MODELING TILLER PRODUCTION AND COMPONENTS OF LEAF AREA IN WINTER WHEAT AS AFFECTED BY TEMPERATURE, WATER, AND PLANT POPULATION

by

JEFF BAKER

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Approved by:

[signature]

Major Professor

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INTRODUCTION

Crop growth may be considered to be the result of an interaction between the genetically inherited traits of a crop and a variable environment in which the crop is grown. Milthorpe and Moorby (1974) point out that while certain aspects of this dynamically interrelated system are understood in considerable detail, an adequate understanding of how all the components of this system interact to determine the rate of change and the ultimate size of the whole is lacking.

The increased use in recent years of plant growth models as research tools has been noted by Maas and Arkin (1980). Thornley (1976) lists several potential uses of plant growth models. Those that have particular relevance to this study are: (1) to provide a unified framework for information on different aspects of plant growth, (2) attempts at model building can help identify areas where data and knowledge are lacking, (3) to provide a method for interpolation, extrapolation, and prediction.

As pointed out by Jewiss (1966), the main photosynthetic surface of a grass crop is made up of an ever changing population of leaves on an ever changing population of tillers. The purpose of this study is to develop for winter wheat (*Triticum aestivum* L. em. Thell.) a growth model that would yield daily estimates of leaf area index (LAI). The study was designed to attain this goal in two steps: (1) develop and test equations predicting the changes in tiller numbers of a wheat crop on a per plant basis (chapter 1); (2) develop and test equations predicting the following remaining components of LAI for wheat: leaves/tiller, leaf area/leaf, and leaf area/plant (chapter 2).

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LITERATURE REVIEW

LEAF GROWTH

The paucity of information available on cereal leaf growth has been noted by Gallagher (1979). Other than intercepting radiation and providing assimilate to the ear during grain growth, little seems to be known of the factors that influence the size and numbers of cereal leaves in the field. Friend et al. (1962) summarizes the total leaf area of a wheat plant at any one time as depending on the relative rates of (a) leaf primordia initiation, (b) leaf emergence, (c) lamina expansion, (d) gain in the number of meristems by branching, (e) leaf senescence, (f) loss of meristems through senescence or transformation into floral primordia.

Five easily recognized stages of growth in wheat leaves and grass leaves in general are: (i) initiation; (ii) pre-appearance; (iii) post-appearance; (iv) maturity; and (v) senescence (Silsbury, 1970).

Initiation

Langer (1972) points out that, while leaf production on a particular tiller can be measured as the rate of leaf primordia initiation or the rate of leaf appearance, these two rates are not always the same. Leaf extension usually continues after initiation, but unexpanded primordia may accumulate on the apex just prior to floral initiation (Silsbury, 1970). Aspinall and Paleg (1963), working with barley (*Hordeum vulgare* L.), found that the rate of leaf primordia initiation is greater than the rate of leaf appearance at high light intensities.

Bremner (1969), working with winter wheat, notes that because developing primordia lack complete vascular differentiation, carbohydrate flow to these organs requires movement across undifferentiated parenchyma. A large concentration gradient is required for this even though the demand by these primordia is small. Therefore Bremner suggests that primordial leaf or ear growth may possibly be sensitive to the total amount of carbohydrate in the shoot.

By plotting total primordia number against time, Kirby (1974) found two constant primordia initiation rates for spring wheat. A slower first rate for leaves was followed, after formation of the collar primordia, by a second faster rate for spikelet primordia. Gallagher (1979) obtained similar results for the mainstem of winter wheat, by plotting the total number of primordia initiated against a Celsius growing degree day (°Cd) with a base temperature 0°C.

Pre and Post-appearance

When a leaf primordium is first initiated it is entirely meristematic and growth is mainly the result of cell division. After the leaf reaches a length of one to two cm, two meristematic regions appear. The upper region is associated with the growth of the lamina and the lower with that of the leaf sheath. As a result of cell division and expansion, the leaf elongates through the sheaths of older leaves. Meristematic activity of the laminia terminates with the differentiation of the ligule. Growth of the sheath continues until the liguel is exposed, at which time the leaf has reached its final size (Sharman, 1942; Begg and Wright, 1962; Silsbury, 1970; Langer, 1972).

The appearance of the leaf tip marks the end of the pre-appearance stage of growth and the beginning of the post-appearance stage of growth (Mitchell, 1953a). As the leaf emerges, that part of the exposed leaf stops growing due to a discontinuance of cell extension (Sharman, 1942). According to Begg and Wright (1962), the reason for this cessation of growth is the sudden change in the environment of the leaf as it emerges. The enclosed leaf tissue receives only far red radiation transmitted through the sheaths of older leaves. At emergence the leaf receives much more radiation in the red wavelengths. When the ligule appears the leaf no longer contains any active meristematic tissue and further growth is terminated.

Considering leaf growth on a particular tiller, Robson (1967) found a close correlation between the duration of growth of a particular leaf and the interval between the appearance of successive leaves. One leaf was found to be actively expanding while the preceding leaf had almost ceased growing. Silsbury (1970) points out that while the physiological basis for this synchronized growth pattern is not fully understood, competition for assimilates may be involved.

Williams (1975) shows that, while at emergence the dry weight of each successive leaf increases, the relative growth rate of each successive leaf is slightly slower than that of its predecessor. The dry weight increase of an emerging leaf follows a typical logistic growth curve, with the large middle portion of the graph being essentially linear with time (Silsbury, 1970). Gallagher (1979) and Williams and Rijven (1965) found the same general pattern with increasing leaf length in winter wheat.

The relative leaf extension rate increases to a maximum just prior to the emergence of the leaf. The post-appearance stage of growth is characterized by a gradually declining relative leaf extension rate which accounts for 80 to 90% of the total leaf extension (Gallagher, 1979). This finding is confirmed by Williams (1964), who shows that the dry weight of a wheat leaf at appearance is only 10% of its final dry weight at maturity.

It appears that light intensity has little (Aspinall and Paleg, 1964) or essentially no (Silsbury, 1970) effect on the rate of leaf extension. At increased levels of light intensity there is an accelerated rate of leaf primordia initiation, which results in an accumulation of leaves in the pre-emergence state (Aspinall and Paleg, 1963). Aspinall and Paleg (1964) suggest that since there is more tiller development at high light intensities, this extra sink might absorb much of the extra assimilate produced at these higher light intensities.

Using rule and auxanometer measurements, Gallagher et al. (1979) found that the rate of leaf extension increases linearly with both day and nighttime air temperatures. They also found that leaf extension continued slowly throughout the winter and stopped at 0°C. Faster transpiration, caused by bright sunshine, lowered leaf water potential and slowed the rate of leaf extension.

Rate of Leaf Appearance

Under constant conditions of temperature and light, the number of leaves emerged on the mainstem of wheat increases linearly with time, with the highest rate of leaf appearance occurring at a temperature of 25°C (Friend et al., 1962). Under field conditions with fluctuating temperatures, Gallagher (1979) found that the rate of leaf appearance is not linearly related with time and is slowed during the winter. By using a Celsius growing degree day with a base temperature of 0°C, Gallagher obtained a linear relationship between thermal time and mainstem leaf appearance stage of .09 ($\pm$ 0.001) leaves d^{-1} at 10°C.

Langer (1954) and Ryle (1964), working with timothy (*Phleum pratense*) and perennial ryegrass (*Lolium perenne* L.) respectively, also found that the rate of leaf appearance is slowed during the winter. By comparing plants grown in heated glass houses to those grown outside, they concluded that this slow down in the rate of leaf appearance was due to decreased temperature. Patel and Cooper (1961) also reported a slowing in the rate of leaf appearance during the winter in ryegrass, timothy, and meadow fescue but attributed this to changes in photoperiod or total light energy rather than reduced temperatures. Kirby and Eisenberg (1966) also suggest that the slow down in the rate of leaf appearance is due to reduced photoperiod. Kirby and Faris (1972) found that with increasing plant density the rate of leaf appearance on the mainstem of barley becomes slightly slower for later formed leaves. Bean (1964), working with cocksfoot (Dactylis glomerata), found that the average number of leaves/tiller and the rate of leaf production and death are not affected by changing the light intensity.

Mitchell (1953a), working with ryegrass, concluded that while the rate of leaf appearance varies with environment, this rate quickly adjusts itself to current conditions. The rate of leaf appearance does not change with the age of the apex or the stage of development and there is no difference in the rate of leaf appearance between the mainstem and the tillers (Cooper, 1951; Mitchell, 1953a; Langer, 1963; Robson, 1967).

While selecting for a rapid rate of leaf appearance in ryegrass, Edwards and Cooper (1963) found this trait to be associated with a smaller leaf size and vice versa. Ryle (1964) also reported that the ability to develop larger leaves is associated with a slower rate of leaf production in several perennial grasses.

Assimilate Partitioning

During the pre-appearance stage, a young growing leaf, enclosed in the sheaths of older leaves, obtains all the assimilates needed for the growth of that leaf from the rest of the plant (Begg and Wright, 1962; Friend et al., 1962). Even during the post-appearance stage a growing leaf is still dependent on the rest of the plant for most of the assimilates needed for its growth. As pointed out by Silsbury (1970), while a portion of the growing leaf has emerged and can carry on photosynthesis in accordance with the area of leaf exposed, that amount of leaf area is insufficient to account for the total growth of the leaf. He shows that in ryegrass, when leaf five has reached one-half of its ultimate area, the exposed portion of the leaf is only contributing one-third of the carbohydrates needed for its growth. Similarly for wheat, Doodson et al. (1964) found that the importation of assimilates by growing leaves reaches a maximum when they are one-half to three-fourths expanded.

Shortly after a leaf is fully expanded, apparent photosynthesis reaches a maximum and declines as the leaf ages (Jewiss and Woledge, 1967; Doodson et al., 1964; Thorne, 1962). Doodson et al. (1964) shows that assimilate translocation from a leaf also reaches a maximum at maturity. During vegetative growth, young, recently expanded leaves feed preferentially the younger growing leaves while older leaves translocate assimilates to the roots and dependent tillers (Doodson et al., 1964; Jewiss and Woledge, 1967; Rawson and Hofstra, 1969).

Rawson and Hofstra (1969) found that the main source of assimilate for a young, growing leaf is the second youngest fully expanded leaf. Tanaka (1961) found this to be true in rice and identified this leaf as "active center leaf".

Donald (1961) points out that older leaves contribute less assimilate to the plant than younger leaves not only because of a decreased photosynthetic capacity but also because they are located towards the bottom of the canopy and receive less light. Osman and Milthorpe (1971), working with wheat under different levels of illumination, found the total seasonal gross photosynthesis of a leaf was the same regardless of the level of light intensity. This was attributed to the leaves under high light intensity having a higher photosynthetic capacity, but shorter life span.

Mature Leaf Size

The final size of a particular wheat leaf has been shown to depend on a number of environmental factors. The experiments conducted in growth chambers by Friend et al. (1962) show the effects of temperature and light intensity on the final dimensions of wheat leaves. They found that the maximum leaf length, width, area, and thickness occurred at 25°C, 15°C, 20°C, and 10 to 15°C, respectively. The maximum leaf length, width, and area occurred at 200-250 Ftc., 2500 Ftc., and 1750 Ftc. The light intensity data are difficult to interpret because of the measurement technique. Leaf thickness was found to increase with increasing light intensity.

However, Gallagher et al. (1979) conclude that final length in the field depends on the rate and duration of extension and does not vary with temperature as demonstrated in growth chambers by Friend et al. (1962). Gallagher et al. show that, in the absence of others effects, the reciprocal of duration during the linear phase of leaf extension and the rate of extension of a leaf are linear with temperature. Further, water stress can decrease final leaf size by slowing the rate of leaf extension without affecting the duration of extension.

According to Borril (1959), successive leaves on a particular tiller increase in length to a maximum occurring at inflorescence initiation. A possible explanation for smaller leaves after floral initiation is the competitive demand for assimilates between the young growing leaves and the developing inflorescence and elongating stem (Jewiss, 1966). The results obtained by Gallagher (1979) contrast with Borill's. Gallagher found that for wheat, successive leaves increase in length up to the penultimate leaf.

TILLERING

The Tillers

Because auxillary buds are usually formed at the base of each leaf sheath, prophyll, and coleoptile, the growth of a wheat plant is potentially unlimited given adequate environmental conditions (Friend, 1965). Since the leaves on the mainstem subtend auxillary buds which can give rise to tillers, which in turn produce other auxillary buds and more tillers, a hierarchy of shoots is produced. Tillers formed by the mainstem are referred to as primary tillers. Shoots produced by the primary tillers are called secondary tillers which in turn can give rise to tertiary tillers and so on denoting successive orders of tillers (Langer, 1963).

The order in which tillers are formed on a plant is essentially the same for wheat (Rawson, 1971) and barley (Thorne, 1962; Cannell, 1969). For the first few tillers the order as given by Rawson is: the main shoot (M), T1 (the first primary true leaf tiller), P (the coleoptile node tiller), T2 (the second primary true leaf tiller), T1P (the first secondary prophyll tiller) and T3 (the third primary true leaf tiller). The average contribution to grain yield by each tiller was 27, 22, 12, 20, 8, and 8% respectively, under a closely spaced planting. The prophyll tiller (P), emerges just prior to or just after T1. Thorne (1962), working with barley, also found that the order of appearance is not the same as the order of yield.

