41	1.08
2021	gb	102	191.8	383.65	3.84	1.71
2021	gb	204	202.5	404.9	4.05	1.81
2021	gb	303	197.0	394	3.94	1.76
2021	gb	401	210.5	420.95	4.21	1.88
2021	gr	101	297.7	595.4	5.95	2.66
2021	gr	203	297.8	595.65	5.96	2.66
2021	gr	304	311.4	622.85	6.23	2.78
2021	gr	402	328.3	656.5	6.57	2.93

Forage quality data from cereal rye biomass

Trt: 1 – check; 2 – early; 3 – green; 4 – late

Year	plot	trt	Total N %	Total C %	C:N	NDF %	ADF %	Ash %
2022	103	2	4.39	42.06	9.58	35.3	14.8	10.3
2022	201	2	3.7	41.91	11.33	35.2	16.4	9.8
2022	302	2	3.71	42.15	11.36	33.9	15.6	9.8
2022	404	2	3.88	42.32	10.91	37.5	16.2	9.2
2023	103	2	4.51	41.64	9.23	32.8	8.9	10.4
2023	201	2	4.51	41.54	9.21	32.1	13.9	10.1
2023	302	2	4.51	41.57	9.22	33.1	14.9	10.6
2023	404	2	4.52	41.8	9.25	33	14.9	10.1

2022	102	3	2.69	42.38	15.75	56.3	29.9	9.9
2022	203	3	2.61	42.21	16.17	57	30.3	9.6
2022	304	3	2.79	42.33	15.17	55.3	29.3	9.3
2022	401	3	2.33	42.35	18.18	59	31.8	9.4
2023	102	3	4.14	40.96	9.89	34.9	17.5	9.9
2023	203	3	4.18	41.48	9.92	33.7	16.7	9.5
2023	304	3	4.36	40.9	9.38	34.4	17.7	10.2
2023	401	3	3.78	41.03	10.85	34.6	17.9	9.3
2022	101	4	3.02	42.61	14.11	40.8	19.5	9
2022	204	4	2.98	42.25	14.18	41.8	20.3	9.2
2022	303	4	3.26	42.77	13.12	41.9	20	9.1
2022	402	4	3.25	42.29	13.01	40.2	20.1	9.5
2023	101	4	4.37	41.55	9.51	35.7	18.2	10.7
2023	204	4	4.33	41.77	9.65	36.3	18.2	10.4
2023	303	4	4.33	41.8	9.65	35.9	18	10.2
2023	402	4	4.24	41.56	9.80	38.1	19.4	10.5

Stalk rot

Trt: 1 – check; 2 – early; 3 – green; 4 – late

Year	State	Plot #	Treatment	Replicate	Row	Plant	Total # of nodes + internodes	Total # of rotted nodes + internodes	% Rot
2021	KS	101	4	1	5	1	10	1	10%
2021	KS	101	4	1	5	2	12	1	8%
2021	KS	101	4	1	5	3	11	0	0%
2021	KS	101	4	1	12	1	11	0	0%
2021	KS	101	4	1	12	2	11	0	0%
2021	KS	101	4	1	12	3	11	1	9%
2021	KS	102	3	1	5	1	13	0	0%
2021	KS	102	3	1	5	2	11	0	0%
2021	KS	102	3	1	5	3	11	0	0%
2021	KS	102	3	1	12	1	13	0	0%
2021	KS	102	3	1	12	2	11	0	0%
2021	KS	102	3	1	12	3	13	1	8%
2021	KS	103	2	1	5	1	11	3	27%
2021	KS	103	2	1	5	2	11	1	9%
2021	KS	103	2	1	5	3	11	0	0%

2021	KS	103	2	1	12	1	13	0	0%
2021	KS	103	2	1	12	2	13	0	0%
2021	KS	103	2	1	12	3	11	0	0%
2021	KS	104	1	1	5	1	9	0	0%
2021	KS	104	1	1	5	2	9	0	0%
2021	KS	104	1	1	5	3	10	1	10%
2021	KS	104	1	1	12	1	11	3	27%
2021	KS	104	1	1	12	2	9	1	11%
2021	KS	104	1	1	12	3	11	3	27%
2021	KS	201	2	2	5	1	13	0	0%
2021	KS	201	2	2	5	2	11	1	9%
2021	KS	201	2	2	5	3	11	1	9%
2021	KS	201	2	2	12	1	12	0	0%
2021	KS	201	2	2	12	2	11	1	9%
2021	KS	201	2	2	12	3	11	0	0%
2021	KS	202	1	2	5	1	9	0	0%
2021	KS	202	1	2	5	2	10	1	10%
2021	KS	202	1	2	5	3	9	0	0%
2021	KS	202	1	2	12	1	13	2	15%
2021	KS	202	1	2	12	2	11	2	18%
2021	KS	202	1	2	12	3	11	0	0%
2021	KS	203	3	2	5	1	11	0	0%
2021	KS	203	3	2	5	2	11	1	9%
2021	KS	203	3	2	5	3	11	0	0%
2021	KS	203	3	2	12	1	13	0	0%
2021	KS	203	3	2	12	2	12	0	0%
2021	KS	203	3	2	12	3	11	0	0%
2021	KS	204	4	2	5	1	11	0	0%
2021	KS	204	4	2	5	2	11	0	0%
2021	KS	204	4	2	5	3	11	1	9%
2021	KS	204	4	2	12	1	12	4	33%
2021	KS	204	4	2	12	2	13	0	0%
2021	KS	204	4	2	12	3	13	0	0%
2021	KS	301	1	3	5	1	11	0	0%
2021	KS	301	1	3	5	2	11	1	9%
2021	KS	301	1	3	5	3	13	0	0%
2021	KS	301	1	3	12	1	11	0	0%
2021	KS	301	1	3	12	2	11	0	0%
2021	KS	301	1	3	12	3	10	0	0%
2021	KS	302	2	3	5	1	11	0	0%

2021	KS	302	2	3	5	2	11	3	27%
2021	KS	302	2	3	5	3	9	0	0%
2021	KS	302	2	3	12	1	11	0	0%
2021	KS	302	2	3	12	2	11	0	0%
2021	KS	302	2	3	12	3	10	1	10%
2021	KS	303	4	3	5	1	13	1	8%
2021	KS	303	4	3	5	2	11	0	0%
2021	KS	303	4	3	5	3	13	0	0%
2021	KS	303	4	3	12	1	13	2	15%
2021	KS	303	4	3	12	2	13	2	15%
2021	KS	303	4	3	12	3	13	0	0%
2021	KS	304	3	3	5	1	11	0	0%
2021	KS	304	3	3	5	2	12	1	8%
2021	KS	304	3	3	5	3	11	1	9%
2021	KS	304	3	3	12	1	13	0	0%
2021	KS	304	3	3	12	2	13	0	0%
2021	KS	304	3	3	12	3	10	1	10%
2021	KS	401	3	4	5	1	10	0	0%
2021	KS	401	3	4	5	2	12	0	0%
2021	KS	401	3	4	5	3	11	0	0%
2021	KS	401	3	4	12	1	13	0	0%
2021	KS	401	3	4	12	2	13	1	8%
2021	KS	401	3	4	12	3	13	4	31%
2021	KS	402	4	4	5	1	11	0	0%
2021	KS	402	4	4	5	2	11	0	0%
2021	KS	402	4	4	5	3	12	0	0%
2021	KS	402	4	4	12	1	11	1	9%
2021	KS	402	4	4	12	2	13	1	8%
2021	KS	402	4	4	12	3	13	0	0%
2021	KS	403	1	4	5	1	11	0	0%
2021	KS	403	1	4	5	2	9	1	11%
2021	KS	403	1	4	5	3	9	0	0%
2021	KS	403	1	4	12	1	11	1	9%
2021	KS	403	1	4	12	2	11	0	0%
2021	KS	403	1	4	12	3	11	1	9%
2021	KS	404	2	4	5	1	11	1	9%
2021	KS	404	2	4	5	2	11	1	9%
2021	KS	404	2	4	5	3	11	0	0%
2021	KS	404	2	4	12	1	12	0	0%
2021	KS	404	2	4	12	2	11	0	0%

2021	KS	404	2	4	12	3	11	0	0%
2022	KS	101	4	1	5	1	11	0	0%
2022	KS	101	4	1	5	2	13	1	8%
2022	KS	101	4	1	5	3	13	0	0%
2022	KS	101	4	1	12	1	10	0	0%
2022	KS	101	4	1	12	2	12	2	17%
2022	KS	101	4	1	12	3	13	1	8%
2022	KS	102	3	1	5	1	10	1	10%
2022	KS	102	3	1	5	2	12	0	0%
2022	KS	102	3	1	5	3	9	0	0%
2022	KS	102	3	1	12	1	7	0	0%
2022	KS	102	3	1	12	2	11	0	0%
2022	KS	102	3	1	12	3	12	1	8%
2022	KS	103	2	1	5	1	11	1	9%
2022	KS	103	2	1	5	2	13	0	0%
2022	KS	103	2	1	5	3	14	1	7%
2022	KS	103	2	1	12	1	13	0	0%
2022	KS	103	2	1	12	2	14	0	0%
2022	KS	103	2	1	12	3	13	5	38%
2022	KS	104	1	1	5	1	13	4	31%
2022	KS	104	1	1	5	2	12	1	8%
2022	KS	104	1	1	5	3	11	1	9%
2022	KS	104	1	1	12	1	13	0	0%
2022	KS	104	1	1	12	2	12	4	33%
2022	KS	104	1	1	12	3	12	0	0%
2022	KS	201	2	2	5	1	11	1	9%
2022	KS	201	2	2	5	2	11	0	0%
2022	KS	201	2	2	5	3	11	1	9%
2022	KS	201	2	2	12	1	13	3	23%
2022	KS	201	2	2	12	2	11	3	27%
2022	KS	201	2	2	12	3	11	0	0%
2022	KS	202	1	2	5	1	13	0	0%
2022	KS	202	1	2	5	2	12	1	8%
2022	KS	202	1	2	5	3	11	1	9%
2022	KS	202	1	2	12	1	11	0	0%
2022	KS	202	1	2	12	2	10	0	0%
2022	KS	202	1	2	12	3	12	0	0%
2022	KS	203	3	2	5	1	12	0	0%
2022	KS	203	3	2	5	2	11	1	9%
2022	KS	203	3	2	5	3	12	0	0%

2022	KS	203	3	2	12	1	11	0	0%
2022	KS	203	3	2	12	2	13	1	8%
2022	KS	203	3	2	12	3	11	2	18%
2022	KS	204	4	2	5	1	12	0	0%
2022	KS	204	4	2	5	2	12	1	8%
2022	KS	204	4	2	5	3	14	0	0%
2022	KS	204	4	2	12	1	14	0	0%
2022	KS	204	4	2	12	2	11	0	0%
2022	KS	204	4	2	12	3	12	7	58%
2022	KS	301	1	3	5	1	12	0	0%
2022	KS	301	1	3	5	2	13	0	0%
2022	KS	301	1	3	5	3	14	0	0%
2022	KS	301	1	3	12	1	13	1	8%
2022	KS	301	1	3	12	2	10	0	0%
2022	KS	301	1	3	12	3	12	0	0%
2022	KS	302	2	3	5	1	11	0	0%
2022	KS	302	2	3	5	2	10	1	10%
2022	KS	302	2	3	5	3	10	1	10%
2022	KS	302	2	3	12	1	12	1	8%
2022	KS	302	2	3	12	2	12	2	17%
2022	KS	302	2	3	12	3	13	0	0%
2022	KS	303	4	3	5	1	12	0	0%
2022	KS	303	4	3	5	2	11	1	9%
2022	KS	303	4	3	5	3	12	0	0%
2022	KS	303	4	3	12	1	12	0	0%
2022	KS	303	4	3	12	2	12	0	0%
2022	KS	303	4	3	12	3	10	0	0%
2022	KS	304	3	3	5	1	13	4	31%
2022	KS	304	3	3	5	2	14	1	7%
2022	KS	304	3	3	5	3	12	0	0%
2022	KS	304	3	3	12	1	12	0	0%
2022	KS	304	3	3	12	2	12	0	0%
2022	KS	304	3	3	12	3	13	1	8%
2022	KS	401	3	4	5	1	14	4	29%
2022	KS	401	3	4	5	2	14	0	0%
2022	KS	401	3	4	5	3	12	3	25%
2022	KS	401	3	4	12	1	12	4	33%
2022	KS	401	3	4	12	2	12	4	33%
2022	KS	401	3	4	12	3	12	1	8%
2022	KS	402	4	4	5	1	13	0	0%

2022	KS	402	4	4	5	2	11	0	0%
2022	KS	402	4	4	5	3	12	1	8%
2022	KS	402	4	4	12	1	14	0	0%
2022	KS	402	4	4	12	2	12	0	0%
2022	KS	402	4	4	12	3	12	0	0%
2022	KS	403	1	4	5	1	12	0	0%
2022	KS	403	1	4	5	2	11	0	0%
2022	KS	403	1	4	5	3	12	2	17%
2022	KS	403	1	4	12	1	12	0	0%
2022	KS	403	1	4	12	2	12	4	33%
2022	KS	403	1	4	12	3	12	1	8%
2022	KS	404	2	4	5	1	10	2	20%
2022	KS	404	2	4	5	2	12	6	50%
2022	KS	404	2	4	5	3	10	0	0%
2022	KS	404	2	4	12	1	12	1	8%
2022	KS	404	2	4	12	2	12	0	0%
2022	KS	404	2	4	12	3	13	0	0%
2023	KS	101	4	1	5	1	13	1	8%
2023	KS	101	4	1	5	2	11	0	0%
2023	KS	101	4	1	5	3	13	0	0%
2023	KS	101	4	1	12	1	13	1	8%
2023	KS	101	4	1	12	2	10	3	30%
2023	KS	101	4	1	12	3	13	3	23%
2023	KS	102	3	1	5	1	11	4	36%
2023	KS	102	3	1	5	2	12	2	17%
2023	KS	102	3	1	5	3	11	2	18%
2023	KS	102	3	1	12	1	12	2	17%
2023	KS	102	3	1	12	2	11	1	9%
2023	KS	102	3	1	12	3	13	1	8%
2023	KS	103	2	1	5	1	11	2	18%
2023	KS	103	2	1	5	2	11	1	9%
2023	KS	103	2	1	5	3	11	0	0%
2023	KS	103	2	1	12	1	11	0	0%
2023	KS	103	2	1	12	2	11	0	0%
2023	KS	103	2	1	12	3	9	1	11%
2023	KS	104	1	1	5	1	12	2	17%
2023	KS	104	1	1	5	2	12	2	17%
2023	KS	104	1	1	5	3	11	2	18%
2023	KS	104	1	1	12	1	13	1	8%
2023	KS	104	1	1	12	2	11	0	0%

2023	KS	104	1	1	12	3	13	0	0%
2023	KS	201	2	2	5	1	11	0	0%
2023	KS	201	2	2	5	2	13	3	23%
2023	KS	201	2	2	5	3	11	1	9%
2023	KS	201	2	2	12	1	11	0	0%
2023	KS	201	2	2	12	2	13	2	15%
2023	KS	201	2	2	12	3	11	2	18%
2023	KS	202	1	2	5	1	13	0	0%
2023	KS	202	1	2	5	2	14	0	0%
2023	KS	202	1	2	5	3	11	3	27%
2023	KS	202	1	2	12	1	11	1	9%
2023	KS	202	1	2	12	2	11	0	0%
2023	KS	202	1	2	12	3	11	0	0%
2023	KS	203	3	2	5	1	9	0	0%
2023	KS	203	3	2	5	2	9	1	11%
2023	KS	203	3	2	5	3	13	0	0%
2023	KS	203	3	2	12	1	9	2	22%
2023	KS	203	3	2	12	2	11	0	0%
2023	KS	203	3	2	12	3	10	1	10%
2023	KS	204	4	2	5	1	11	0	0%
2023	KS	204	4	2	5	2	11	0	0%
2023	KS	204	4	2	5	3	11	1	9%
2023	KS	204	4	2	12	1	11	1	9%
2023	KS	204	4	2	12	2	11	4	36%
2023	KS	204	4	2	12	3	13	1	8%
2023	KS	301	1	3	5	1	11	3	27%
2023	KS	301	1	3	5	2	11	1	9%
2023	KS	301	1	3	5	3	13	0	0%
2023	KS	301	1	3	12	1	12	0	0%
2023	KS	301	1	3	12	2	10	0	0%
2023	KS	301	1	3	12	3	12	1	8%
2023	KS	302	2	3	5	1	11	0	0%
2023	KS	302	2	3	5	2	10	0	0%
2023	KS	302	2	3	5	3	13	4	31%
2023	KS	302	2	3	12	1	13	0	0%
2023	KS	302	2	3	12	2	13	0	0%
2023	KS	302	2	3	12	3	11	0	0%
2023	KS	303	4	3	5	1	11	1	9%
2023	KS	303	4	3	5	2	12	2	17%
2023	KS	303	4	3	5	3	12	1	8%

2023	KS	303	4	3	12	1	12	0	0%
2023	KS	303	4	3	12	2	11	3	27%
2023	KS	303	4	3	12	3	11	2	18%
2023	KS	304	3	3	5	1	9	0	0%
2023	KS	304	3	3	5	2	11	2	18%
2023	KS	304	3	3	5	3	11	0	0%
2023	KS	304	3	3	12	1	11	0	0%
2023	KS	304	3	3	12	2	11	4	36%
2023	KS	304	3	3	12	3	12	5	42%
2023	KS	401	3	4	5	1	11	0	0%
2023	KS	401	3	4	5	2	10	0	0%
2023	KS	401	3	4	5	3	11	0	0%
2023	KS	401	3	4	12	1	10	0	0%
2023	KS	401	3	4	12	2	11	2	18%
2023	KS	401	3	4	12	3	11	1	9%
2023	KS	402	4	4	5	1	11	1	9%
2023	KS	402	4	4	5	2	13	3	23%
2023	KS	402	4	4	5	3	11	2	18%
2023	KS	402	4	4	12	1	12	2	17%
2023	KS	402	4	4	12	2	10	1	10%
2023	KS	402	4	4	12	3	9	2	22%
2023	KS	403	1	4	5	1	11	0	0%
2023	KS	403	1	4	5	2	11	1	9%
2023	KS	403	1	4	5	3	10	1	10%
2023	KS	403	1	4	12	1	11	5	45%
2023	KS	403	1	4	12	2	11	3	27%
2023	KS	403	1	4	12	3	13	2	15%
2023	KS	404	2	4	5	1	11	4	36%
2023	KS	404	2	4	5	2	11	4	36%
2023	KS	404	2	4	5	3	11	3	27%
2023	KS	404	2	4	12	1	10	0	0%
2023	KS	404	2	4	12	2	11	2	18%
2023	KS	404	2	4	12	3	11	1	9%

Seedling Vigor

Year	Plot	Trt	Rep	Growth Stage	Row	# of seedlings in 1/1000th ac	Growth stage of the majority of seedlings in 1/1000th ac	# of seedlings at least one growth stage behind in 1/1000th ac	ratio seedlings behind
2023	101	4	1	V3	8	23	V3	2	0.09
2023	101	4	1	V3	9	22	V3	3	0.14
2023	102	3	1	V3	8	27	V3	3	0.11
2023	102	3	1	V3	9	24	V3	1	0.04
2023	103	2	1	V3	8	18	V3	3	0.17
2023	103	2	1	V3	9	25	V3	2	0.08
2023	104	1	1	V3	8	22	V3	0	0.00
2023	104	1	1	V3	9	26	V3	1	0.04
2023	201	2	2	V3	8	20	V3	2	0.10
2023	201	2	2	V3	9	20	V3	6	0.30
2023	202	1	2	V3	8	25	V3	2	0.08
2023	202	1	2	V3	9	26	V3	1	0.04
2023	203	3	2	V3	8	22	V3	2	0.09
2023	203	3	2	V3	9	8	V3	3	0.38
2023	204	4	2	V3	8	25	V3	5	0.20
2023	204	4	2	V3	9	26	V3	2	0.08
2023	301	1	3	V3	8	19	V3	4	0.21
2023	301	1	3	V3	9	24	V3	1	0.04
2023	302	2	3	V3	8	20	V3	1	0.05
2023	302	2	3	V3	9	26	V3	1	0.04
2023	303	4	3	V3	8	26	V3	1	0.04
2023	303	4	3	V3	9	18	V3	3	0.17
2023	304	3	3	V3	8	26	V3	3	0.12
2023	304	3	3	V3	9	25	V3	4	0.16
2023	401	3	4	V3	8	24	V3	2	0.08
2023	401	3	4	V3	9	23	V3	3	0.13
2023	402	4	4	V3	8	24	V3	4	0.17
2023	402	4	4	V3	9	22	V3	1	0.05
2023	403	1	4	V3	8	22	V3	0	0.00
2023	403	1	4	V3	9	18	V3	2	0.11
2023	404	2	4	V3	8	24	V3	0	0.00