Rawson (1971) shows that there is a direct relationship between the time of appearance of each true leaf tiller, the final weight of that tiller, and the amount of grain that tiller yields. He also found that older true leaf tillers not only have a greater survival ability, but are also heavier and yield more grain than younger tillers. This relationship did not extend to prophyll tillers when compared with true leaf tillers formed at about the same time. For example, in Rawson's experiments, the coleoptile node tiller was formed at about the same time as T1 (the first primary true leaf tiller), but never yielded as much. In fact the coleoptile node tiller did not yield as much as T2, which was formed much later. One possible reason for this discrepancy is that leaves supply assimilate to the tillers in their axis and prophyll tillers must rely, in part, on their respective prophyll for assimilate, thus giving true leaf tillers an advantage during early growth (Rawson, 1971). Because prophyll tillers do not yield as well as true leaf tillers of a similar age, Rawson suggests that plants producing only true leaf tillers in rapid succession would be more efficient grain producers.

Bremner (1969) working with wheat at different plant densities, found that the mainstems produced at least 70% of the grain yield at high densities, but less than 50% at low densities. He also found that the size of the ear was closely related to the leaf area of its shoot.

Tiller Growth

Usually on the apical meristem of ungerminated seed, buds are visible in the axil of the coleoptile, and the first one to three leaf primordia (Percival, 1921; Friend et al., 1962; Langer, 1963, 1972). A tiller bud is usually formed in the axis of a subtending leaf primordia by the time that leaf has overarched the apex (Jewiss, 1972). Tiller buds are formed at the same rate as leaf primordia, but usually two to three plastochrons later (Langer, 1972). Kirby and Faris (1970) conclude that the initiation of tiller buds is internally controlled by the plant and is little affected by differences in environment induced by various planting densities. Mitchell (1953a) and Kirby and Faris (1970) found that a tiller bud has the ability to develop into a tiller for only a limited amount of time after its initiation. Mitchell (1953a,b) found that an auxillary bud does not begin to develop until its subtending leaf has finished growing.

In a number of grass species, it has been shown that low temperature favors tiller production (Mitchell, 1953a; Newell, 1951; Templeton et al., 1961) especially low nighttime temperatures (Alberda, 1951; Mitchell and Lucanus, 1960). However, Langer (1963) points out that other environmental factors, especially light intensity, must be considered in conjunction with the effects of temperature. He found that the development of tiller buds to form tillers depends largely on the availability of carbohydrates, which in turn depends on the relative rates of respiration and photosynthesis. According to Langer (1963), if light is limited during short days or by low intensity, then high temperatures, especially at night, can result in a carbohydrate balance in the plant that is unfavorable for tillering. Mitchell (1953b) found that the development of tiller buds could be inhibited by shading, reduction of the period of illumination, partial defoliation of the plant, or high temperatures.

Jewiss (1972) and Mitchell (1953b) suggest that tillering might not depend solely on the level of carbohydrate concentration, but may also depend on the interaction between carbohydrate and auxin concentration. They found that apical dominance is increased when plants are grown at low light intensities. Jewiss (1972) concludes that a rise in the carbohydrate concentration in the plant increases the level of auxin necessary for the suppression of lateral bud development.

Before a newly formed tiller has produced its own adventitious roots, it must rely on the rest of the plant for its supply of minerals (Langer, 1957, 1959, 1963) and carbohydrates (Doodson et al., 1964; Rawson and

Horstra, 1969). Tillers are usually considered to be independent units, but there is no clear evidence to show when or if they ever achieve this (Jewiss, 1966). Using labeled carbon dioxide, Doodson et al. (1964) and Rawson and Hofstra (1969) found that the movement of assimilates from the main stem to the tillers occurred freely. In similar experiments Quinlan and Sagar (1962) and Lupton (1966) found that tillers become independent when the mainstem began to enlongate. In the experiments by Rawson and Hofstra (1969), the tillers never became completely independent of the mainstem. They found that the flag leaf and the lower leaves on the mainstem feed a large portion of their assimilate to the tillers throughout grain filling. They conclude that the direction of assimilate flow is governed by the size and proximity of the various sinks and that tiller ears provide a stronger sink than the mainstem.

Tiller Survival

Generally, during periods of stress, young recently formed tillers are the first to die (Langer, 1963). Although in some situations tillers that die are not always the last to be produced (Thorne, 1962; Bremner, 1969; Rawson, 1971). Thorne (1962) found that for each particular growing condition, the dead tiller number and position was consistent. She is unable to explain why some tillers of one variety died while comparable tillers of another variety survived. She suggests that the development and survival of tillers may be controlled by the apical dominance of the main stem and older tillers.

Rawson (1971), using different temperature regimes and planting densities, found a large difference in the total number of tillers produced by different varieties, but a much smaller difference in the number of surviving, ear-bearing tillers. The main stem and the first and second true leaf tillers survived in all plants while the third true leaf tiller and the first prophyll tiller has less success in producing an ear. All remaining tillers rarely survived. Rawson found that the survival of the coleoptile node tiller and its resulting secondary tillers are greatly influenced by temperature and had higher survival ability at lower than higher temperatures.

Thorne (1962) also found that the main stem and the first two true leaf tillers have the greatest ability to survive and contribute the most to yield. In her experiments, the coleoptile node tiller frequently did not appear and contributed little to yield. She found that most of the varietal differences in percent shoot survival are accounted for by the first and second secondary prophyll tillers in plants grown with nitrogen and by the the third primary true leaf tiller grown without nitrogen. According to Rawson (1971), the age of a shoot and its point of origin on the plant, both influence tiller survival. Rawson points out that the primary true leaf tillers have an advantage over the prophyll tillers in that they are better positioned on the plant, and, therefore, have a higher survival potential.

Kirby and Faris (1972), working with barley at different plant densities, found that competition for light often determines whether a tiller will survive. They found that the length of the leaf sheath of the first leaf of a tiller increases with increasing density and order of tiller. They conclude that newly formed tillers push their leaves into the upper leaves of the canopy by lengthening their leaf sheaths and internodes. Later formed tillers that fail to survive are thought to be shaded out because this morphological response is not strong enough to push their leaves into the upper layers of the canopy. They also found that tillers from buds that fail to develop into tillers in 50% of the plants also fail to survive. They show that with increasing plant density, the tillers that died are produced at the higher, rather than lower, nodes. At the highest density (1600 plants m^{-2}), the coleoptile node tiller died in all plants.

Knight (1961), working with cocksfoot, found that as plant weight increases the rate of tillering is slowed because of an increased competition for light. Cooper (1948) reports that perennial ryegrass stopped tillering earlier in close spacing than wide spacing.

As pointed out by Bunting and Dreman (1966) and Thorne (1962), surviving tillers recover somewhat from the effects of competition after unproductive tillers are shed. This happens by removing a source of competition or by a transfer of materials from the dying shoots. Lupton (1966), conducting labeled carbon dioxide experiments, found no translocation from tillers that died without forming an ear. He concludes that these tillers make no useful contribution to grain yield. In a similar experiment Rawson and Hofstra (1969) conclude that remobilization of assimilates were not a major factor in determining grain yield.

Thorne (1962) found that by removing the heads of surviving tillers while other tillers were dying did not increase the survival of these dying shoots. But when ears are removed from older tillers before emergence, auxillary buds that are normally dormant develop into ear bearing tillers. She found that the nitrogen content of the plants did not alter during the period when tillers are dying. She concludes that nitrogen is transferred from the dying shoots to the surviving ones.

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CHAPTER I

MODELING TILLER PRODUCTION AND SURVIVAL IN WINTER WHEAT

MODELING TILLER PRODUCTION AND SURVIVAL IN WINTER WHEAT

ABSTRACT

Yield models requiring a leaf area index (LAI) term for the estimation of various quantities such as photosynthesis and evapotranspiration are hindered by the fact that methods of estimating LAI in the field are time consuming and costly. Because the leaves of a wheat crop grow on tillers, as the first step in ultimately developing an LAI model, a plant growth model was developed to predict tiller production and senescence for winter wheat (Triticum aestivum L. em. Thell) on a per plant basis as a function of plant population, growth stage, water, and temperature. The equations used in the model were developed from easily obtainable meteorological data and data collected in the field on five cultivars of winter wheat hand planted on two different planting dates. Using a concept developed by Friend (1965) from growth chamber experiments, increases in tillers/plant were modeled as following the Fibonacci series during the vegetative phase of growth until this rate was limited presumably by competition and/or limiting soil moisture. In order to adapt this concept to the field environment, accumulated daily thermal units (ΣTu where $\Sigma Tu = \Sigma(TMAX + TMIN)/2$) with a base temperature of 0°C were substituted for the chronological time used in Friend's experiments.

INTRODUCTION

The tillering habit of cereal crops is a topic of interest primarily because the grain yield of these crops is partly determined by the number of tillers that survive to produce a head. Tillering is dependent upon a number of environmental factors such as water, light, nutrient supply, and the degree of competition within the crop.

In recent years models of plant growth have become increasingly popular as research tools (Maas and Arkin, 1980). Thornley (1976) lists several potential uses of plant growth models. Some of these are: (1) to provide a method for testing hypotheses of plant growth, (2) to provide a unified framework for information on different aspects of plant growth, and (3) to provide a method for interpolation, extrapolation, and prediction.

As pointed out by Maas and Arkin (1980), one of the main obstacles in early modeling efforts with wheat was a lack of quantitative description of tillering. Our objective in this study was to develop and test, for winter wheat (Triticum aestivum L. em. Thell), a model that would yield a daily estimate of the number of living tillers/plant as a function of plant population, growth stage, water, and temperature.

MATERIALS AND METHODS

Field Experiment

Five cultivars of hard red winter wheat (*Triticum aestivum* L. em. Thell) were planted during the first week of September and the second week of October 1979 at the Evapotranspiration Research site 7 km southwest of Manhattan, KS. The planting was done by hand with each seed placed approximately 3.1 cm apart. Each plot consisted of 10 rows 7.6 m long and 17.8 cm apart. This resulted in an actual seeding rate of 1,747,700 seeds/ha. The experimental design was a completely randomized design with planting dates as the main treatments and cultivars as the subtreatments. Each cultivar was replicated twice at each planting date. The cultivars planted were 'Bezostaya 1'. 'Centurk', 'Eagle', 'Newton', and 'Tam W-101'.

The soil type was a Eudora silt loam (course-silty, mixed, mesic, Fluventic Hapludolls). The field was fertilized with approximately 67 kg/ha total N and 26 kg/ha P_2O_5 (44% P) on 23 August 1979. Soil moisture was measured periodically in each plot to a depth of 150 cm with a neutron probe and scaler. Soil moisture of the top 15 cm was determined gravimetrically. The plots were irrigated on the 14 through 17 October and 5 through 7 May with approximately 7.2 and 7.1 cm of water, respectively. Because of soil differences in water holding capacity, plots randomly assigned to the northern end of the field were wetter throughout the growing season than those located in the southern end of the field.

Growth Analysis

Components of leaf area index (LAI) were measured by means of destructive sampling at intervals (see Appendix A) throughout the growing season.

On each sampling date two samples consisting of 30.5 cm of row were taken from each plot. The total number of plants in each sample were counted in the field and the above ground portion of each sample was then bulked and transported to the laboratory for further analysis. Total number of living leaves and tillers were counted and laminar area of the leaves was then measured for each sample, using a leaf area meter (LI-COR 3100, Lincoln, Nebraska). Living tillers were defined as those tillers with living leaves or tillers that survived to produce a head when the leaves became senescent at the end of the growing season. In the spring living leaves were further separated into growing and expanded leaves. Total leaf number and exposed laminar area was then determined for each. Dry weights for each plant part was obtained after oven drying at 70°C for at least 48 hours. Data for each plant part were then expressed on a per plant basis for each sample.

Model Development

A daily estimate of tillers/plant was calculated differently depending on the stages of development. For fields lacking growth stage data, the growth stages of emergence, jointing, and boot were estimated using a biometeorological time scale (BMTS) (Feyerherm and Paulsen, 1976). Each of five growth stages represented a different subroutine in the model. The growth stages considered were:

EMRG (from seedling emergence (BMTS = 1.00) until the beginning of tillering),

STG2 (from the beginning of tillering until double ridges),

DRDG (from double ridges (BMTS = 1.83) until jointing, JNT (from jointing (BMTS = 2.33) until boot stage),

BOOT (from boot stage (BMTS = 2.70) until all leaves were assumed to be dead).

Gallagher (1979) points out that, because of fluctuating temperatures in the field, the effects of temperature can be separated from those of ontogeny by using accumulated thermal time rather than chronological time. In the model, a Celsius degree day (C°d), similar to the one suggested by Gallagher, was used to drive tiller production per plant. Daily thermal units (Tu) were calculated from daily maximum (TMAX) and minimum (TMIN) air temperatures as follows:

$$Tu = (TMAX + TMIN)/2 \qquad \text{if } TMAX > 30°C,\ TMAX = 30°C$$

$$\text{if } TMIN < 0°C,\ Tu = Tu/2$$

$$\text{if } Tu < 0°d,\ Tu = 0°d.$$

Daily thermal units were summed to provide accumulated Tu.

Since competition among plants especially for light can slow the rate of tillering, a competition factor (CFACT) was incorporated into the model. Based on an analysis of data from Puckridge and Donald (1976), Maas and Arkin (1980) concluded that competition did not begin to affect plant growth until LAI exceeded 1.6. In the model, CFACT limited the rate of tillering by reducing daily accumulated thermal units. CFACT was calculated as follows:

$$CFACT = 7.81\ (LAIMX)^{-6.62} \qquad (LAIMX \geq 1.6)$$

$$CFACT = 1 \qquad (LAIMX < 1.6)$$

$$CFACT = .01 \qquad (CFACT < .01)$$

where LAIMX is the maximum LAI achieved by the crop.