2023	404	2	4	V3	9	23	V3	2	0.09
2022	101	4	1	V3	8	25	V3	3	0.12
2022	101	4	1	V3	9	20	V3	8	0.40
2022	102	3	1	V3	8	19	V2	7	0.37
2022	102	3	1	V3	9	17	V2	9	0.53
2022	103	2	1	V3	8	21	V3	4	0.19
2022	103	2	1	V3	9	24	V3	5	0.21
2022	104	1	1	V3	8	24	V3	5	0.21
2022	104	1	1	V3	9	23	V3	3	0.13
2022	201	2	2	V3	8	21	V3	3	0.14
2022	201	2	2	V3	9	23	V3	3	0.13
2022	202	1	2	V3	8	19	V3	4	0.21
2022	202	1	2	V3	9	18	V3	3	0.17
2022	203	3	2	V3	8	19	V1	4	0.21
2022	203	3	2	V3	9	21	V1	3	0.14
2022	204	4	2	V3	8	15	V3	4	0.27
2022	204	4	2	V3	9	21	V3	8	0.38
2022	301	1	3	V3	8	22	V2	3	0.14
2022	301	1	3	V3	9	25	V3	2	0.08
2022	302	2	3	V3	8	14	V3	2	0.14
2022	302	2	3	V3	9	21	V3	2	0.10
2022	303	4	3	V3	8	20	V3	5	0.25
2022	303	4	3	V3	9	24	V3	5	0.21
2022	304	3	3	V3	8	16	V1-V2	3	0.19
2022	304	3	3	V3	9	21	V1	3	0.14
2022	401	3	4	V3	8	15	V1-V2	1	0.07
2022	401	3	4	V3	9	12	V1	2	0.17
2022	402	4	4	V3	8	22	V3	3	0.14
2022	402	4	4	V3	9	24	V3	4	0.17
2022	403	1	4	V3	8	23	V3	1	0.04
2022	403	1	4	V3	9	24	V3	4	0.17
2022	404	2	4	V3	8	23	V3	4	0.17
2022	404	2	4	V3	9	22	V3	2	0.09
2021	101	4	1	V3	8	27	V4	6	0.22
2021	101	4	1	V3	9	27	V4	5	0.19
2021	102	3	1	V3	8	29	V4	6	0.21
2021	102	3	1	V3	9	31	V4	5	0.16
2021	103	2	1	V3	8	29	V4	3	0.10
2021	103	2	1	V3	9	30	V4	6	0.20
2021	104	1	1	V3	8	31	V4	6	0.19

2021	104	1	1	V3	9	29	V4	4	0.14
2021	201	2	2	V3	8	25	V4	4	0.16
2021	201	2	2	V3	9	30	V4	7	0.23
2021	202	1	2	V3	8	26	V4	5	0.19
2021	202	1	2	V3	9	27	V4	3	0.11
2021	203	3	2	V3	8	31	V4	5	0.16
2021	203	3	2	V3	9	25	V4	5	0.20
2021	204	4	2	V3	8	20	V3	3	0.15
2021	204	4	2	V3	9	31	V3	9	0.29
2021	301	1	3	V3	8	32	V5	7	0.22
2021	301	1	3	V3	9	24	V5	9	0.38
2021	302	2	3	V3	8	30	V5	7	0.23
2021	302	2	3	V3	9	27	V5	8	0.30
2021	303	4	3	V3	8	28	V4	3	0.11
2021	303	4	3	V3	9	26	V4	1	0.04
2021	304	3	3	V3	8	29	V5	10	0.34
2021	304	3	3	V3	9	28	V4	1	0.04
2021	401	3	4	V3	8	26	V4	12	0.46
2021	401	3	4	V3	9	25	V4	7	0.28
2021	402	4	4	V3	8	27	V4	11	0.41
2021	402	4	4	V3	9	27	V4	6	0.22
2021	403	1	4	V3	8	31	V5	6	0.19
2021	403	1	4	V3	9	31	V5	5	0.16
2021	404	2	4	V3	8	28	V5	12	0.43
2021	404	2	4	V3	9	26	V5	9	0.35

Seedling Shoot and Root Biomass

Year	Plot	Trt	Rep	Row	Shoot dry weight (g)	Root dry weight (g)	shoot:root ratio
2023	101	4	1	5	1.19	0.41	2.90
2023	101	4	1	12	1.17	0.43	2.72
2023	102	3	1	5	1.13	0.63	1.79
2023	102	3	1	12	0.67	0.46	1.46
2023	103	2	1	5	0.88	0.58	1.52
2023	103	2	1	12	0.99	0.41	2.41
2023	104	1	1	5	1.65	0.67	2.46

2023	104	1	1	12	1.31	0.54	2.43
2023	201	2	2	5	1.35	0.5	2.70
2023	201	2	2	12	1.68	0.78	2.15
2023	202	1	2	5	1.32	0.33	4.00
2023	202	1	2	12	1.6	0.83	1.93
2023	203	3	2	5	1.08	0.42	2.57
2023	203	3	2	12	1.04	0.5	2.08
2023	204	4	2	5	1.39	0.85	1.64
2023	204	4	2	12	0.94	0.23	4.09
2023	301	1	3	5	1.48	0.96	1.54
2023	301	1	3	12	1.37	0.49	2.80
2023	302	2	3	5	1.6	0.84	1.90
2023	302	2	3	12	1.16	0.74	1.57
2023	303	4	3	5	0.87	0.66	1.32
2023	303	4	3	12	0.72	0.39	1.85
2023	304	3	3	5	1.1	0.45	2.44
2023	304	3	3	12	1.09	0.51	2.14
2023	401	3	4	5	0.78	0.75	1.04
2023	401	3	4	12	0.96	0.49	1.96
2023	402	4	4	5	1.36	0.56	2.43
2023	402	4	4	12	1.4	0.95	1.47
2023	403	1	4	5	1.77	1.07	1.65
2023	403	1	4	12	1.06	0.9	1.18
2023	404	2	4	5	1.65	0.75	2.20
2023	404	2	4	12	1.07	1	1.07
2022	101	4	1	5	1.32	0.52	2.54
2022	101	4	1	12	1.52	0.43	3.53
2022	102	3	1	5	0.17	0.17	1.00
2022	102	3	1	12	0.18	0.28	0.64
2022	103	2	1	5	0.96	1	0.96
2022	103	2	1	12	1.68	0.74	2.27
2022	104	1	1	5	2.42	0.71	3.41
2022	104	1	1	12	2.19	1.03	2.13
2022	201	2	2	5	1.74	0.63	2.76
2022	201	2	2	12	2.32	0.94	2.47
2022	202	1	2	5	2.45	0.76	3.22
2022	202	1	2	12	2.33	0.97	2.40
2022	203	3	2	5	.	0.27	.
2022	203	3	2	12	0.43	0.02	21.50
2022	204	4	2	5	1.41	0.87	1.62

2022	204	4	2	12	1.62	0.54	3.00
2022	301	1	3	5	2.67	0.64	4.17
2022	301	1	3	12	3.75	1.1	3.41
2022	302	2	3	5	1.84	0.56	3.29
2022	302	2	3	12	1.82	0.63	2.89
2022	303	4	3	5	0.63	0.39	1.62
2022	303	4	3	12	1.7	0.78	2.18
2022	304	3	3	5	0.59	0.26	2.27
2022	304	3	3	12	0.52	0.2	2.60
2022	401	3	4	5	0.37	0.28	1.32
2022	401	3	4	12	0.26	0	.
2022	402	4	4	5	1.57	0.69	2.28
2022	402	4	4	12	1.64	0.34	4.82
2022	403	1	4	5	1.79	0.66	2.71
2022	403	1	4	12	2.25	0.68	3.31
2022	404	2	4	5	2.14	0.68	3.15
2022	404	2	4	12	1.87	0.58	3.22
2021	101	4	1	5	0.51	0.43	1.19
2021	101	4	1	12	0.61	0.37	1.65
2021	102	3	1	5	1.31	0.72	1.82
2021	102	3	1	12	0.84	0.55	1.53
2021	103	2	1	5	1.47	0.65	2.26
2021	103	2	1	12	1.4	0.76	1.84
2021	104	1	1	5	1.18	0.67	1.76
2021	104	1	1	12	2.29	0.85	2.69
2021	201	2	2	5	2.42	0.91	2.66
2021	201	2	2	12	1.41	0.37	3.81
2021	202	1	2	5	3.96	1.14	3.47
2021	202	1	2	12	1.07	3.12	0.34
2021	203	3	2	5	0.97	0.52	1.87
2021	203	3	2	12	0.83	0.64	1.30
2021	204	4	2	5	1.02	0.51	2.00
2021	204	4	2	12	1.1	0.59	1.86
2021	301	1	3	5	3.23	1.15	2.81
2021	301	1	3	12	1.99	0.85	2.34
2021	302	2	3	5	1	0.59	1.69
2021	302	2	3	12	1.56	0.59	2.64
2021	303	4	3	5	1.07	0.54	1.98
2021	303	4	3	12	0.8	0.63	1.27
2021	304	3	3	5	0.89	0.55	1.62

2021	304	3	3	12	0.39	0.1	3.90
2021	401	3	4	5	1.39	0.62	2.24
2021	401	3	4	12	0.71	0.29	2.45
2021	402	4	4	5	0.6	0.5	1.20
2021	402	4	4	12	0.78	0.46	1.70
2021	403	1	4	5	1.49	0.69	2.16
2021	403	1	4	12	2.29	0.98	2.34
2021	404	2	4	5	0.91	0.39	2.33
2021	404	2	4	12	1.94	0.6	3.23

Seedling vigor at V3

Year	Plot	Trt	Rep	Growth Stage	Row	# of seedlings in 1/1000th ac	Growth stage of the majority of seedlings in 1/1000th ac	# of seedlings at least one growth stage behind in 1/1000th ac	fraction seedlings behind
2023	101	4	1	V3	8	23	V3	2	0.09
2023	101	4	1	V3	9	22	V3	3	0.14
2023	102	3	1	V3	8	27	V3	3	0.11
2023	102	3	1	V3	9	24	V3	1	0.04
2023	103	2	1	V3	8	18	V3	3	0.17
2023	103	2	1	V3	9	25	V3	2	0.08
2023	104	1	1	V3	8	22	V3	0	0.00
2023	104	1	1	V3	9	26	V3	1	0.04
2023	201	2	2	V3	8	20	V3	2	0.10
2023	201	2	2	V3	9	20	V3	6	0.30
2023	202	1	2	V3	8	25	V3	2	0.08
2023	202	1	2	V3	9	26	V3	1	0.04
2023	203	3	2	V3	8	22	V3	2	0.09
2023	203	3	2	V3	9	8	V3	3	0.38
2023	204	4	2	V3	8	25	V3	5	0.20
2023	204	4	2	V3	9	26	V3	2	0.08
2023	301	1	3	V3	8	19	V3	4	0.21
2023	301	1	3	V3	9	24	V3	1	0.04
2023	302	2	3	V3	8	20	V3	1	0.05
2023	302	2	3	V3	9	26	V3	1	0.04