An evapotranspiration model for sorghum and soybeans (Kanemasu, Stone, and Powers, 1976), adapted to winter wheat, was used to limit the rate of tillering by reducing thermal units accumulated while the crop was considered to be under water stress. The water stress factor (KSWAT) was calculated as follows:

$$KSWAT = K_{s30} + .80 \qquad (K_{s30} \leq .20)$$

$$KSWAT = 1 \qquad (K_{s30} > .20)$$

where K_{s30} is the ratio of the available water to the maximum available water in the upper 30 cm profile.

During the stages of STG2 and DRDG the rate of tillering was reduced on days when values of KSWAT and CFACT were less than one. This was accomplished by limiting accumulated daily thermal units for tillering (ΣTu_t):

$$\Sigma Tu_t = \Sigma Tu_t + (Tu * KSWAT * CFACT).$$

In order to test the model, data sets from Texas, Arizona, and North Dakota were obtained. The data sets consisted of: 12 fields from both Vernon and Bushland, Texas, planted to winter wheat (cultivar: 'Tam W-101') 6 fields planted to each of two spring wheat cultivars ('Anza and Produra') from Phoenix, Arizona; and one field planted to spring wheat (cultivar: 'Waldron') and one field planted to durum wheat (cultivar: 'Cando') from Mandan, North Dakota. In addition to the climatic data necessary to run the model, each data set contained estimates of plant population, periodic measurements of tillers/plant, and observed stage of dates of emergence, jointing, booting, heading, and ripe.

RESULTS AND DISCUSSION

Plant Density

All plots were planted at approximately 175 seeds/m^2, but because of differences in the seed weight of the seed planted, in some cases there were rather large differences in the total kg/ha of seed planted (Table 1). Table 2 lists the final plant density for each plot at harvest which is

THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

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Table 1. Seed weights and seeding rates for each cultivar.

Cultivar	Seed Weight (mg/seed)	Seeding Rate (kg/ha)
Bezostaya 1	43.60	76.20
Centurk	28.40	49.63
Eagle	31.70	55.40
Newton	38.70	67.40
Tam W-101	37.90	66.24

Table 2. Final plant density and percent emergence for early and late plantings.

Cultivar	Rep	Early Planting Plants/m^2	Early Planting %Emergence	Late Planting Plants/m^2	Late Planting %Emergence
Bezostaya 1	1	102	58	121	69
	2	97	56	122	70
Centurk	1	138	79	151	86
	2	132	76	156	89
Eagle	1	140	80	165	94
	2	145	83	167	96
Newton	1	151	86	167	96
	2	154	88	170	97
Tam W-101	1	134	77	136	78
	2	131	75	154	88

an average of the number of plants in two 1.08 m^2 yield samples. In all cases the late planted wheat (LPW) had a higher plant density than that of the early planted wheat (EPW) because of a larger percent emergence, presumably due to the irrigation shortly after the late planting. These results indicate that seeding rates, in some cases, may provide a misleading picture of the actual plant population. Other factors such as seed viability and seed bed condition can have large effects on the initial plant density.

Tillering

As shown in growth chamber experiments by Friend (1965), if the number of leaves formed on a tiller before that tiller produces a daughter tiller (leaf number interval) is constant, a regular pattern of tillering should emerge. Friend found that at any particular leaf number interval the total number of tillers/plant on any given day was the sum of the total number of tillers/plant of the two previous days, forming a Fibonacci series between the total number of tillers/plant and time. Friend also notes that if such a series is continued, it becomes close to exponential and the ratio of leaves/plant to total number of tillers/plant approaches a constant.

In the present experiment, when tillers/plant were plotted against ΣTu it was found that during the early growth of the EPW, a Fibonacci series did form. An idealized diagram of the pattern of tiller production with ΣTu can be found in Fig. 1. The vertical bars represent "independent tillers" or tillers that have produced enough leaves to equal or exceed the leaf number interval necessary to begin forming daughter tillers. These independent tillers are shown to produce a dependent tiller every 100 Tu. The horizontal bars represent "dependent tillers" or daughter tillers. These tillers are diagramed as having to accumulate 100 Tu in order to become independent and an additional 100 Tu in order to produce their first dependent tiller. Also shown in Fig. 1 are the mainstem (M)

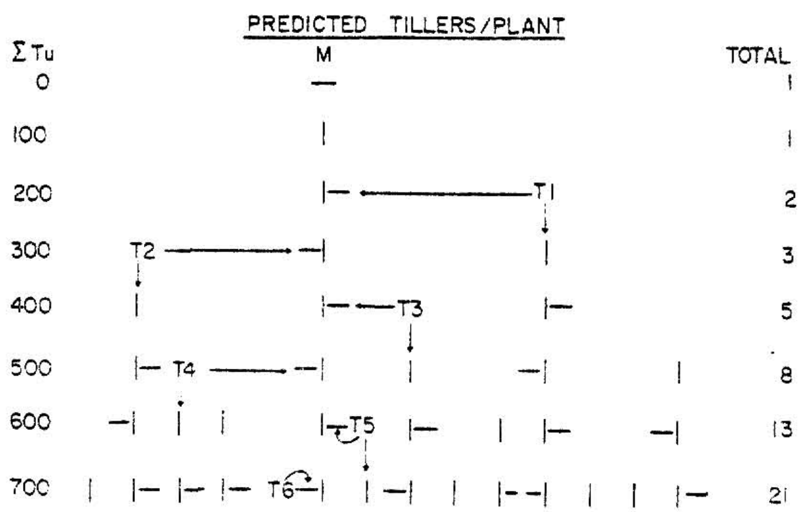

Fig. 1. Idealized diagram of the pattern of tillering with thermal time for wheat.

and the first six (T1-T6) primary tillers.

During the early stages of growth the rate of leaf production per tiller and thus tiller production per tiller is linear. As this rate continues in all tillers of a plant, the increase in total tiller number becomes exponential as long as this process remains unrestricted (Patel and Cooper, 1961). Table 3 illustrates how the tillering process may become restricted by competition or water stress. In the wetter plots the value of KSWAT never fell below one, while in the dryer plots KSWAT was less than one from 1 to 16 October for Bezostaya 1 and less than one from 27 September to 16 October for Eagle, indicating water stressed conditions for the plants in these dryer plots. As shown in Table 3, by the 3 October sampling it becomes apparent that the rate of tillering in the dryer plots is less than the rate of tillering predicted by the Fibonacci series with ΣTu, presumably because of water stress. In the wetter plots, the observed rate of tillering falls behind the predicted rate by 17 October for Bezostaya 1 and by 25 October for Eagle. The observed LAI for these two plots on these two sampling dates was 2.0 and 2.1 respectively. This would appear to support the conclusion of Maas and Arkin (1980) that competition begins to affect plant growth at LAI near 1.6.

Tillers/plant (TNO) is set to one during the first stage of growth (EMRG) and on the first day of this stage ΣTu_t begins to accumulate Tu. After the crop has accumulated 230 Tu, the second stage of growth (STG2) begins. On the first day of STG2, ΣTu_t is reset to 100 and during the first 200 Tu of STG2, tillering proceeds at a linear rate with ΣTu_t:

$$TNO = \Sigma Tu_t/100 \qquad (\Sigma Tu_t \leq 300).$$

After ΣTu_t exceeds 300 the exponential phase of tillering begins and TNO is calculated as follows:

Table 3. Comparison of observed tillers/plant with tillers/plant predicted by the Fibonacci series with thermal time for wet and dry plots of early planted Bezostaya 1 and Eagle.

Date	ΣTu	Predicted Tillers/ Plant	Actual† ΣTu	Observed Tillers/Plant: Wet Plots Eagle	Wet Plots Bezostaya 1	Dry Plots Eagle	Dry Plots Bezostaya 1
19 Sept	100	1	100.00	1.00	1.09	1.00	1.15
	200	2		-	-	-	-
28 Sept.	300	3	287.10	3.34	3.50	2.89	2.86
3 Oct.	400	5	390.20	6.81	5.42	4.31	3.81
10 Oct.	500	8	497.10	8.26	8.70	6.50	6.07
17 Oct.	600	13	611.30	13.13	11.25‡	9.21	8.43
25 Oct.	700	21	731.80	17.75§	14.97	13.51	8.39

†Without the values of KSWAT and CFACT multiplied by daily Tu.

‡LAI = 2.0

§LAI = 2.1

$$TNO = .7156 \ Exp\ (.0048 * \Sigma Tu_t) \qquad (\Sigma Tu_t > 300)$$

which is an exponential curve fit of the Fibonacci series with increments of 100 Tu from ΣTu of 300 to 1000.

Tillering ceases at the beginning of stem formation or jointing (Mitchell, 1953a,b; Jewiss, 1972). At this time in the model (JNT), the plants are assumed to have reached maximum TNO and also maximum number of tillers/m^2 (MXTNO = TNO * plant population). On the first day of JNT, final number of tillers/m^2 (FTNOSM) is calculated from MXTNO by a method similar to the one used by Maas and Arkin (1980). Final number of tillers/m^2 was regressed against maximum number of tillers/m^2 for both the EPW and LPW as shown in Fig. 2 where

$$FTNOSM = 3.598(MXTNO)^{.701}$$

with $R^2 = .80$. MXTNO and FTNOSM are then expressed on a per plant basis by dividing by plants population to obtain TNO. TNO is reduced at an exponential rate with additional accumulated Tu for a period of 640 Tu.

<u>Model Tests</u>

Jointing in the field is often defined as having occurred when a node is first detectable at the base of the tillers. In order for a node to become detectable in this way, it was assumed that the actual beginning of stem extension must have occurred at an earlier date. Therefore, for all data sets from Texas and Arizona, the observed day for this critical stage was assigned to the sampling date when most of the fields in each data set reached a maximum in average number of tillers/plant.

Shown in Figs. 3 and 4 are the temporal trends in observed and predicted tillers/plant for winter wheat grown at two locations in Texas. In general, the model followed the observed trends quite well for fields

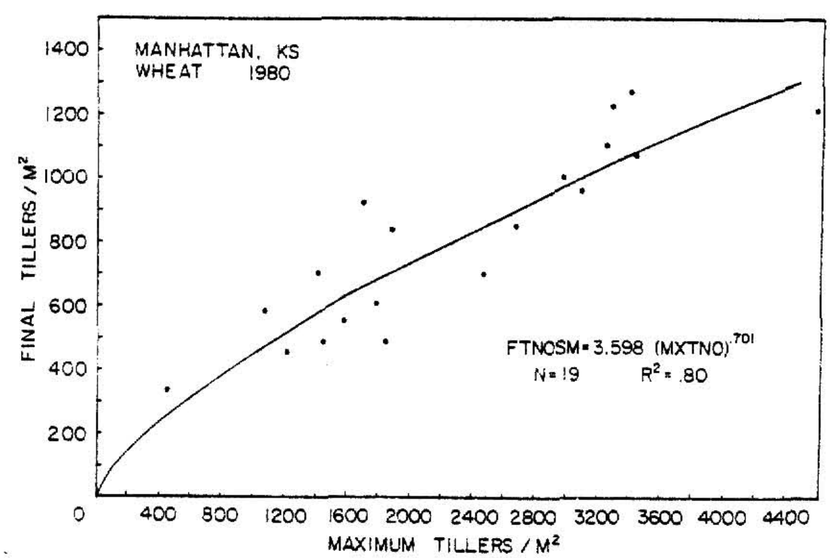

Fig. 2. Final number of tillers/m^2 (FTNOSM) plotted against maximum number of tillers/m^2 (MXTNOSM) for the data sets used in model development.

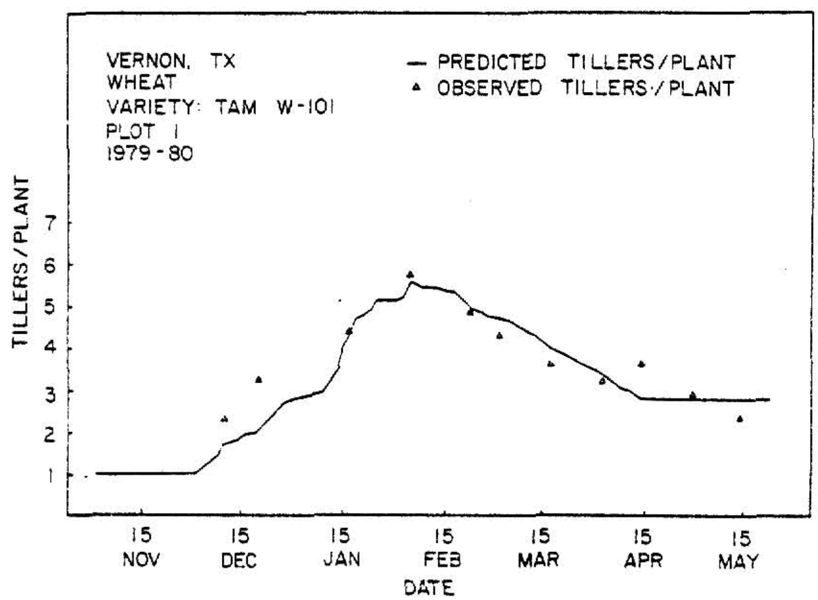

Fig. 3. Seasonal trends in observed and predicted tillers/plant (TNO) for a winter wheat test field from Vernon, Texas (1979-80).

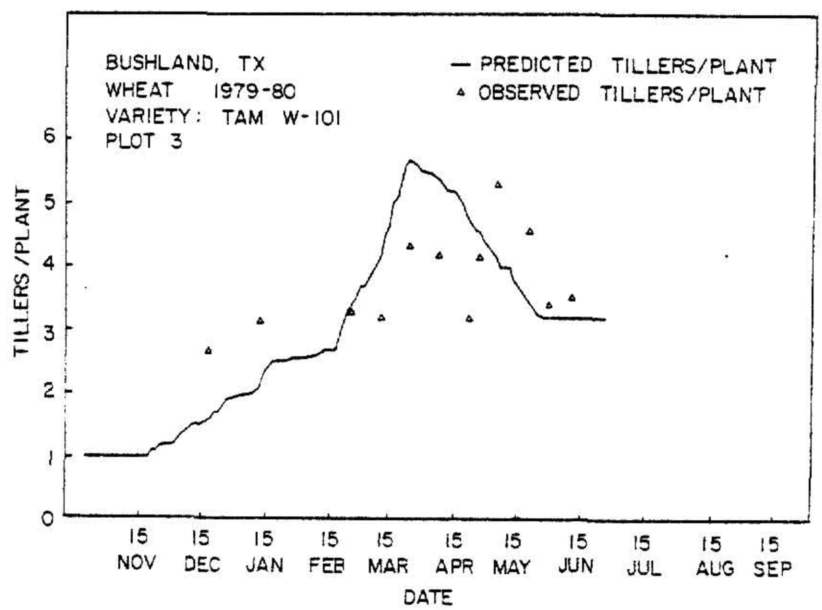

Fig. 4. Seasonal trends in observed and predicted tillers/plant (TNO) for a winter wheat test field from Bushland, Texas (1979-80).

located at Vernon, but tended to overestimate tillers/plant during March and April for fields located at Bushland.

In Figs. 5 and 6 observed and predicted tillers/plant are plotted and compared to a 1:1 line for all 12 fields at both locations. The slope (SL) of less than one, from the linear regression between observed and predicted values, indicates a tendency of the model to underestimate tillers/plant. The low correlation coefficient (r) associated with the data from Bushland was due in part to the sometimes rather large fluctuations in observed tillers/plant as shown in Fig. 4.

Shown in Figs. 7 and 8 are the observed and predicted trends in tillers/plant for two varieties of irrigated spring wheat grown at Phoenix, Arizona. In Figs. 9 and 10 observed and predicted tillers/plant are plotted and compared to a 1:1 line for all six fields planted to each variety. In this case, the slopes (SL) of slightly greater than one from the linear regression between observed and predicted values, indicate a tendency of the model to overestimate tillers/plant, especially during February when maximum tillers/plant was reached.

Shown in Figs. 11 and 12 are the observed and predicted tillers/plant for a spring and a durum wheat grown at two sites in North Dakota. The model appears to overestimate final number of tillers/plant for the spring wheat, but there appears to be a close agreement in final tillers/plant for the durum wheat.

In Fig. 13 observed and predicted tillers/plant are plotted and compared to a 1:1 line for all fields used to test the model. In general the points lie along the 1:1 line.

Table 4 presents a statistical analysis for all data sets used to test the model. The observed and predicted values were well correlated ($r \geq .70$) for all data sets except for the data set from Bushland, Texas,

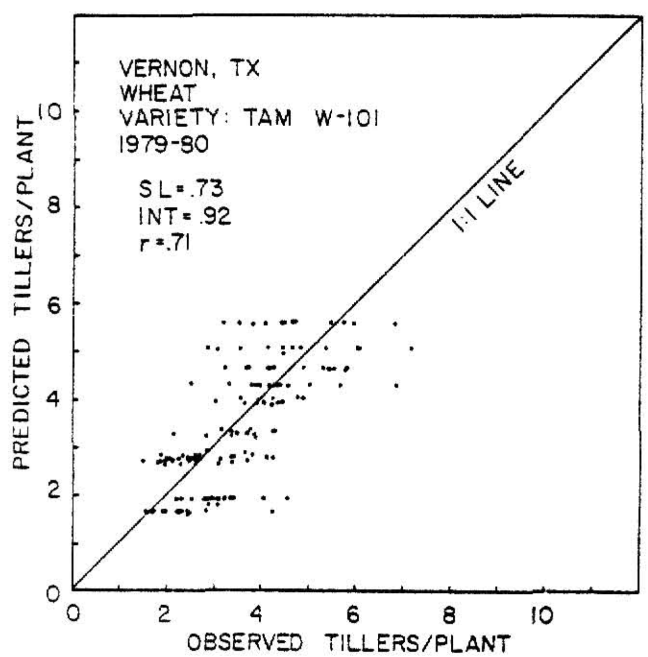

Fig. 5. Observed versus predicted tillers/plant (TNO) diagram for all 12 winter wheat test fields from Vernon, Texas (1979-80).

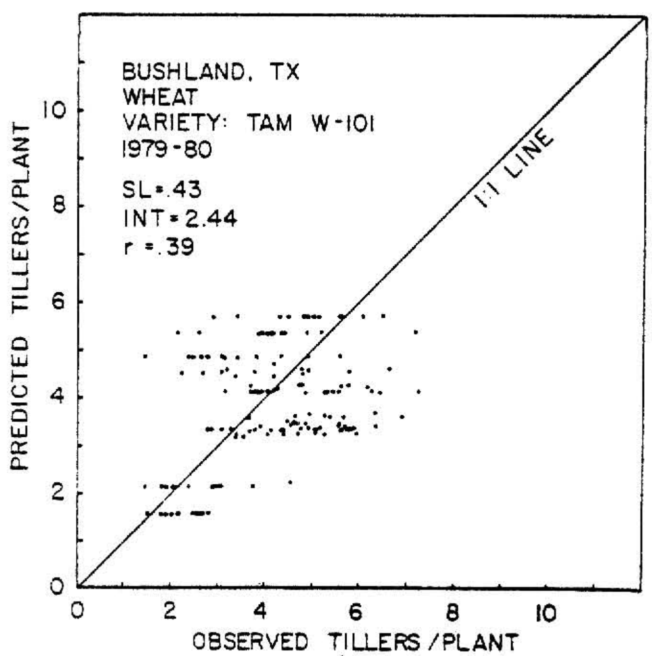

Fig. 6. Observed versus predicted tillers/plant (TNO) diagram for all 12 winter wheat test fields from Bushland, Texas (1979-80).

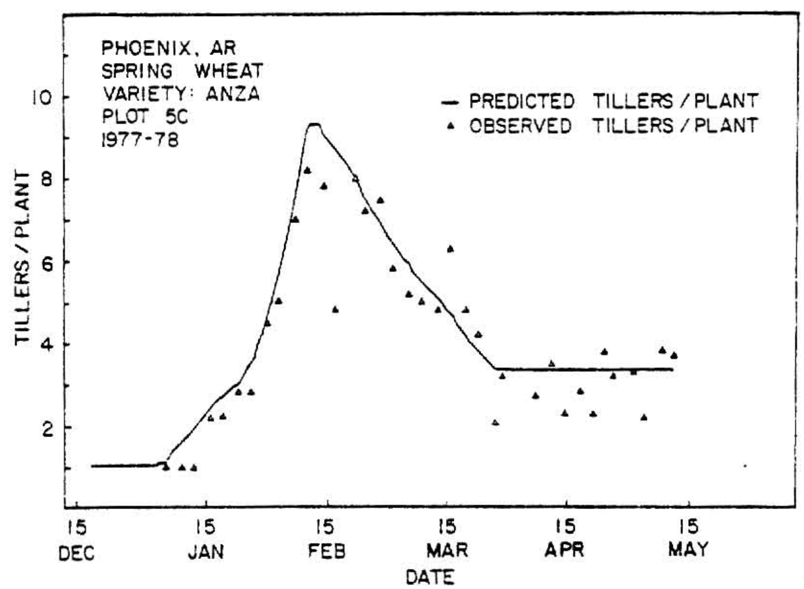

Fig. 7. Seasonal trends in observed and predicted tillers/plant (TNO) for a spring wheat test field from Phoenix, Arizona (1977-78).

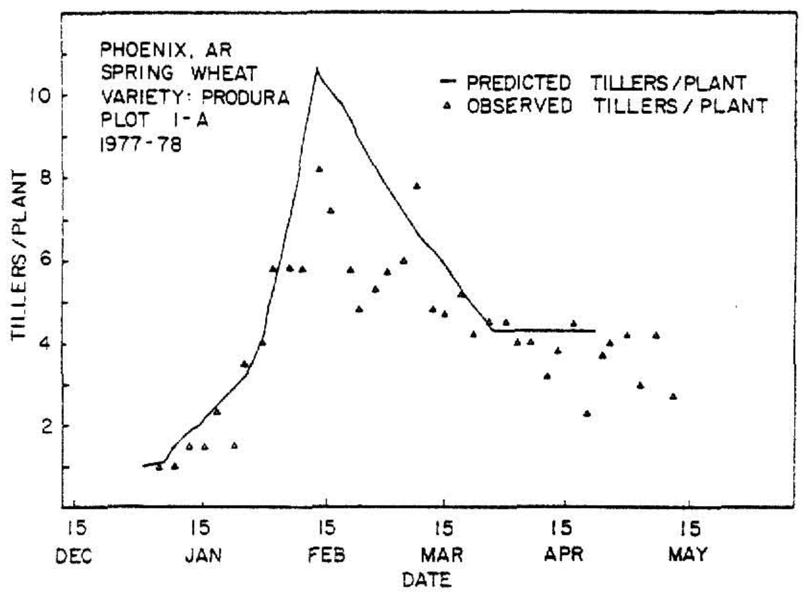

Fig. 8. Seasonal trends in observed and predicted tillers/plant (TNO) for a spring wheat test field from Phoenix, Arizona (1977-78).

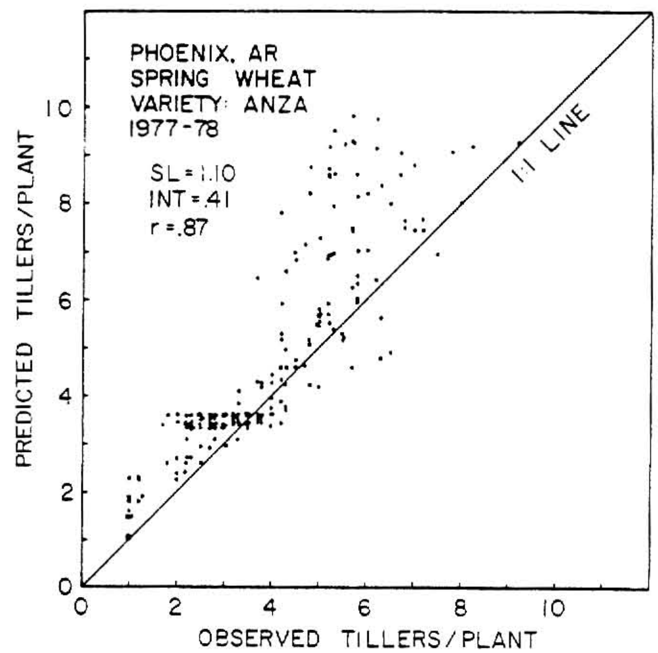

Fig. 9. Observed versus predicted tillers/plant (TNO) diagram for all 6 test fields (variety: Anza) from Phoenix, Arizona (1977-78).

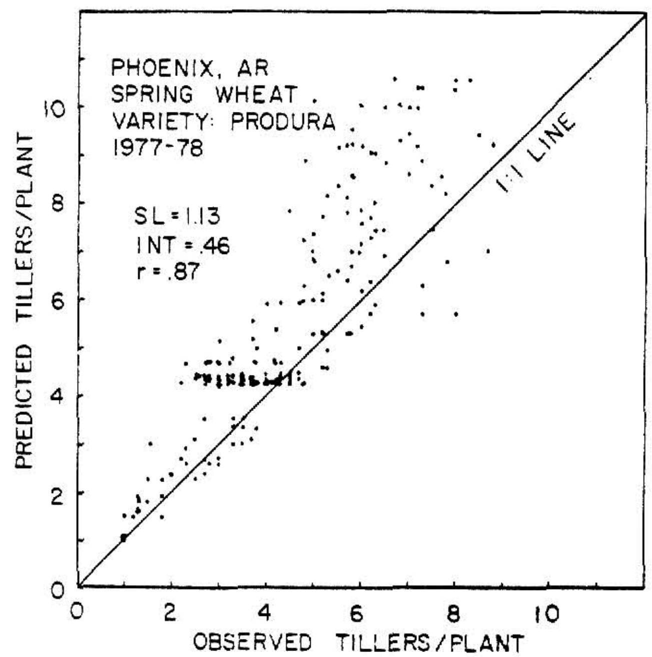

Fig. 10. Observed versus predicted tillers/plant (TNO) diagram for all 6 test fields (variety: Produra) from Phoenix, Arizona (1977-80).