2023	303	4	3	V3	8	26	V3	1	0.04
2023	303	4	3	V3	9	18	V3	3	0.17
2023	304	3	3	V3	8	26	V3	3	0.12
2023	304	3	3	V3	9	25	V3	4	0.16
2023	401	3	4	V3	8	24	V3	2	0.08
2023	401	3	4	V3	9	23	V3	3	0.13
2023	402	4	4	V3	8	24	V3	4	0.17
2023	402	4	4	V3	9	22	V3	1	0.05
2023	403	1	4	V3	8	22	V3	0	0.00
2023	403	1	4	V3	9	18	V3	2	0.11
2023	404	2	4	V3	8	24	V3	0	0.00
2023	404	2	4	V3	9	23	V3	2	0.09
2022	101	4	1	V3	8	25	V3	3	0.12
2022	101	4	1	V3	9	20	V3	8	0.40
2022	102	3	1	V3	8	19	V2	7	0.37
2022	102	3	1	V3	9	17	V2	9	0.53
2022	103	2	1	V3	8	21	V3	4	0.19
2022	103	2	1	V3	9	24	V3	5	0.21
2022	104	1	1	V3	8	24	V3	5	0.21
2022	104	1	1	V3	9	23	V3	3	0.13
2022	201	2	2	V3	8	21	V3	3	0.14
2022	201	2	2	V3	9	23	V3	3	0.13
2022	202	1	2	V3	8	19	V3	4	0.21
2022	202	1	2	V3	9	18	V3	3	0.17
2022	203	3	2	V3	8	19	V1	4	0.21
2022	203	3	2	V3	9	21	V1	3	0.14
2022	204	4	2	V3	8	15	V3	4	0.27
2022	204	4	2	V3	9	21	V3	8	0.38
2022	301	1	3	V3	8	22	V2	3	0.14
2022	301	1	3	V3	9	25	V3	2	0.08
2022	302	2	3	V3	8	14	V3	2	0.14
2022	302	2	3	V3	9	21	V3	2	0.10
2022	303	4	3	V3	8	20	V3	5	0.25
2022	303	4	3	V3	9	24	V3	5	0.21
2022	304	3	3	V3	8	16	V1-V2	3	0.19
2022	304	3	3	V3	9	21	V1	3	0.14
2022	401	3	4	V3	8	15	V1-V2	1	0.07
2022	401	3	4	V3	9	12	V1	2	0.17
2022	402	4	4	V3	8	22	V3	3	0.14
2022	402	4	4	V3	9	24	V3	4	0.17

2022	403	1	4	V3	8	23	V3	1	0.04
2022	403	1	4	V3	9	24	V3	4	0.17
2022	404	2	4	V3	8	23	V3	4	0.17
2022	404	2	4	V3	9	22	V3	2	0.09
2021	101	4	1	V3	8	27	V4	6	0.22
2021	101	4	1	V3	9	27	V4	5	0.19
2021	102	3	1	V3	8	29	V4	6	0.21
2021	102	3	1	V3	9	31	V4	5	0.16
2021	103	2	1	V3	8	29	V4	3	0.10
2021	103	2	1	V3	9	30	V4	6	0.20
2021	104	1	1	V3	8	31	V4	6	0.19
2021	104	1	1	V3	9	29	V4	4	0.14
2021	201	2	2	V3	8	25	V4	4	0.16
2021	201	2	2	V3	9	30	V4	7	0.23
2021	202	1	2	V3	8	26	V4	5	0.19
2021	202	1	2	V3	9	27	V4	3	0.11
2021	203	3	2	V3	8	31	V4	5	0.16
2021	203	3	2	V3	9	25	V4	5	0.20
2021	204	4	2	V3	8	20	V3	3	0.15
2021	204	4	2	V3	9	31	V3	9	0.29
2021	301	1	3	V3	8	32	V5	7	0.22
2021	301	1	3	V3	9	24	V5	9	0.38
2021	302	2	3	V3	8	30	V5	7	0.23
2021	302	2	3	V3	9	27	V5	8	0.30
2021	303	4	3	V3	8	28	V4	3	0.11
2021	303	4	3	V3	9	26	V4	1	0.04
2021	304	3	3	V3	8	29	V5	10	0.34
2021	304	3	3	V3	9	28	V4	1	0.04
2021	401	3	4	V3	8	26	V4	12	0.46
2021	401	3	4	V3	9	25	V4	7	0.28
2021	402	4	4	V3	8	27	V4	11	0.41
2021	402	4	4	V3	9	27	V4	6	0.22
2021	403	1	4	V3	8	31	V5	6	0.19
2021	403	1	4	V3	9	31	V5	5	0.16
2021	404	2	4	V3	8	28	V5	12	0.43
2021	404	2	4	V3	9	26	V5	9	0.35

Appendix C - Common mixed-layer clay minerals: what they are and how to identify them

Introduction

Mixed-layer minerals are interstratified phyllosilicate clays with alternating mineral layers. Illite-smectite and chlorite-smectite are of the most observed and studied mixed-layer minerals, yet there are still relatively few studies on their formation and kinetics. There is interest in exploring these clay minerals as “geological thermometers” for low-temperature environments, but mineral metastability and difficulties in studying thermodynamic properties hinder these interests, thus the interest in the mixed-layer minerals. Unlike mixed minerals such as dolomite ($0.5 \text{ MgCO}_3 + 0.5 \text{ CaCO}_3$), the mixed-layer clays that will be discussed are not necessarily found in the consistent composition or order as characteristic of dolomite, but rather they exist in unique phases of varying order. Different degrees of substitution may be present in these minerals, and studying them helps geologists, soil scientists, and other investigators understand the provenance of the clays they are studying and their previous geologic conditions. This literature review will concisely cover the common mixed interlayer clays, their relevance in interpreting historical pressure and temperature conditions, and how they are studied and analyzed in laboratory settings.

Common Types of Mixed-Layer Clays and Their Geological Significance

Illite-smectite

One of the best studied mixed-layer clay minerals is illite-smectite (I/S). The general reaction for smectite decomposition to illite is $\text{smectite} + \text{Al}^{3+} + \text{K}^+ = \text{illite} + \text{Si}^{4+}$, and the availability of the Al^{3+} and K^+ in this reaction (and other mineral formation reactions) is

dependent on the surrounding rocks and minerals present (Wilson, 1999). The compositional and metamorphic relationships are discussed in the classic paper by Hower et al. (1976). They investigated the relationship between mineral composition of shales with increasing burial depth in the Gulf of Mexico, finding increased illite proportion and ordering of I/S layer interstratification with depth associated with burial metamorphism.

The relationship between I/S phases and their proposed mechanisms of formation are further explored in a study by Dong et al. (1997), where they compared Gulf Coast shale sequences (similar to Hower et al., 1976), hydrothermal bentonite from eastern Europe, and other shales from the Nankai Trough (Japan), Michigan, and the Welsh sedimentary basin. Their results related increasing burial metamorphic grade with increasing illite proportion including some more specific sequencing than explored in the 1976 Hower study but in general agreement. Smectite is the dominating phase in lower grades, I/S at moderate or middle grades, and illite at the highest grade, and assemblages of various proportions of the three phases together exist throughout the shale sequences observed. This supports the hypothesis that the smectite – I/S – illite transformation is a diagenetic process influenced by pressure in lower-temperature systems affected by burial metamorphism.

The mechanism of formation of I/S and progression of the smectite-I/S-illite system is somewhat controversial in the study of clay minerals. The proposed reaction mechanisms are solid-state transformation, dissolution and crystallization, and Ostwald ripening (which is similar to the dissolution and crystallization mechanism, but is specific to smaller crystals reforming onto larger crystals (Perkins, 2002)), and these mechanisms were explored by Altaner and Ylagan (1997) for I/S specifically. They found the solid-state transformation mechanism suitable in rock-dominated systems (e.g. bentonite) and

the dissolution and crystallization mechanism suitable in fluid dominated systems (e. g. sandstones and hydrothermal environments). Both of these mechanisms may be present in shale environments, but the Ostwald ripening mechanism is not likely (Altaner & Ylagan, 1997). The study by Dong et al. (1997) supports the dissolution and recrystallization theory of mechanism due to the lack of observed continuously variable smectite-like and illite-like layer phases. They proposed that this mechanism could occur across a single layer or packet of mineral layers or through massive dissolution and transport by fluids in the shales. This is consistent with the Altaner & Ylagan (1997) study, considering they were observing shale sequences. The debate on mechanism theories discussed through a kinetics lens in Stixrude and Peacor's 2002 Nature article. Their models and computations support the sequences observed in the aforementioned shale sequences but emphasize the gaps in the series, that it is not continuous. They found the mixed-layered R1 (first-order) I/S mixed-layer illite-smectite analogous to corrensite, which is an intermediate in the chlorite-smectite system.

Chlorite-Smectite

Another common mixed-layer clay mineral is chlorite-smectite (C/S). Chlorite is a low-grade metamorphic mineral, and the C/S mixed layer clay is associated with low-temperature burial metamorphic environments, similar to the I/S clays (Beaufort et al., 2015; Hower et al., 1976). In shale sequences, chlorite content peaks at around the 3000m depth (Hower et al., 1976) and may have experienced hydrothermal or diagenetic processes. The existence of randomly interlayered C/S has been debated, but the study by Bettison-Varga & Mackinnon (1997) closely investigated this and did not find evidence for long-range ordering of these mixed-layer clays.

The chloritization process of smectites to form mixed-layer minerals are associated with low-temperature environments (<220°C), and this process was explored in a review by Beaufort et al. (2015) to uncover the reaction mechanisms associated with chloritization and the observed C/S minerals intermediately produced in the process. Saponite (a common variety of smectite) crystallizes at low temperatures and is replaced by corrensite as temperature (or grade) increases, through a reaction where there are distinct sequences of chlorite-corrensite distinguishable from chlorite-smectite mixed layers (Beaufort et al., 2015). Similar to the aforementioned I/S sequences, Beaufort describes two models proposed to describe this conversion; a gradual continuous model influenced by depth (pressure) in which smectite and chlorite layers are stacked along the *c* axis dominated by solid-state transformation reaction mechanism and 2) a continuous model that is dominated by the dissolution-crystallization reaction mechanism where the original structure of the saponite is lost and reaction progress is more abrupt. They confirm, however, that the dissolution and crystallization mechanism is best supported by analytical data (Beaufort et al., 2015). Fluid inclusions at these depths provide H⁺ ions for the formation and recrystallization of the phyllosilicates. For the berthierine-chlorite reaction, they conclude that the solid-state transformation mechanism dominates due to the preservation of crystal habit and the reversal in the tetrahedral sheet by cross-shifting of Si and O atoms between layers. Either way, the reaction mechanism is proposed to happen along the layer transition boundaries (Bettison-Varga & Mackinnon, 1997).

As previously mentioned, the smectite-C/S-chlorite progression can be observed by depths and increasing temperature. As temperature increases, the proportion of chlorite in the interstratified mixed-layer minerals increases until the composition is just chlorite (Beaufort et al., 2015). The mixed-layer C/S minerals are a pale green color and occur in patches the

groundmass of ophiolites, whereas chlorite is more commonly found filling vesicles (Bettison-Varga & Mackinnon, 1997).