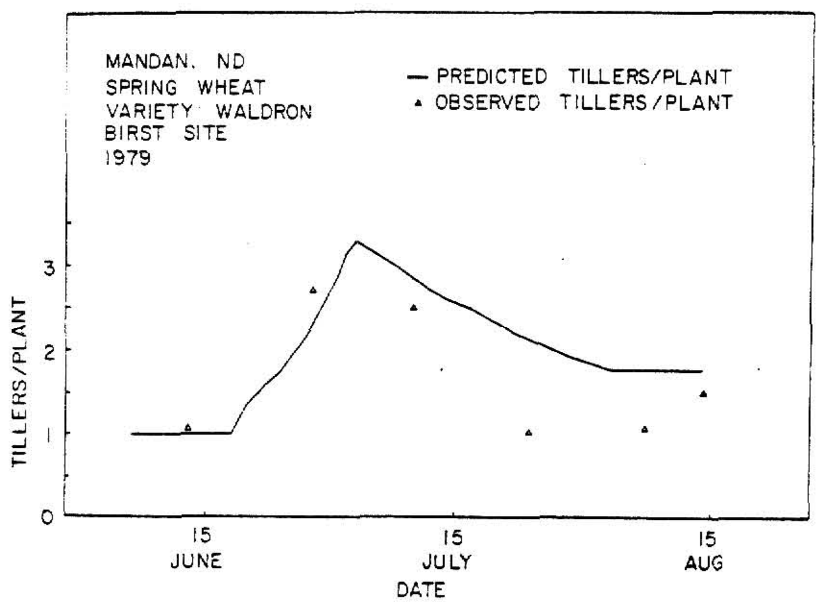

Fig. 11. Seasonal trends in observed and predicted tillers/plant (TNO) for the spring wheat test field from Mandan, North Dakota (1979).

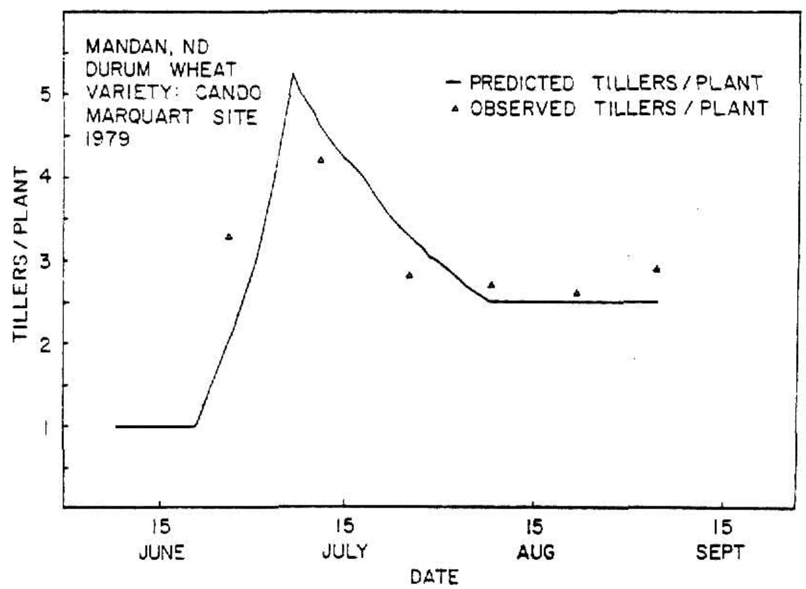

Fig. 12. Seasonal trends in observed and predicted tillers/plant (TNO) for the durum wheat test field from Mandan, North Dakota (1979).

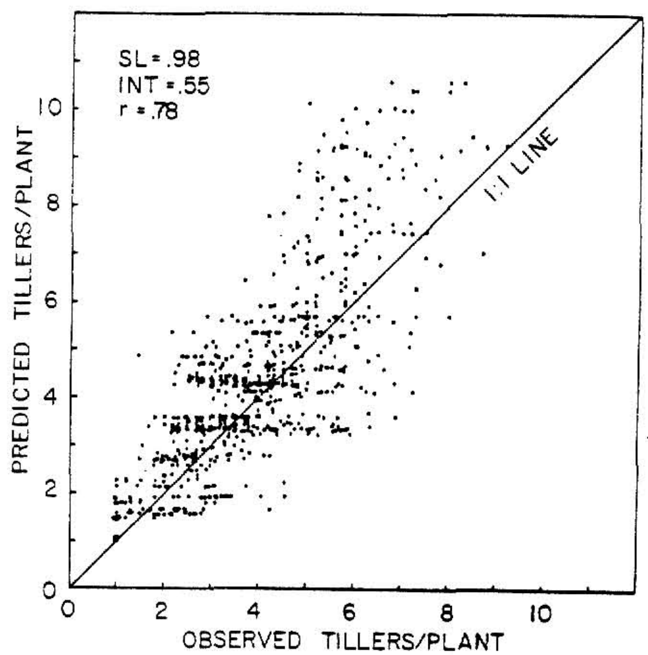

Fig. 13. Observed versus predicted tillers/plant (TNO) diagram for all fields used to test the model.

Table 4. Statistical analyses of the observed and predicted tillers/plant for data sets used to test the model.

Location	Vernon, TX	Bushland, TX	Phoenix, AZ	Phoenix, AZ	Mandan, ND	Mandan, ND	All Fields
Variety	Tam W-101	Tam W-101	Anza	Produra	Cando	Waldron	
Correlation coefficient (r)	0.71	0.39	0.87	0.87	0.70	0.74	0.78
Standard Deviation from Regression (tillers/plant)	0.86	1.10	1.08	1.15	0.77	0.47	1.26
Standard Deviation from Regression coefficient	0.063	0.068	0.042	0.043	0.576	0.493	0.029
Slope	0.73	0.43	1.10	1.13	1.13	0.61	0.98
Intercept (tillers/plant)	0.92	2.44	0.41	0.46	-0.55	0.97	0.55
Mean of Predicted (tillers/plant)	3.53	3.87	4.61	5.29	2.92	1.98	4.44
Mean of Observed (tillers/plant)	3.58	4.21	3.81	4.27	3.08	1.65	3.97
Number of Observations	132	144	222	220	6	6	730
Maximum of Predicted (tillers/plant)	5.59	5.70	9.79	10.63	4.66	2.86	10.63
Maximum of Observed (tillers/plant)	6.88	7.27	9.20	8.80	4.20	2.70	9.20
Minimum of Predicted (tillers/plant)	1.68	1.58	1.00	1.00	1.93	1.00	1.00
Minimum of Observed (tillers/plant)	1.53	1.46	1.00	1.00	2.60	1.04	1.00

which had a low correlation of .39. The overall correlation coefficient for all fields used to test the model was .78.

The mean values for observed and predicted tillers/plant (Table 4) differed by less than one tiller/plant for all data sets except for the data set from Phoenix, Arizona, (cultivar: Produra), which differed by slightly over one while the mean overall difference for all fields was less than one half a tiller/plant.

SUMMARY

By subsituting accumulated thermal units for chronological time, we adapted to the field environment the concept of quantitatively describing increases in tillers/plant as following the Fibonacci series, as described by Friend (1965), from experiments conducted on wheat in growth chambers. This rate was reduced by a water stress factor when the available soil moisture in the top 30 cm of soil was less than 20 percent of the maximum available soil moisture and a competition factor when LAI (leaf area index) exceeded a value of 1.6. Using a method similar to the one outlined by Maas and Arkin (1980), final tiller number/m^2 was calculated from maximum tiller number/m^2.

The model was tested on data sets from sites in Texas, Arizona, and North Dakota. In general, there was good agreement between predicted values of tillers/plant and observed values for winter, spring, and durum wheat cultivars.

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CHAPTER II

MODELING COMPONENTS OF LEAF AREA IN WINTER WHEAT

MODELING COMPONENTS OF LEAF AREA IN WINTER WHEAT

ABSTRACT

A leaf area index (LAI) term is used by many growth models to estimate various quantities such as photosynthesis and evapotranspiration. Because manual techniques for measuring LAI are extremely tedious, alternative methods of estimating LAI for these models are being sought. A model for predicting LAI was developed using the individual components of LAI: tillers/plant, leaves/tiller, leaf area/leaf, and leaf area/plant as a function of plant population, growth stage, water, and temperature. Equations were developed for winter wheat (*Triticum aestivum* L. em. Thell.) to provide a daily estimate of each component from easily obtainable meteorological data and data collected on plant growth in the field.

The model was tested on independent data sets from Texas, Arizona, and North Dakota. The model performed best when predicting LAI for fields in which soil moisture became limiting, but failed to match higher values of LAI on irrigated fields in which soil moisture did not become limiting, presumably because of an inability to adequately assess the effects of water on average leaf size.

INTRODUCTION

The importance of the leaves of a crop in intercepting light energy for the fixation of carbon dioxide has long been recognized. The percentage of incoming light energy intercepted by a crop for this purpose is often expressed as a function of the ratio of the unit area of exposed photosynthetic tissue per unit area of ground, called leaf area index (LAI). An LAI term is used by many plant growth and yield models to estimate various quantities such as daily photosynthesis, respiration, and evapotranspiration (Duncan, Loomis, Williams, and Hanau, 1967; Kanemasu, Stone, and Powers, 1976; Vanderlip and Arkin, 1977).

The increasing popularity of the use of plant growth models as research tools in recent years has been noted by Maas and Arkin (1980). Thornley (1976) lists several potential benefits of modeling plant growth. Those that have particular relevance to this study are: (1) attempts at model building can help identify areas where data and knowledge are lacking, (2) constructing models can stimulate new ideas and experimental approaches.

The paucity of information available on cereal leaf growth has been noted by Gallagher (1979). Other than intercepting radiation and providing assimilate to the ear during grain growth little seems to be known of the factors that influence the size and numbers of cereal leaves in the field. Our objective in this study was to develop for winter wheat (*Triticum aestivum* L. em. Thell) a non-specific cultivar model that would yield a daily estimate of LAI. Utilizing the tiller model as described in Chapter I, we chose to arrive at a daily estimate of LAI by modeling the following components of LAI: leaves/tiller, leaf area/leaf and leaf area/plant, as affected by plant population, growth stage, temperature, and soil moisture.

MATERIALS AND METHODS

Field Experiment

Five cultivars of hard red winter wheat (Triticum aestivum L. em. Thell.) were planted during the first week of September (early planted wheat, EPW) and the second week of October 1979 (late planted wheat, LPW) at the Evapotranspiration Research site 7 km southwest of Manhattan, KS. Each plot consisted of 10 rows 7.6 m long and 17.8 cm apart. Each seed was placed approximately 3.1 cm apart within the rows. This resulted in an actual seeding rate of 1,747,000 seeds/ha. The experimental design was a completely randomized design with planting dates as the main treatments and cultivars as the subtreatments. The cultivars planted were 'Bezostaya 1', 'Centurk', 'Eagle','Newton', and'Tam W-101'.

The soil type was a Eudora silt loam (course-sily, mixed, mesic, Fluventic Hapludolls). The field was fertilized with approximately 67 kg/ha total N and 26 kg/ha P_2O_5 (44% P) on 23 August 1979. Soil moisture was measured periodically in each plot to a depth of 150 cm with a neutron probe and scaler. Soil moisture of the top 15 cm was determined gravimetrically. The plots were irrigated on the 14 through 17 October and 5 through 7 May with approximately 7.2 and 7.1 cm of water, respectively.

Growth Analysis

Components of leaf area index (LAI) were measured by means of destructive sampling at intervals (see Appendix A) throughout the growing season. On each sampling date, two samples consisting of 30.5 cm of row were taken from each plot. Total number of plants in each sample was determined in the field and the above ground portion of each sample was then bulked and transported to the laboratory for further analysis. Total number of living leaves and tillers was counted and laminar area of the leaves was then measured for each sample, using a leaf area meter (LI-COR 3100, Lincoln, Nebraska). Living tillers were defined as those tillers with living leaves or tillers that survived to produce a head when the leaves became senescent at the end of the growing season. In the spring living leaves were further separated into growing and expanded leaves. Total number of leaves and exposed laminar area was then determined for each. Dry weights for each plant part were obtained after oven drying at 70°C for at least 48 hours. Data for each plant part were then expressed on a per plant basis for each sample.

The mainstem tiller of three plants from each of the late planted plots (October planting) were tagged as they emerged with a small wire loop attached to a galvanized metal tag. Green laminar length and width for each leaf produced by these tagged tillers were recorded during the fall and spring. The product of length and width of lamina harvested five times during the growing season was regressed against laminar area of these leaves measured with the leaf area meter. With these simple linear equations, laminar area per leaf was then estimated for each leaf recorded from the tagged tillers.

Adverse weather conditions such as snow, rain, and entreme cold, prevented taking measurements of laminar length and width of leaves on tagged tillers during the winter. In March, when the measurements were resumed, the oldest living leaf was assigned a leaf stage of one. Successive leaves on each tiller were then incremented by one leaf stage each.

Model Development

Components of LAI were calculated differently depending on the stages of growth. For fields lacking observed growth stage data, the growth stages of emergence, jointing, and boot were estimated using a biometeorological time scale (BMTS) (Feyerherm and Paulsen, 1976). Each of the five identified growth stages represented different subroutines in the model. The growth stages considered were:

EMRG (from seedling emergence (BMTS = 1.00) until the beginning of tillering),

STG2 (from the beginning of tillering until double ridges),

DRDG (from double ridges (BMTS = 1.83) until jointing),

JNT (from jointing (BMTS = 2.33) until boot stage),

BOOT (from boot stage (BMTS = 2.70) until all leaves were assumed to be dead).