Kaolinite

An honorable mention in the discussion of mixed-layer minerals is kaolinite, or specifically kaolinite-sudoite (a chlorite group mineral). Kaolinite is generally understood as the most basic phyllosilicate that can form from the decomposition of other 2:1 minerals and is associated with highly weathered systems (Wilson, 1999). However, the review by Beaufort et al. (2015) covers the kaolinite to sudoite conversion. This conversion is not documented as the I/S and C/S mixed-layer clays and their progressions, which the review calls for investigation due to the findings of kaolinite, tosudite (1:1 interstratified chlorite-smectite different from corrensite), and sudoite together in reported sedimentary and hydrothermal systems. Mixed-layer kaolinite-smectite have reportedly been observed in Jiujiang red earth in southeastern China as evidence of climate change from dry to humid condition, and they reportedly were mostly kaolinite with random interstratification of smectite (Hong et al., 2012).

Vermiculite

A study of Xuancheng red soils from east-central China investigated mixed-layer illite-vermiculite and reports that its presence in the soils indicated an acidic soil-forming environment while acknowledging the challenges in identifying it (Yin et al., 2016). Hydrogen ions (acidic conditions) and other ions in solution continue to be reported as necessary for the development of mixed-layer minerals in general (Yin et al., 2016; Beaufort et al., 2015; Wilson, 1999). Their associated challenges in identifying the illite-vermiculite will be briefly covered in the next section.

X-Ray Diffraction and Other Identification Techniques

X-Ray Diffraction Methods

Mixed-layer clay minerals are challenging to identify using traditional x-ray diffraction (XRD) methods, especially when in the presence of their simple mineral components, as they will appear as broad, undefined peaks without additional treatment (Moore & Reynolds, 1997). The similar crystal structure of chlorite and berthierine, for example, result in close clustered peaks and general challenges in studying their interstratified mixed-mineral structures (Beaufort et al., 2015). All the spectra generated from heat and chemical treatments of the sample must be considered in order to interpret XRD data containing evidence of mixed-layer minerals. The peaks produced from mixed-layer minerals can be characterized initially using Mering's principles, which to paraphrase, describe how mixed-layer minerals will result in reflections (or displacements) proportional to the end-members in the interstratification (Moore & Reynolds, 1997; Plançon, 2013). These are not explicit in the XRD output, but rather they can be extrapolated by studying the XRD outputs following different treatments. Using Mering's principle, one can calculate a value for the variable Q by taking the ratio of their proposed interstratified minerals and multiply that ratio by the supposed ordering of the mix (i.e. 1 for a first-order reflection, etc.), and the Q value can be used to predict the line breadth (Moore & Reynolds, 1997). Comparing Q to calculated line breadths can help investigators identify the presence and type of mixed-layer minerals in their sample. This method is not perfect, however, and may only be useful for low quantities of one component or random ordering in mixed-layer minerals. Computations using the NEWMOD program are useful to standardizing and attempting to quantify samples.

For I/S mixed-layer silicates, high-quality diffraction patterns from different sample treatments, especially ethylene glycol solvation, are very useful for determining if it is present in

your sample. Ethylene glycol solvation results in separation of the illite and I/S peaks in the XRD pattern. This diagnostic data only provides insight on the presence or absence of I/S in the sample and does not provide quantitative data (Moore & Reynolds, 1997). Previously, Inoue et al. (1989) challenged the validity of the saddle/001 method which used the ratio of the peak intensity at the 001 peak and that at the down-angle from the 001 peak to quantify the percentage of smectite layers in the I/S mixed-layer clay in a sample. They determined that this method may result in 10-15% error when taking into consideration the effects of preferred orientation and crystallite size (sizes of crystalline domains) distribution in the sample, so it is not alone reliable for quantifying smectite in these samples.

For C/S mixed-layer silicates, resulting XRD patterns similarly respond the ethylene glycol solvation similar to that in I/S samples. For C/S samples, interpretation of these patterns is more challenging, and samples must be compared to totally dehydrated and heated (375°) samples. Ethylene glycol will expand the smectite peak and heating the sample will collapse it, confirming its identification (Moore & Reynolds, 1997). The heat treatment will also help differentiate C/S from possible chlorite-vermiculite that may be present, as heat collapses the peak to 10Å if it is vermiculite and sharpens the reflection near 18.5 2θ if the sample is C/S. The dehydrated sample can be quantitatively analyzed for mineral percentages (chlorite, smectite, and corrensite) by integrating the area under the peaks and their reflections alongside estimated Fe content using NEWMOD program (Moore & Reynolds, 1997).

For kaolinite-smectite, which as previously discussed is not as well studied as the other mixed-layer silicates, ethylene glycol solvation results in the characteristic migration of smectite peaks and no impact on the kaolinite peaks. It may be especially useful to compare sample spectra to pure kaolinite spectra. Kaolinite percentage can be calculated by the positions of

001/002 and 002/005 reflections in the spectra (Table 8.6 Moore & Reynolds, 1997). Generally, the data provided by XRD is much more useful when the sample is treated with the appropriate diagnostic treatments and the resulting spectra can be compared to one another to get the full picture.

Transmission Electron Microscopy

The use of transmission electron microscopy (TEM) for studying mixed-layer silicates presents an amazing opportunity to extrapolate formation mechanisms and layer ordering in samples by visually examining the phyllosilicates. Dong et al. (1997) used TEM along with analytical electron microscopy (AEM) and selected area electron diffraction (SAED) to investigate the phase reactions for smectite-I/S-illite progression in shales. This was not a methods study, but they used these methods to observe lattice-fringe images from TEM to visually and quantitatively measure the differences in layer spaces and morphology. Proposed reaction progressions would be expansive or compressive, and measuring the layer spaces in the I/S clays would support or oppose the disputed models. Samples are expanded with L.R. White Resin prior to TEM imaging. The AEM data provides chemical information for the layers and the SAED data is used to understand the crystallographic structure.. They ultimately supported the continuous replacement theory based on their TEM observations and accompanying XRD data (Dong et al., 1997). In the study by Bettison-Varga and Mackinnon (1997), they used AEM to determine if individual layers were “chlorite-like” or “smectite-like,” allowing them to interpret the layers as randomly interlayered or detect a level of order in the sequences. They similarly observed TEM images and used XRD patterns to study the progression of smectite-C/S-chlorite. In the review by Beaufort et al. (2015), they also cite and reproduce electron microscopy images to emphasize morphological differences in different chlorite compositions.

Conclusions and Research Directions

Understanding mixed-layer minerals is important for developing the understanding of low-grade burial metamorphic environments. The composition of I/S and C/S minerals are associated with these deep sedimentary (often shale) environments, and their components are proportioned according to their depth. The reaction mechanisms of mixed-layer silicate formation are widely debated. Different investigations have concluded that both reactions are possible, but dissolution and recrystallization may be the most likely. There is still work to be done for this inquiry. Studying mixed-layer minerals is challenging, as the traditional XRD methods require more nuance and other data to fully understand their presence and proportions. However, quantifying the proportion of components in a mixed-layer silicate can be challenging, especially using XRD alone. Additional sample treatments and advanced TEM and AEM imagery may help complete the picture for a specific sample or series of samples in a geological progression.

Relevance to Magruder Clays Study

The clay mineralogy of the Magruder plots is being studied for the purpose of understanding anthropogenic impacts on soil forming factors and shallow geology. The Magruder plots are located in Stillwater, Oklahoma and have been consistently managed for over 100 years. They are mapped as the Kirkland soil series and the geology is mapped as alluvium over Permian age shale. Residuum soil sampled deeper in the profile may have some amounts of these mixed-layer minerals, perhaps in the surface horizon as well if they were transported in the alluvium. The acidification associated with long-term soil fertility management may also influence the formation of mixed-layer minerals through the proposed and supported reaction mechanism of dissolution and recrystallization. An understanding of mixed-mineral clays and the methods

associated with identifying them may prove very useful in the investigation of these agricultural clays.

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Appendix D - Cover crops on-farm: Grain yield, and cover crop decomposition data

Materials and methods

These fields were part of the on-farm network through Precision Sustainable Agriculture. Following farmer decisions, two replicate strips were established representing bare no-till (or conservation till, but most sites were no-till) and cover crops. Acclima TDR-310H sensors (Appendix Figure A.1) were placed in each strip at 15, 45, and 80-cm depths, and the first replicate had moisture sensors at 5 cm (Appendix Figure A.2). Moisture data was collected every 15 minutes from the TDR sensors (data available through North Carolina State; on-farm web interface is no longer live).

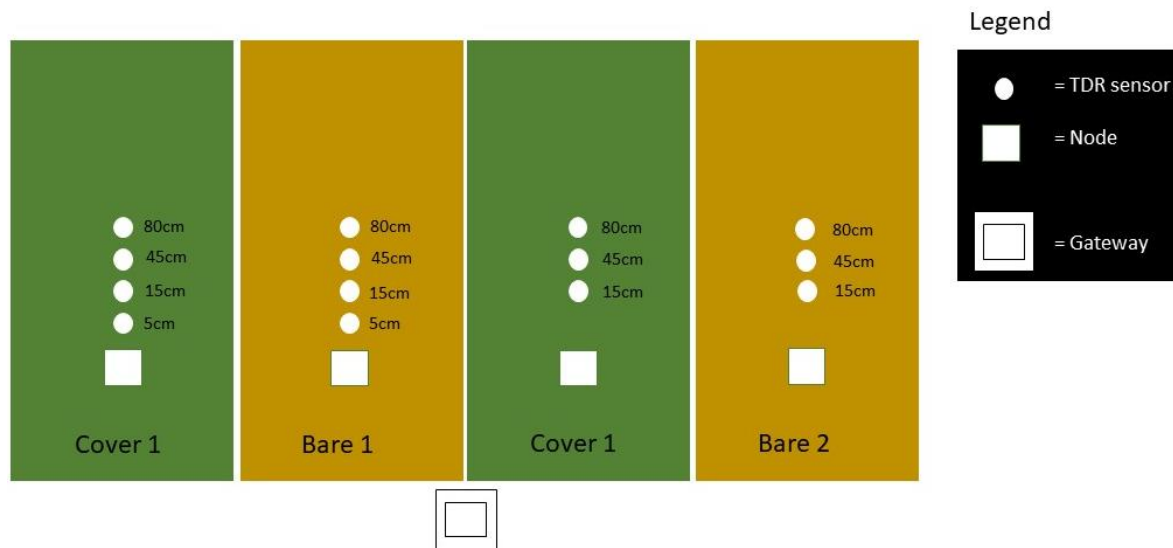
Just before cover crop termination on the farm, biomass samples were taken from two 1-m² quadrats in each cover crop replicate. Biomass was then combined and distributed into 12 total litterbags – 10 mesh and 2 paper. Mesh bags were deployed in the field and secured with lawn staples, and paper bags were returned to the lab for drying and weighing of the biomass at termination (Time 0). Bags were then retrieved 14 days (T1), 30 days (T2), 60 days (T3), 90 days (T4), and at harvest (T5). At retrieval, bags were brought to the lab to dry to constant weight. Litterbags were pre-tared and weighed at filling. Dried contents were ground to 1-mm size in a wiley mill and sent to North Carolina State University EATS lab for analyses. Harvest on-farm was generally executed with the farmer's combine and a weigh wagon brought to the station.

Producer information

producer_id	last_name	code	year	affiliation	county	longitude	latitude
2021KS101	Roeser	DFV	2022	KS	Riley	96.7348896	39.0514823
2021KS827	Flickner	GWP	2023	KS	McPherson	97.5717371	38.230474
2021KS101	Roeser	IWY	2023	KS	Riley	96.7354647	39.0516057
2021KS485	Henson	JBB	2021	KS	Coffey	95.6764069	38.2577972
2021KS01	Duncan	OOA	2021	KS	Pottawatomie	96.4367294	39.3358574
2021KS01	Duncan	QYI	2023	KS	Pottawatomie	96.4381818	39.3365206
2021KS827	Flickner	SVA	2022	KS	McPherson	97.6013862	38.196775
2021KS01	Duncan	UCG	2022	KS	Pottawatomie	96.4372144	39.3355413
2021KS101	Roeser	VOP	2021	KS	Geary	96.7348862	39.0507164
2021KS485	Henson	YLM	2022	KS	Coffey	95.6554957	38.252966
2021KS827	Flickner	YRV	2021	KS	McPherson	97.5736313	38.2391586



Appendix Figure D.1 Acclima True TDR-310H Soil Volumetric Water Content and Temperature Sensor



Appendix Figure D.2 Example of sensor and receiver placement in cover crop and bare replicate strips

Results

B = bare, C = cover

Litterbag Biomass and CN

code	cash_crop	subplot	subsample	time	percent_c	percent_n	recovery_date	dry_biomass_wt	year
DFV	Soybeans	1	A	0	41.5	1.5	5/9/2022	74.5	2022
DFV	Soybeans	1	A	5	38.1	1.9	10/17/2022	57.3	2022
DFV	Soybeans	1	B	0	41.1	1.3	5/9/2022	74.5	2022
DFV	Soybeans	1	B	1	40.7	1.3	5/23/2022	94.8	2022
DFV	Soybeans	1	B	2	34.5	1.4	6/10/2022	82.1	2022
DFV	Soybeans	1	B	3	36.1	1.6	7/25/2022	77	2022
DFV	Soybeans	1	B	4	35.4	1.7	8/8/2022	75.5	2022
DFV	Soybeans	1	B	5	38.7	1.7	10/17/2022	64.8	2022
DFV	Soybeans	2	A	0	41.3	1.4	5/9/2022	64	2022
DFV	Soybeans	2	A	1	41.9	1.3	5/23/2022	79.4	2022
DFV	Soybeans	2	A	2	31.2	1.4	6/10/2022	80.2	2022
DFV	Soybeans	2	A	3	31.5	1.4	7/25/2022	71.6	2022
DFV	Soybeans	2	A	4	30.6	1.5	8/8/2022	70.2	2022
DFV	Soybeans	2	A	5	33.9	1.9	10/17/2022	58.6	2022
DFV	Soybeans	2	B	0	41.4	1.3	5/9/2022	65.5	2022
DFV	Soybeans	2	B	1	40.6	1.5	5/23/2022	88.7	2022
DFV	Soybeans	2	B	2	33.0	1.5	6/10/2022	74.6	2022
DFV	Soybeans	2	B	3	32.6	1.7	7/25/2022	70.5	2022
DFV	Soybeans	2	B	4	36.7	1.7	8/8/2022	64.2	2022

DFV	Soybeans	2	B	5	34.8	2.1	10/17/2022	59.2	2022
DFV	Soybeans	1	A	1	39.6	1.4	5/23/2022	85.1	2022
DFV	Soybeans	1	A	2	34.6	1.5	6/10/2022	81	2022
DFV	Soybeans	1	A	3	29.1	1.4	7/25/2022	81.4	2022
DFV	Soybeans	1	A	4	35.3	1.9	8/8/2022	72.8	2022
GWP	Soybeans	2	B	3	37.0	2.3	6/12/2023	68.03	2023
GWP	Soybeans	1	A	2	41.4	2.2	5/14/2023	76.8	2023
GWP	Soybeans	1	A	1	42.5	2.4	4/28/2023	88.1	2023
GWP	Soybeans	1	A	0	42.0	2.2	4/11/2023	90.5	2023
GWP	Soybeans	1	A	4	37.3	2.4	6/12/2023	76.15	2023
GWP	Soybeans	1	A	5	32.9	2.7	9/29/2023	66.1	2023
GWP	Soybeans	1	B	0	42.1	2.2	4/11/2023	89.9	2023
GWP	Soybeans	1	B	1	41.7	2.0	4/28/2023	77	2023
GWP	Soybeans	1	B	2	40.1	2.0	5/14/2023	78.3	2023
GWP	Soybeans	1	B	3	34.3	2.5	7/11/2023	72.8	2023
GWP	Soybeans	1	B	4	37.3	2.3	7/11/2023	75.2	2023
GWP	Soybeans	1	B	5	34.3	2.4	9/29/2023	57.8	2023
GWP	Soybeans	2	A	0	41.3	2.1	4/11/2023	92.5	2023
GWP	Soybeans	2	A	1	42.2	2.0	4/28/2023	75.9	2023
GWP	Soybeans	2	A	2	41.1	2.2	5/14/2023	76	2023
GWP	Soybeans	2	A	3	37.7	2.2	6/12/2023	71.6	2023
GWP	Soybeans	2	A	4	31.1	2.4	7/11/2023	65.1	2023
GWP	Soybeans	2	A	5	31.5	2.6	9/29/2023	59.9	2023
GWP	Soybeans	2	B	0	41.9	2.0	4/11/2023	91.2	2023
GWP	Soybeans	2	B	1	42.1	2.2	4/28/2023	75.2	2023
GWP	Soybeans	2	B	2	40.7	2.1	5/14/2023	75.8	2023
GWP	Soybeans	1	A	3	37.0	2.5	6/12/2023	76.43	2023
GWP	Soybeans	2	B	4	34.3	2.5	7/11/2023	64	2023
GWP	Soybeans	2	B	5	30.2	2.4	9/29/2023	59.3	2023
IWY	Corn	2	A	3					2023
IWY	Corn	1	A	0	42.2	4.7	4/10/2023	100.6	2023
IWY	Corn	1	B	0	43.4	4.9	4/10/2023	97.5	2023
IWY	Corn	2	A	0	43.5	5.0	4/10/2023	106	2023
IWY	Corn	2	B	0	43.6	4.9	4/10/2023	86.2	2023
IWY	Corn	1	A	2					2023
IWY	Corn	1	A	3					2023
IWY	Corn	1	A	4					2023
IWY	Corn	1	A	5					2023
IWY	Corn	1	B	1					2023
IWY	Corn	1	B	2					2023
IWY	Corn	1	B	3					2023
IWY	Corn	1	B	4					2023
IWY	Corn	1	B	5					2023

IWY	Corn	2	A	1					2023
IWY	Corn	2	A	2					2023
IWY	Corn	1	A	1					2023
IWY	Corn	2	A	4					2023
IWY	Corn	2	A	5					2023
IWY	Corn	2	B	1					2023
IWY	Corn	2	B	2					2023
IWY	Corn	2	B	3					2023
IWY	Corn	2	B	4					2023
IWY	Corn	2	B	5					2023
JBB	Soybeans	1	A	0	43.0	1.1	5/13/2021	90.2	2021
JBB	Soybeans	1	A	3	42.8	0.7	7/14/2021	75.3	2021
JBB	Soybeans	1	A	4	45.1	1.8	8/13/2021	66.3	2021
JBB	Soybeans	1	A	2	43.0	0.9	6/17/2021	74.8	2021
JBB	Soybeans	1	A	1	43.2	1.0	5/27/2021	75.7	2021
JBB	Soybeans	1	A	5	43.8	0.9	10/7/2021	66.7	2021
JBB	Soybeans	1	B	0	42.4	0.9	5/13/2021	91.3	2021
JBB	Soybeans	1	B	1	43.3	0.9	5/27/2021	85.5	2021
JBB	Soybeans	1	B	2	43.0	0.7	6/17/2021	84.5	2021
JBB	Soybeans	1	B	3	43.9	1.0	7/14/2021	77.5	2021
JBB	Soybeans	1	B	4	44.9	1.6	8/13/2021	76.4	2021
JBB	Soybeans	1	B	5	44.7	1.8	10/7/2021	69.2	2021
JBB	Soybeans	2	A	0	43.0	1.6	5/13/2021	96.1	2021
JBB	Soybeans	2	A	1	44.2	1.7	5/27/2021	86.7	2021
JBB	Soybeans	2	A	2	43.9	1.1	6/17/2021	81.6	2021
JBB	Soybeans	2	A	3	45.1	1.6	7/14/2021	77.6	2021
JBB	Soybeans	2	A	4	43.5	1.5	8/13/2021	77.4	2021
JBB	Soybeans	2	A	5	44.4	1.6	10/7/2021	69.9	2021
JBB	Soybeans	2	B	0	44.0	1.7	5/13/2021	96.1	2021
JBB	Soybeans	2	B	1	42.4	1.1	5/27/2021	87.1	2021
JBB	Soybeans	2	B	2	43.3	1.0	6/17/2021	87.1	2021
JBB	Soybeans	2	B	3	44.7	1.1	7/14/2021	77.4	2021
JBB	Soybeans	2	B	4	43.5	1.7	8/13/2021	72.9	2021
JBB	Soybeans	2	B	5	42.5	2.1	10/7/2021	69.4	2021
OOA	Soybeans	2	A	0	41.6	0.8	5/24/2021	120.9	2021
OOA	Soybeans	1	A	0	42.3	0.8	5/24/2021	138.9	2021
OOA	Soybeans	1	A	1	40.7	0.4	6/7/2021	138	2021
OOA	Soybeans	1	A	2	40.9	0.6	6/23/2021	131.2	2021
OOA	Soybeans	1	A	3	41.3	0.7	7/21/2021	119.5	2021
OOA	Soybeans	1	A	4	41.8	0.8	8/24/2021	106.4	2021
OOA	Soybeans	1	A	5	39.2	1.6	10/5/2021	92.3	2021
OOA	Soybeans	1	B	0	42.5	1.1	5/24/2021	140.7	2021
OOA	Soybeans	1	B	1	41.3	0.8	6/7/2021	127.6	2021