RESULTS AND DISCUSSION

Leaves per Tiller

Total number of leaves per plant (LNO) was regressed against total number of tillers per plant (TNO) for all samples containing living leaves, throughout the growing season, as shown in Fig. 1 where

$$LNO = 2.775(TNO) + .159 \qquad [1]$$

with R^2 = .92. This ratio of leaves to tillers depends on the relative rates of leaf and tiller production and senescence, which may vary with changes in the environment and ontogeny of the crop. Some of the changes in this ratio can be seen in Fig. 2 where the residuals of [1] are plotted against time. Mitchell (1953a,b) defines a minimum of this ratio for ryegrass (Lolium spp.). He found that under conditions favoring high rates of tillering, an auxillary bud would not develop into a visible tiller until there was at least one mature leaf above it. According to Mitchell, this results in a tiller becoming visible at 2 to 2.5 leaf-appearance intervals after the appearance of the subtending leaf. Friend (1965) found increasing temperature over the range of 10 to 25°C increased

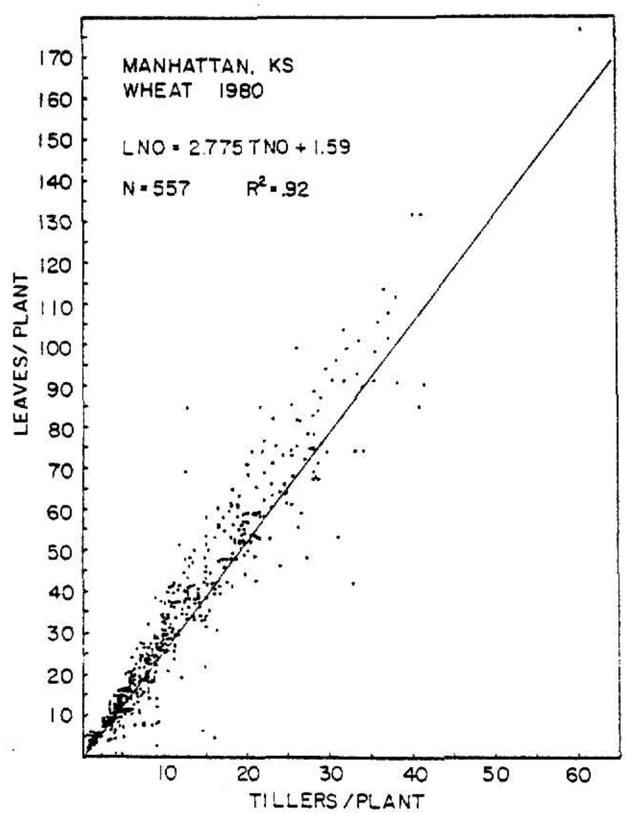

Fig. 1. Number of leaves/plant (LNO) plotted against number of tillers/plant (TNO) for all fields used in model development.

both the rates of leaf and tiller production, but leaf production was increased to an even greater extent. This increased apical dominance and also increased the ratio of leaves to tillers. Conversely, he found that lower temperatures slowed the rates of leaf and tiller production, but retarded the rate of leaf production even more than the rate of tillering, decreasing apical dominance and the ratio of leaves to tillers.

The sample taken during January (Fig. 2) shows all but one observation being overestimated. This could be due not only to the relatively higher rates of tiller production as compared to leaf production during the colder temperatures of the winter, but also possibly due to the winter kill of some of the leaves. The negative residuals on the last sampling date are the result of a normal senescence of the leaves at the end of the growing season.

Competition for light has been shown to increase the ratio of leaves to tillers by increasing apical dominance and decreasing the rate of tillering. Kirby and Faris (1972) found that competition for light at higher plant densities resulted in fewer tillers/plant in barley (Hordeum vulgare L.). Knight (1969), working with cocksfoot (Dactylis, glomerata L.) concluded that the rate of tillering decreased as plant weight increased because of a competition for light.

The residuals of the samples taken during April and May (Fig. 2) indicate a tendency of [1] to underestimate the ratio of leaves to tillers, probably due to the warmer temperatures and increased competition for light at the higher LAI during this period. It was decided that variations in the ratio of leaves to tillers, throughout most of the growing season, were sufficiently small enough to permit the use of [1] from STG2 until BOOT.

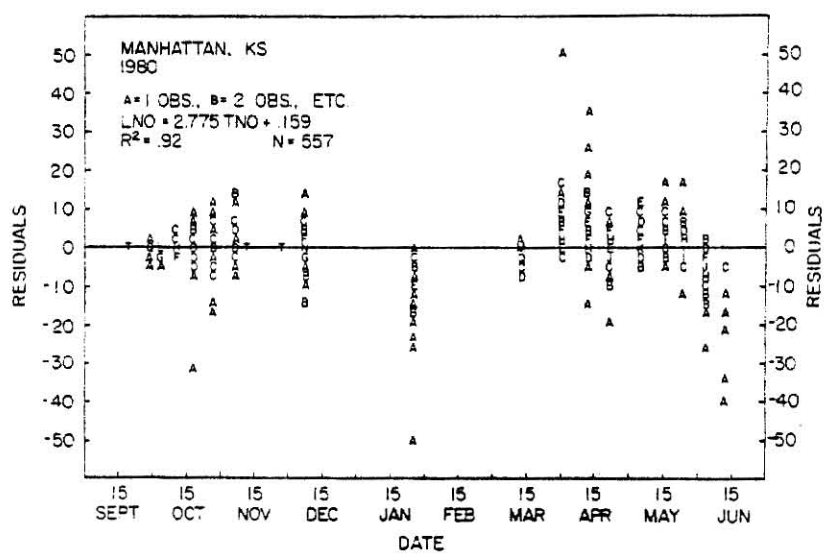

Fig. 2. Residuals of the regression of leaves/plant (LNO) against tillers/plant (TNO) plotted against time.

During EMRG, LNO is increased at a linear rate with ΣTu_t (ΣTu_t= ΣTu_t + (Tu * KSWAT * CFACT) as defined in Chapter 1) to a maximum of 2.8 at the end of EMRG. From STG2 until BOOT, LNO is calculated as in [1]. During BOOT, LNO is decreased to 0 at a linear rate with an additional 511 Tu.

Leaf Area

In order to obtain a measure of laminar area from the length and width measurements of leaves of tagged tillers, specific leaves were harvested five times during the growing season. The product of laminar length and width (LW) was regressed against measured laminar area (A). The following regression equation was found

$$A = .721\ (LW) + .058 \qquad [2]$$

with R^2 = .98. On examination of the residuals (Fig. 3) it was found that this model tends to underestimate the laminar area of leaves from the first harvest, which consisted of the first leaf produced by the plant, and overestimated the laminar area of the flag leaves. The probable reason for this is the difference in the shape of these two leaves. Percival (1921) points out that the first foliage leaf produced by the plant has a blunt tip which would cause the shape of this leaf to more closely approximate the shape of a rectangle than later formed leaves. The lamina of the flag leaf is usually wider but shorter than that of the previous leaf, resulting in a more triangular shaped lamina. For these reasons, LW of the first and the flag leaves were regressed separately against their respective areas.

$$A = .89\ (LW) - .14 \quad \text{(first leaf, } N = 18,\ R^2 = .89) \qquad [3a]$$

$$A = .77\ (LW) - 1.20 \quad \text{(flag leaf, } N = 30,\ R^2 = .97) \qquad [3b]$$

$$A = .81\ (LW) - .53 \quad \text{(all remaining leaves, } N = 89,\ R^2 = .98) \qquad [3c]$$

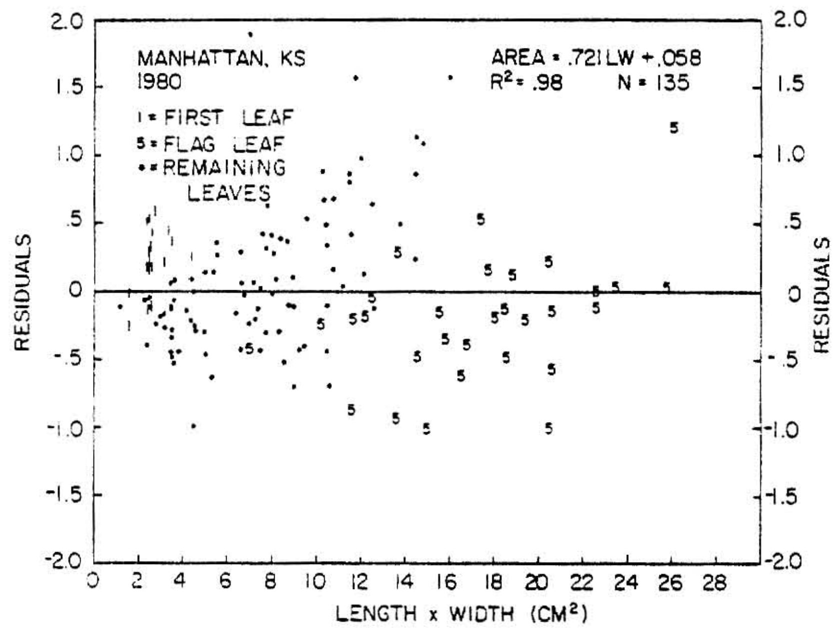

Fig. 3. Residuals of the regression of the product of laminar length x width (LW) against laminar area plotted against (LW) for leaves of the tagged mainstem tillers of the late planted wheat.

Gallagher (1979) found that the mainstem laminar width increased with successive wheat leaves after spikelet initiation. He also found that laminar length on the mainstem increased with successive leaves after spikelet initiation up to and including the penultimate leaf, with the lamina of the flag leaf being shorter than that of the penultimate leaf. The same situation was found with leaves of the tagged tillers of the LPW for both laminar width (Fig. 4) and laminar length (Fig. 5). The resulting areas of these leaves are shown in Fig. 6.

Under favorable growing conditions as each tiller continues to produce successively larger leaves, and as older and relatively smaller leaves become senescent, average laminar area per plant (LAPP) and laminar area per leaf (LAPL) increases. Observed LAPP was regressed against observed LNO (Fig. 7) for the EPW over the period from EMRG to DRDG:

$$LAPP = 1.0143\ (LNO)^{1.2096} \qquad [4]$$

with $R^2 = .94$. In order to make the model more closely simulate the leaf area of winter wheat cultivars commonly grown in the U. S., the Russian wheat Bezostaya 1, because of its larger leaf sizes, was excluded from regressions on data for LAPP and LAPL.

Robson (1967), working with tall fescue (Festuca arundunacea Schreb.), also found that successive leaves on the mainstem were successively longer during the fall and spring. During the winter he found that leaves became shorter in response to cold temperatures. The same situation was found for both laminar length and area for the wheat leaves of tagged tillers formed during periods of cold temperatures. Using the cultivars Newton and Bezostaya 1 as an example, Fig. 8 shows that the lamina of the first and second leaves formed during the fall (labeled A and B

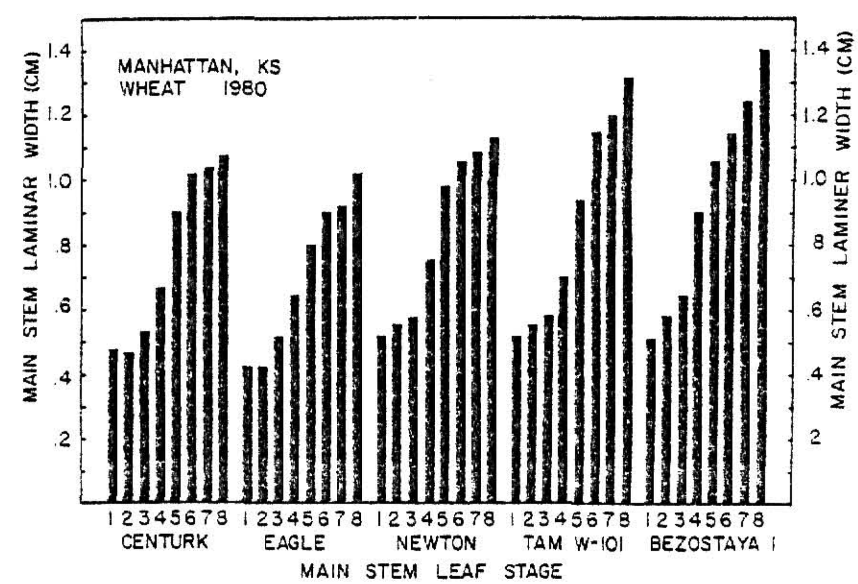

Fig. 4. Histogram of the mainstem laminar width in cm plotted against mainstem leaf stage for all the cultivars of the late planted wheat.

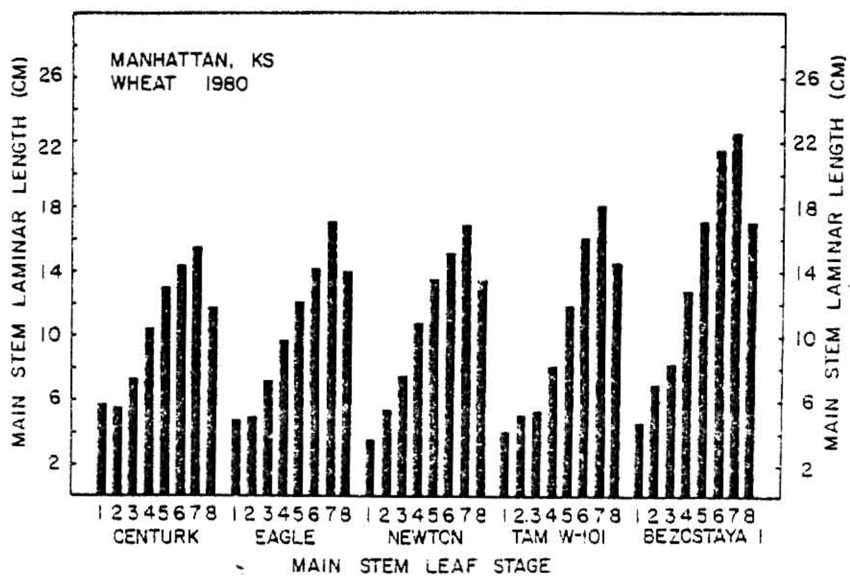

Fig. 5. Histogram of the mainstem laminar length in cm plotted against mainstem leaf stage for all the cultivars of the late planted wheat.