OOA	Soybeans	1	B	2	40.6	0.6	6/23/2021	124.9	2021
OOA	Soybeans	1	B	3	41.0	0.4	7/21/2021	115.3	2021
OOA	Soybeans	1	B	4	42.4	0.9	8/24/2021	96	2021
OOA	Soybeans	1	B	5	41.9	0.5	10/5/2021	97.6	2021
OOA	Soybeans	2	A	1	41.1	0.8	6/7/2021	122.4	2021
OOA	Soybeans	2	A	2	42.1	0.7	6/23/2021	118.8	2021
OOA	Soybeans	2	A	3	42.3	0.8	7/21/2021	102.8	2021
OOA	Soybeans	2	A	4	42.0	0.8	8/24/2021	96.5	2021
OOA	Soybeans	2	A	5	38.9	1.1	10/5/2021	88.8	2021
OOA	Soybeans	2	B	0	41.8	0.9	5/24/2021	125.8	2021
OOA	Soybeans	2	B	1	42.0	0.9	6/7/2021	119.1	2021
OOA	Soybeans	2	B	2	41.2	0.8	6/23/2021	112.7	2021
OOA	Soybeans	2	B	3	41.3	1.0	7/21/2021	96.7	2021
OOA	Soybeans	2	B	4	40.9	0.9	8/24/2021	99.6	2021
OOA	Soybeans	2	B	5	41.1	0.9	10/5/2021	92.6	2021
QYI	Soybeans	2	B	5	30.5	2.8	10/16/2023	49.5	2023
QYI	Soybeans	1	A	0	43.0	2.9	5/2/2023	73.9	2023
QYI	Soybeans	1	A	1	38.7	2.8	5/16/2023	59.81	2023
QYI	Soybeans	1	A	2	38.3	3.0	6/2/2023	54.75	2023
QYI	Soybeans	1	A	3	39.1	3.1	6/30/2023	59.3	2023
QYI	Soybeans	1	A	4	31.2	3.0	7/31/2023	58.3	2023
QYI	Soybeans	1	A	5	30.3	3.0	10/16/2023	58.4	2023
QYI	Soybeans	1	B	0	42.6	2.9	5/2/2023	74.4	2023
QYI	Soybeans	1	B	1	39.5	2.9	5/16/2023	67.25	2023
QYI	Soybeans	1	B	2	36.4	2.8	6/2/2023	63.35	2023
QYI	Soybeans	1	B	3	27.1	2.6	6/30/2023	54	2023
QYI	Soybeans	1	B	4	35.3	3.5	7/31/2023	49.7	2023
QYI	Soybeans	1	B	5	33.6	3.3	10/16/2023	49.3	2023
QYI	Soybeans	2	A	0	42.8	2.7	5/2/2023	71.8	2023
QYI	Soybeans	2	A	1	38.2	2.7	5/16/2023	59.15	2023
QYI	Soybeans	2	A	2	37.1	3.1	6/2/2023	53.34	2023
QYI	Soybeans	2	A	3	35.7	3.1	6/30/2023	51.1	2023
QYI	Soybeans	2	A	4	30.3	3.0	7/31/2023	52	2023
QYI	Soybeans	2	A	5	30.2	2.8	10/16/2023	49.9	2023
QYI	Soybeans	2	B	0	42.4	2.5	5/2/2023	72.4	2023
QYI	Soybeans	2	B	1	38.9	2.8	5/16/2023	56.36	2023
QYI	Soybeans	2	B	2	37.6	2.7	6/2/2023	56.84	2023
QYI	Soybeans	2	B	3	24.3	2.3	6/30/2023	61.6	2023
QYI	Soybeans	2	B	4	32.2	3.1	7/31/2023	51.9	2023
SVA	Corn	1	A	0	-999.0	-999.0	4/25/2022	40.9	2022
SVA	Corn	1	A	1	40.9	4.4	5/10/2022	54.4	2022
SVA	Corn	1	A	2	16.8	1.6	5/25/2022	67.5	2022
SVA	Corn	1	A	3	14.8	1.2	6/22/2022	54.7	2022

SVA	Corn	1	A	4	7.4	0.7	7/24/2022	71.8	2022
SVA	Corn	1	A	5	6.8	0.6	8/30/2022	64	2022
SVA	Corn	1	B	0	-999.0	-999.0	4/25/2022	40.6	2022
SVA	Corn	1	B	1	40.8	4.4	5/10/2022	54.4	2022
SVA	Corn	1	B	2	22.8	2.0	5/25/2022	63.5	2022
SVA	Corn	1	B	3	12.9	1.0	6/22/2022	62.2	2022
SVA	Corn	1	B	4	14.2	1.2	7/24/2022	56.2	2022
SVA	Corn	1	B	5	-999.0	-999.0	8/30/2022	60.3	2022
SVA	Corn	2	A	0	-999.0	-999.0	4/25/2022	38.3	2022
SVA	Corn	2	A	1	43.1	4.3	5/10/2022	50.8	2022
SVA	Corn	2	A	2	31.9	2.8	5/25/2022	56.7	2022
SVA	Corn	2	A	3	19.3	1.7	6/22/2022	53.6	2022
SVA	Corn	2	A	4	17.6	1.5	7/24/2022	52.9	2022
SVA	Corn	2	A	5	-999.0	-999.0	8/30/2022	51.7	2022
SVA	Corn	2	B	0	-999.0	-999.0	4/25/2022	41.1	2022
SVA	Corn	2	B	1	42.5	4.8	5/10/2022	51.6	2022
SVA	Corn	2	B	2	27.5	2.3	5/25/2022	65.4	2022
SVA	Corn	2	B	3	26.9	2.2	6/22/2022	52.5	2022
SVA	Corn	2	B	4	-999.0	-999.0	7/24/2022	60.3	2022
SVA	Corn	2	B	5	-999.0	-999.0	8/30/2022	57.6	2022
UCG	Soybeans	2	A	2	40.9	1.6	6/6/2022	81.1	2022
UCG	Soybeans	1	A	0	42.6	1.3	5/9/2022	80.2	2022
UCG	Soybeans	1	A	1	42.0	1.1	5/24/2022	88	2022
UCG	Soybeans	1	A	2	40.6	1.4	6/6/2022	86	2022
UCG	Soybeans	1	A	3	42.3	1.1	7/25/2022	82.3	2022
UCG	Soybeans	1	A	4	38.1	1.4	8/8/2022	72.5	2022
UCG	Soybeans	1	A	5	42.9	1.4	10/22/2022	72	2022
UCG	Soybeans	1	B	0	42.0	1.3	5/9/2022	81.6	2022
UCG	Soybeans	1	B	1	41.9	1.1	5/24/2022	89.5	2022
UCG	Soybeans	1	B	2	41.2	1.3	6/6/2022	88	2022
UCG	Soybeans	1	B	3	43.0	1.2	7/25/2022	73.9	2022
UCG	Soybeans	1	B	4	43.8	1.2	8/8/2022	75.7	2022
UCG	Soybeans	1	B	5	40.8	1.8	10/22/2022	72.9	2022
UCG	Soybeans	2	A	0	41.8	1.4	5/9/2022	68.4	2022
UCG	Soybeans	2	A	1	40.3	1.4	5/24/2022	83.3	2022
UCG	Soybeans	2	A	3	42.6	1.4	7/25/2022	63.9	2022
UCG	Soybeans	2	A	4	40.3	1.7	8/8/2022	69.6	2022
UCG	Soybeans	2	A	5	41.5	2.0	10/22/2022	64.9	2022
UCG	Soybeans	2	B	0	41.8	1.5	5/9/2022	64.3	2022
UCG	Soybeans	2	B	1	41.9	1.4	5/24/2022	79.4	2022
UCG	Soybeans	2	B	2	41.8	1.8	6/6/2022	77	2022
UCG	Soybeans	2	B	3	40.4	1.7	7/25/2022	63.2	2022
UCG	Soybeans	2	B	4	37.0	2.2	10/22/2022	66.1	2022

UCG	Soybeans	2	B	5	39.4	2.0	8/8/2022	60.2	2022
VOP	Corn	2	B	5	38.3	3.3	9/21/2021	64.5	2021
VOP	Corn	2	B	4	36.3	3.2	7/22/2021	75.3	2021
VOP	Corn	2	B	3	40.1	3.4	6/22/2021	80.3	2021
VOP	Corn	2	B	2	41.2	3.3	5/25/2021	85.3	2021
VOP	Corn	2	B	1	42.0	3.8	5/6/2021	114.3	2021
VOP	Corn	2	B	0	42.4	3.5	4/23/2021	122.1	2021
VOP	Corn	2	A	5	33.6	3.0	9/21/2021	59.7	2021
VOP	Corn	2	A	4	32.5	3.1	7/22/2021	69.7	2021
VOP	Corn	2	A	3	38.8	3.1	6/22/2021	82.6	2021
VOP	Corn	2	A	2	39.9	3.0	5/25/2021	92	2021
VOP	Corn	2	A	1	42.0	3.5	5/6/2021	109.8	2021
VOP	Corn	2	A	0	42.2	3.5	4/23/2021	122.3	2021
VOP	Corn	1	B	5	35.3	3.4	9/21/2021	59.6	2021
VOP	Corn	1	B	4	37.1	3.6	7/22/2021	68.9	2021
VOP	Corn	1	A	0	41.4	3.3	4/23/2021	123.5	2021
VOP	Corn	1	B	3	39.0	3.3	6/22/2021	80.6	2021
VOP	Corn	1	B	2	40.7	3.2	5/25/2021	90	2021
VOP	Corn	1	B	1	41.5	3.2	5/6/2021	113.7	2021
VOP	Corn	1	B	0	42.5	3.3	4/23/2021	122.7	2021
VOP	Corn	1	A	5	34.9	3.4	9/21/2021	58.8	2021
VOP	Corn	1	A	4	37.9	3.4	7/22/2021	69.6	2021
VOP	Corn	1	A	3	41.2	2.9	6/22/2021	79.5	2021
VOP	Corn	1	A	2	41.8	3.1	5/25/2021	89.8	2021
VOP	Corn	1	A	1	42.2	3.4	5/6/2021	114.5	2021
YLM	Corn	2	B	3	30.7	2.1	6/22/2022	62.5	2022
YLM	Corn	1	A	1	42.1	2.3	5/6/2022	60.3	2022
YLM	Corn	1	A	2	40.1	2.5	5/23/2022	61.6	2022
YLM	Corn	1	A	3	29.0	2.3	6/22/2022	58.5	2022
YLM	Corn	1	A	4	34.0	2.7	7/24/2022	62	2022
YLM	Corn	1	A	5	30.7	2.7	9/10/2022	53.2	2022
YLM	Corn	1	B	0	42.1	2.6	4/22/2022	79.8	2022
YLM	Corn	1	B	1	41.6	2.4	5/6/2022	62	2022
YLM	Corn	1	B	2	39.9	2.6	5/23/2022	59.1	2022
YLM	Corn	1	B	3	30.6	2.6	6/22/2022	56.9	2022
YLM	Corn	1	B	4	30.9	2.5	7/24/2022	55.6	2022
YLM	Corn	1	B	5	33.3	2.6	9/10/2022	54	2022
YLM	Corn	2	A	0	42.1	2.2	4/22/2022	82.1	2022
YLM	Corn	2	A	1	38.3	2.0	5/6/2022	71	2022
YLM	Corn	2	A	2	35.7	2.2	5/23/2022	65.1	2022
YLM	Corn	2	A	3	31.0	2.3	6/22/2022	59.3	2022
YLM	Corn	2	A	4	34.0	2.4	7/24/2022	59.8	2022
YLM	Corn	2	A	5	27.5	2.5	9/10/2022	57	2022

YLM	Corn	2	B	0	42.2	2.3	4/22/2022	82.7	2022
YLM	Corn	2	B	1	41.3	2.3	5/6/2022	66	2022
YLM	Corn	2	B	2	39.7	2.3	5/23/2022	74.3	2022
YLM	Corn	2	B	4	33.5	2.4	7/24/2022	68.5	2022
YLM	Corn	2	B	5	32.6	2.5	9/10/2022	57.2	2022
YLM	Corn	1	A	0	42.2	2.4	4/22/2022	80.6	2022
YRV	Soybeans	1	A	1	41.6	1.2	5/8/2021	116.8	2021
YRV	Soybeans	2	B	5	33.5	1.9	10/8/2021	74.2	2021
YRV	Soybeans	2	B	4	35.1	1.8	7/29/2021	82.5	2021
YRV	Soybeans	2	B	3	40.0	1.5	6/25/2021	91.1	2021
YRV	Soybeans	2	B	2	41.4	1.4	5/27/2021	96.7	2021
YRV	Soybeans	2	B	1	40.7	1.2	5/8/2021	110.2	2021
YRV	Soybeans	2	B	0	41.6	1.1	4/26/2021	119.5	2021
YRV	Soybeans	2	A	5	37.6	2.0	10/8/2021	70.6	2021
YRV	Soybeans	2	A	4	39.3	1.6	7/29/2021	83	2021
YRV	Soybeans	2	A	3	40.9	1.5	6/25/2021	91.5	2021
YRV	Soybeans	2	A	2	41.7	1.4	5/27/2021	98.5	2021
YRV	Soybeans	2	A	1	40.7	1.2	5/8/2021	109.5	2021
YRV	Soybeans	2	A	0	41.7	1.1	4/26/2021	117.4	2021
YRV	Soybeans	1	B	5	34.0	1.5	10/8/2021	86.2	2021
YRV	Soybeans	1	B	4	37.3	1.5	7/29/2021	90.6	2021
YRV	Soybeans	1	B	3	36.9	1.3	6/25/2021	102.9	2021
YRV	Soybeans	1	B	2	40.1	1.2	5/27/2021	102.5	2021
YRV	Soybeans	1	B	1	41.3	1.3	5/8/2021	106.6	2021
YRV	Soybeans	1	B	0	41.6	1.1	4/26/2021	114.2	2021
YRV	Soybeans	1	A	5	37.8	2.0	10/8/2021	75.8	2021
YRV	Soybeans	1	A	4	39.5	1.8	7/29/2021	82.3	2021
YRV	Soybeans	1	A	0	41.6	1.1	4/26/2021	116.4	2021
YRV	Soybeans	1	A	3	40.2	1.5	6/25/2021	90.5	2021
YRV	Soybeans	1	A	2	41.5	1.5	5/27/2021	102.4	2021

Fresh biomass from 1 m² in each cover crop rep

code	cash_crop	subplot	fresh_wt_a	fresh_wt_b	bag_wt_a	bag_wt_b	year
DFV	Soybeans	2	830.6	897.7	34.4	34.4	2022
DFV	Soybeans	1	815.7	1279.5	33.7	33.7	2022
GWP	Soybeans	2	1113.4	454.9	17.9	17.9	2023
GWP	Soybeans	1	818	702.9	17.9	17.9	2023
IWY	Corn	2					2023
IWY	Corn	1	210	210	20	20	2023
JBB	Soybeans	1	675.9	1344.7	32.4	32.9	2021
JBB	Soybeans	2	472.4	1763.2	33.1	31.3	2021

OOA	Soybeans	2	1810.7	1950.2	28.3	28.7	2021
OOA	Soybeans	1	1673.6	2678.2	27.7	28.8	2021
QYI	Soybeans	2	287.5	356.8	17.7	17.7	2023
QYI	Soybeans	1	381.1	366.9	17.7	17.7	2023
SVA	Corn	1	197	184.3	18.1	18.1	2022
SVA	Corn	2	132.6	131.5	18.1	18.1	2022
UCG	Soybeans	1	1099.1	994.9	34.4	34.4	2022
UCG	Soybeans	2	685.5	815.6	32.6	32.6	2022
VOP	Corn	2	2869.9	2787.7	26.8	26.8	2021
VOP	Corn	1	2994.4	2204	27	27	2021
YLM	Corn	2	505.2	547.3	18.1	18.1	2022
YLM	Corn	1	466	419.9	18.1	18.1	2022
YRV	Soybeans	1	1576.8	1638.8	27.4	27.3	2021
YRV	Soybeans	2	1342.3	1920.1	27.5	27.8	2021

Cash crop planting and cover crop sampling dates

year	longitude	latitude	code	cc.sampling.date	cash.crop	cash.crop.planting.date
2021	-96.7349	39.0507	VOP	4/24/2021	Corn	5/1/2021
2021	-96.7349	39.0507	VOP	4/24/2021	Corn	5/1/2021
2021	-96.7349	39.0507	VOP	4/24/2021	Corn	5/1/2021
2021	-96.7349	39.0507	VOP	4/24/2021	Corn	5/1/2021
2022	-97.6014	38.1968	SVA	4/26/2022	Corn	4/23/2022
2022	-97.6014	38.1968	SVA	4/26/2022	Corn	4/23/2022
2022	-95.6555	38.253	YLM	4/19/2022	Corn	4/22/2022
2022	-95.6555	38.253	YLM	4/19/2022	Corn	4/22/2022
2023	-96.7355	39.0516	IWY	4/10/2023	Corn	4/18/2023
2023	-96.7355	39.0516	IWY	4/10/2023	Corn	4/18/2023
2021	-95.6764	38.2578	JBB	5/13/2021	Soybeans	6/9/2021
2021	-95.6764	38.2578	JBB	5/13/2021	Soybeans	6/9/2021
2021	-96.4367	39.3359	OOA	5/26/2021	Soybeans	6/10/2021
2021	-96.4367	39.3359	OOA	5/26/2021	Soybeans	6/10/2021
2021	-97.5736	38.2392	YRV	4/30/2021	Soybeans	5/7/2021
2021	-97.5736	38.2392	YRV	4/30/2021	Soybeans	5/7/2021
2022	-96.7349	39.0515	DFV	5/10/2022	Soybeans	5/13/2022
2022	-96.7349	39.0515	DFV	5/10/2022	Soybeans	5/13/2022
2022	-96.4372	39.3355	UCG	5/10/2022	Soybeans	5/26/2022
2022	-96.4372	39.3355	UCG	5/10/2022	Soybeans	5/26/2022
2023	-97.5717	38.2305	GWP	4/11/2023	Soybeans	5/25/2023
2023	-97.5717	38.2305	GWP	4/11/2023	Soybeans	5/25/2023
2023	-96.4382	39.3365	QYI	5/2/2023	Soybeans	5/6/2023
2023	-96.4382	39.3365	QYI	5/2/2023	Soybeans	5/6/2023

Adjusted grain yields

year	code	crop	trt	harvest_protocol	row_space	fresh_harvest_wt	population.plants_ha	yield.Mg_ha
2021	VOP	Corn	B	hand_weight_per_rows	76.2	3.6	73194.6	16.366
2021	VOP	Corn	B	wagon_weight_per_area	76.2		73194.6	14.989
2021	VOP	Corn	C	hand_weight_per_rows	76.2	3	69965.4	12.949
2021	VOP	Corn	C	wagon_weight_per_area	76.2		68889	12.458
2022	SVA	Corn	B	wagon_weight_per_area	76.2			1.138
2022	SVA	Corn	C	wagon_weight_per_area	76.2			1.05
2022	YLM	Corn	B	monitor_flow_rate				3.724
2022	YLM	Corn	C	monitor_flow_rate				4.082
2023	IWY	Corn	B	hand_weight_per_rows	76.2	2.6	64583.4	11.855
2023	IWY	Corn	C	hand_weight_per_rows	76.2	2.8	65659.9	12.64
2021	JBB	Soybeans	B	monitor_flow_rate				2.684
2021	JBB	Soybeans	C	monitor_flow_rate				2.973
2021	OOA	Soybeans	B	wagon_weight_per_area	19.1			3.582
2021	OOA	Soybeans	C	wagon_weight_per_area	19.1			2.707
2021	YRV	Soybeans	B	wagon_weight_per_area	76.2			2.653
2021	YRV	Soybeans	C	wagon_weight_per_area	76.2			2.395
2022	DFV	Soybeans	B	wagon_weight_per_area				4.883
2022	DFV	Soybeans	C	wagon_weight_per_area				4.783
2022	UCG	Soybeans	B	wagon_weight_per_area	19.1			1.97
2022	UCG	Soybeans	C	wagon_weight_per_area	19.1			1.904
2023	GWP	Soybeans	B	wagon_weight_per_area	76.2			0.15
2023	GWP	Soybeans	C	wagon_weight_per_area	76.2			0.094
2023	QYI	Soybeans	B	wagon_weight_per_area	19.1			0.862
2023	QYI	Soybeans	C	wagon_weight_per_area	19.1			0.86

Appendix E - SAS ANOVA Code Example

```
%macro mixanova/parmbuff;

%PUT ***Syspbuff contains: &syspbuff***;

%let num=1;

%let respvar=%scan(&syspbuff,&num);

%do %while(&respvar ne);

PROC GLIMMIX DATA=RCB; TITLE2 'GLIMMIX MIXED MODEL CYCLE 4 SPLIT PLOT
ANALYSIS - BY PHASE, YEAR RANDOM';
CLASS PHASE BLOC YEAR CCROP NITROGEN; BY PHASE;
MODEL &respvar = CCROP NITROGEN CCROP*NITROGEN/DDFM=SATTERTH;
RANDOM YEAR BLOC BLOC*CCROP;
LSMEANS CCROP NITROGEN/LINES;
LSMEANS CCROP*NITROGEN/LINES;

%let num=%eval(&num+1);
    %let respvar=%scan(&syspbuff,&num);
%end;

%mend mixanova;

**Enter response variable list as follows:
    %mixanova(VAR1, VAR2, ...) in next line;

%mixanova(KG_HA);
RUN;
QUIT;
```