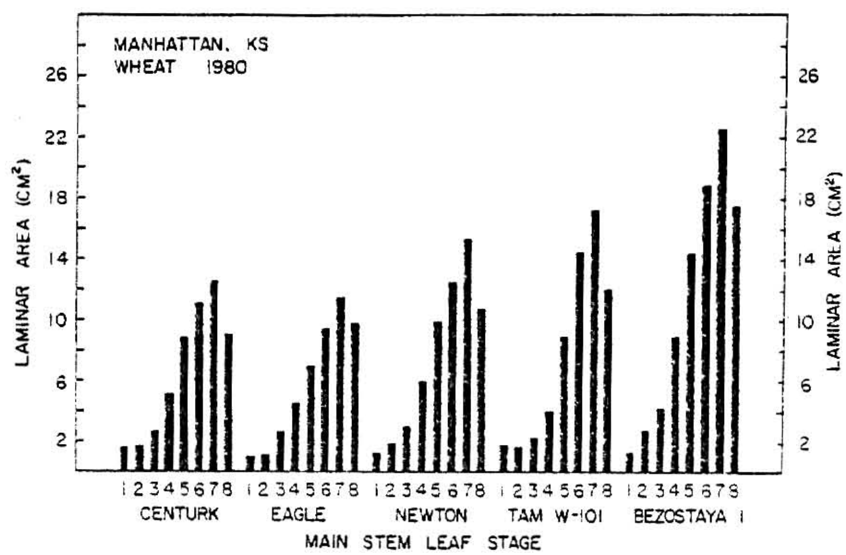

Fig. 6. Histogram of the mainstem laminar area in cm plotted against mainstem leaf stage for all the cultivars of the late planted wheat.

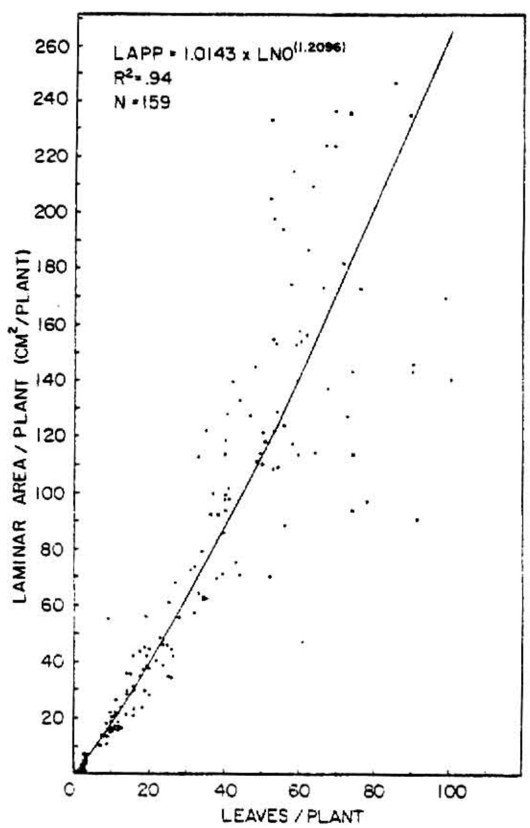

Fig. 7. Laminar area/plant (LAPP) plotted against leaves/plant (LNO) for all early planted wheat samples taken prior to double ridges.

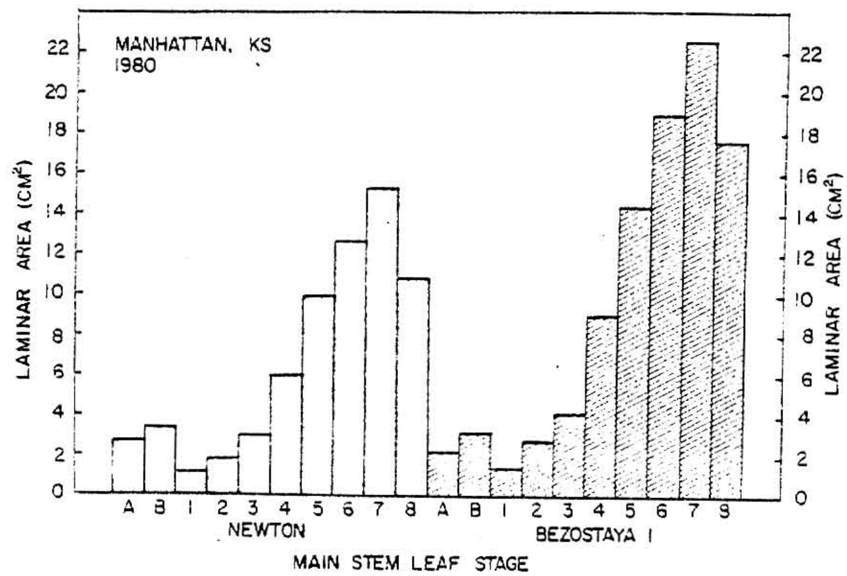

Fig. 8. Comparison of the laminar area of the first and second leaves formed during the fall (labeled A and B) with the laminar areas of the leaves formed during the spring for the cultivars Newton and Bezostaya 1 of the late planted wheat.

respectively) were larger than the later formed lamina of leaf 1, formed under colder temperature early in the spring.

In an attempt to account for smaller leaves being formed during periods of cold temperatures and a reduction in average leaf size due to winter kill, LAPP, during the period from EMRG to DRDG, and LAPL, from DRDG to BOOT, are multiplied by a cold temperature factor (TFACT). Small widely spaced plants are more susceptible to frost damage than canopies that are more dense and temperatures below -3°C are necessary for significant frost damage (Mass and Arkin, 1980).

In the model TFACT cumulatively reduces LAPP during STG2 and LAPL during DRDG by 1% (LAIMX $\leq$ 1.0) or by 0.5% (LAIMX > 1.0) on days when TMIN $\leq$ 3°C. TFACT also begins to repair any damage by 0.5% after each accumulated 40 Tu.

In the spring it was found that LAPL increased at a faster rate than in the fall and winter for both EPW and LPW as shown in Figs. 9-13. From DRDG to BOOT observed LAPL was regressed against Tu as shown in Fig. 14 where:

$$\mathrm{LAPL} = .1853(\Sigma \mathrm{Tu})^{.5936} \qquad (\mathrm{LAIMX} \geq 1.6) \qquad [5]$$

with R^2 = .86 for EPW or

$$\mathrm{LAPL} = .0168(\Sigma \mathrm{Tu})^{.9512} \qquad (\mathrm{LAIMX} < 1.6) \qquad [6]$$

with R^2 = .89 for LPW.

Estimates of LAI during EMRG and STG2 are originally based on LAPP as calculated by [4]. During DRDG and JNT, estimates of LAI are calculated by [5] and [6]. During BOOT, LAPL is decreased to 0 exponentially with Tu for 511 Tu.

Model Tests

The LAI model was tested on the same data sets ued to test the tiller model in Chapter 1. Shown in Fig. 15-20 are the trends in observed and

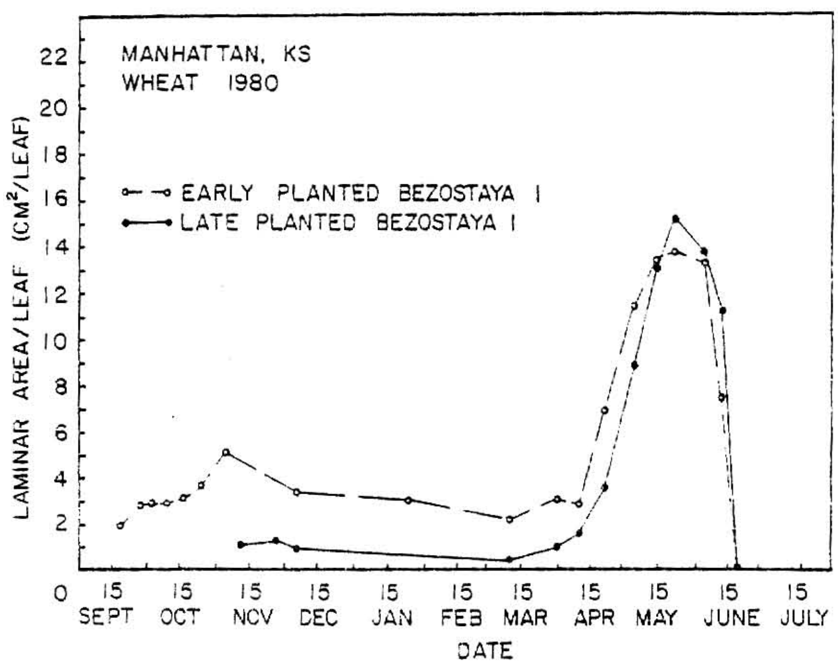

Fig. 9. Laminar area/leaf plotted against time for early and late planted Bezostaya 1.

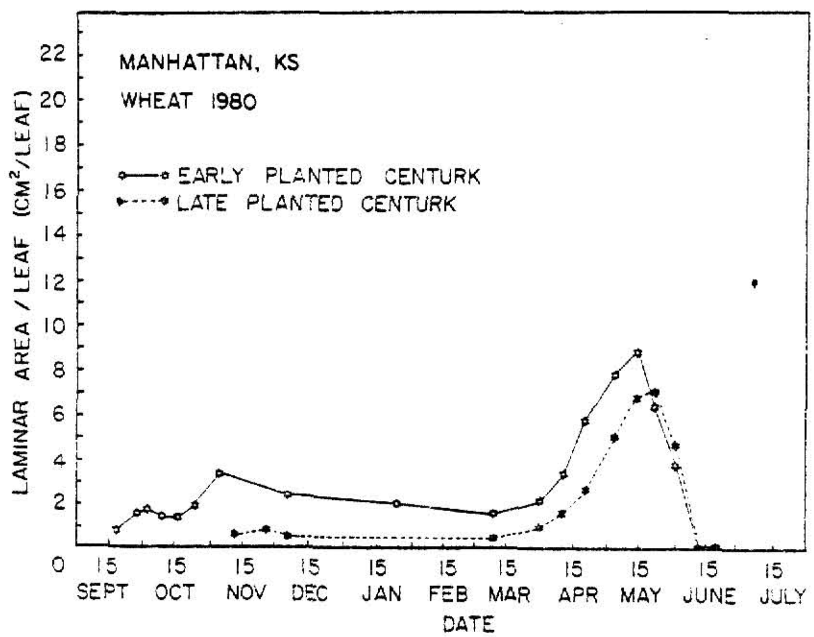

Fig. 10. Laminar area/leaf plotted against time for early and late planted Centurk.

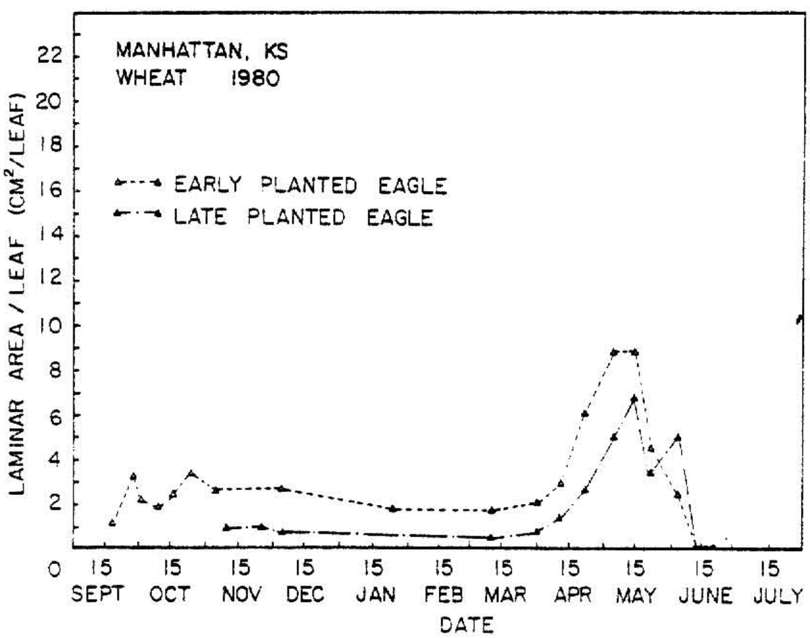

Fig. 11. Laminar area/leaf plotted against time for early and late planted Eagle.

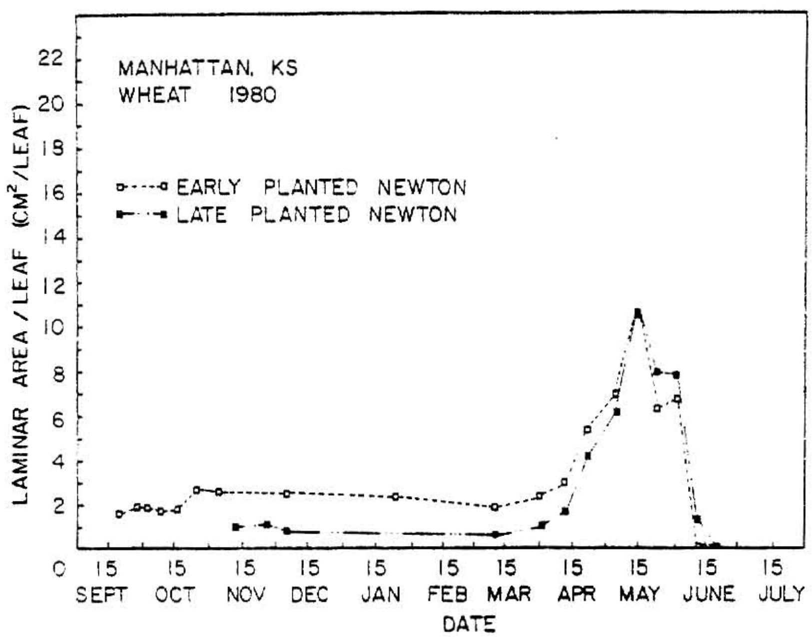

Fig. 12. Laminar area/leaf plotted against time for early and late planted Newton.

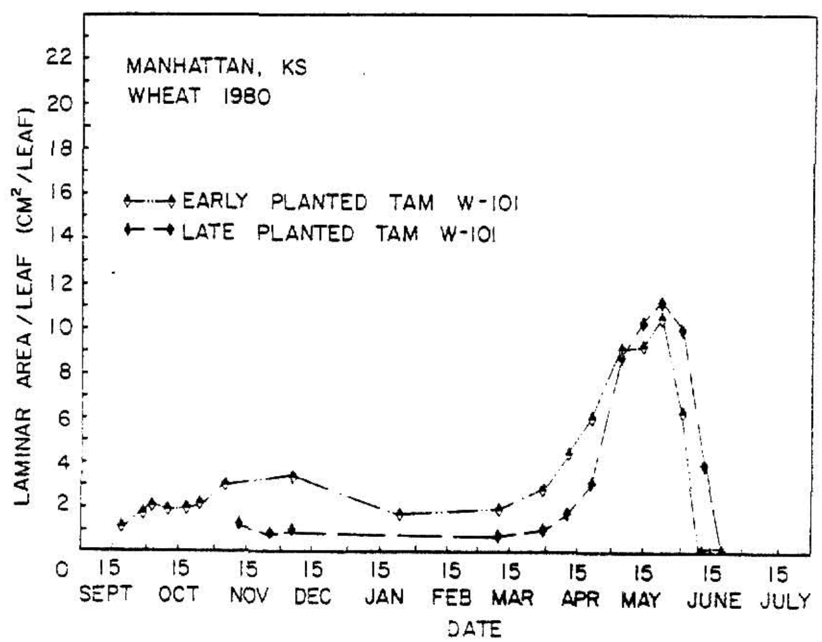

Fig. 13. Laminar area/leaf plotted against time for early and late planted Tam W-101.

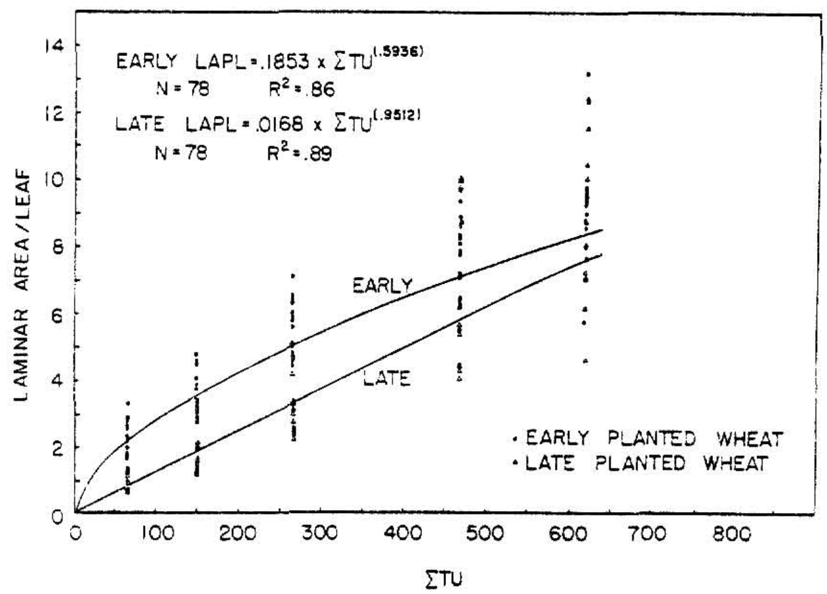

Fig. 14. Laminar area/leaf (LAPL) plotted against thermal time (Tu) from double ridges to boot stage for both early and late planted wheat.

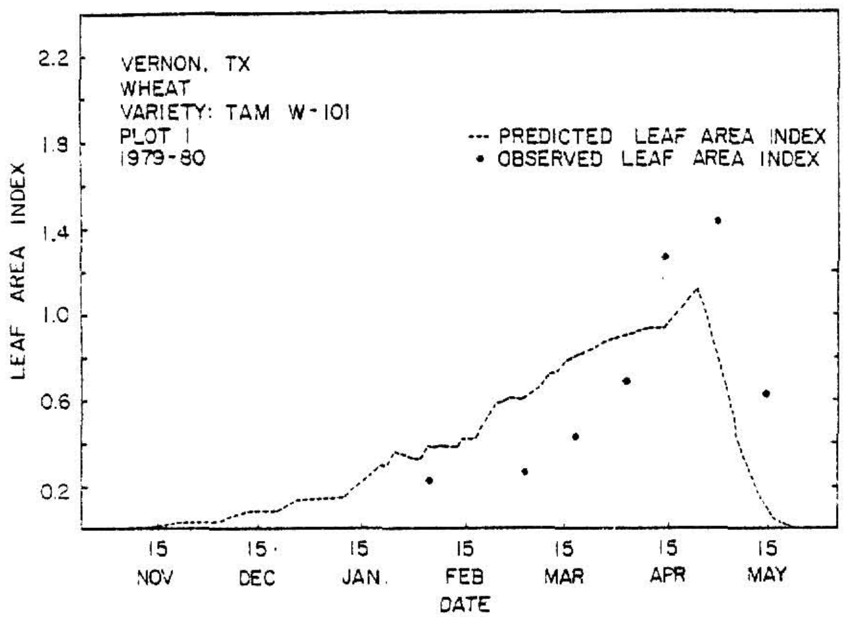

Fig. 15. Seasonal trends in observed and predicted LAI for a winter wheat test field from Vernon, Texas (1979-80).

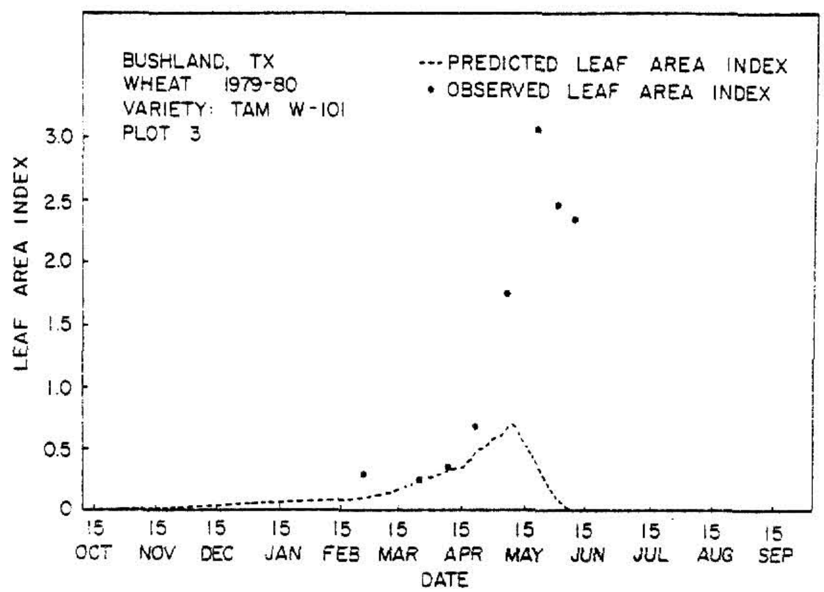

Fig. 16. Seasonal trends in observed and predicted LAI for a winter wheat test field from Bushland, Texas (1979-80).

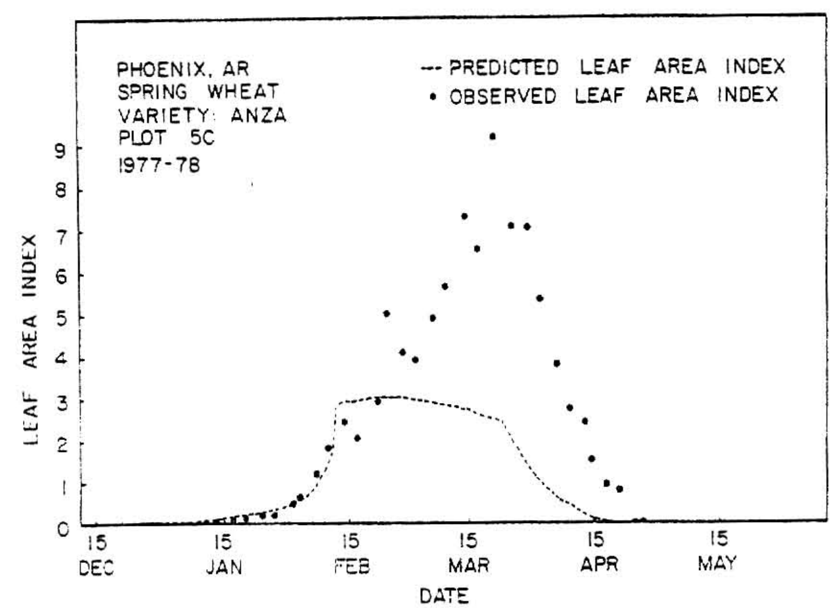

Fig. 17. Seasonal trends in observed and predicted LAI for a winter wheat test field from Phoenix, Arizona (1977-78).

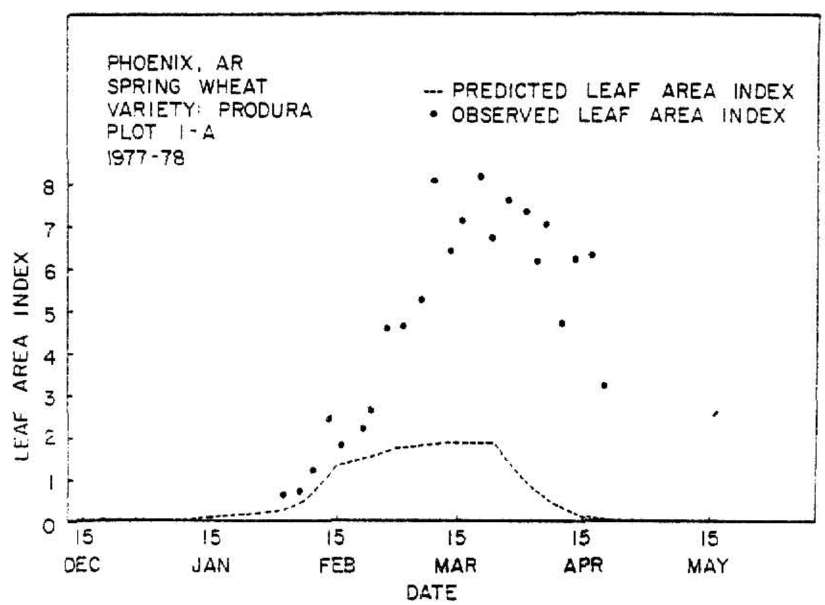

Fig. 18. Seasonal trends in observed and predicted LAI for a spring wheat test field from Phoenix, Arizona (1977-78).

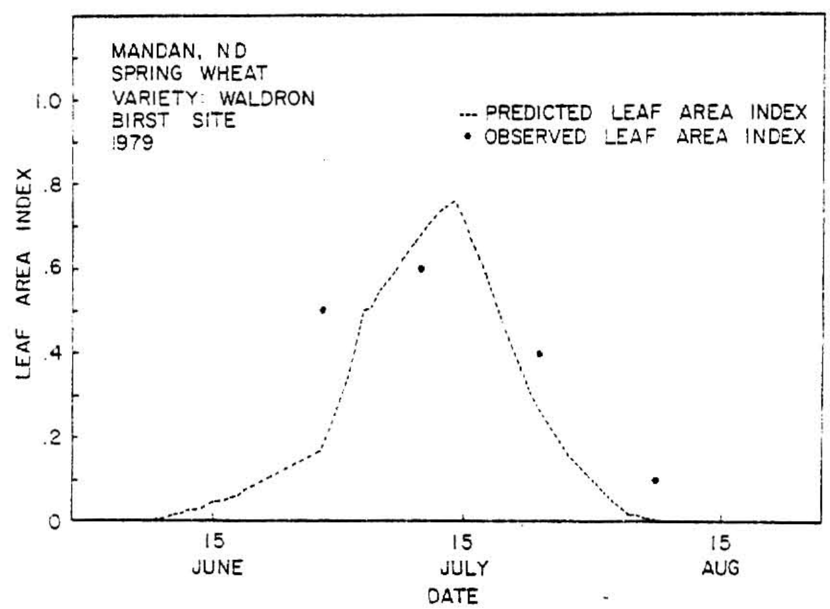

Fig. 19. Seasonal trends in observed and predicted LAI for the spring wheat test field from Mandan, North Dakota (1979).

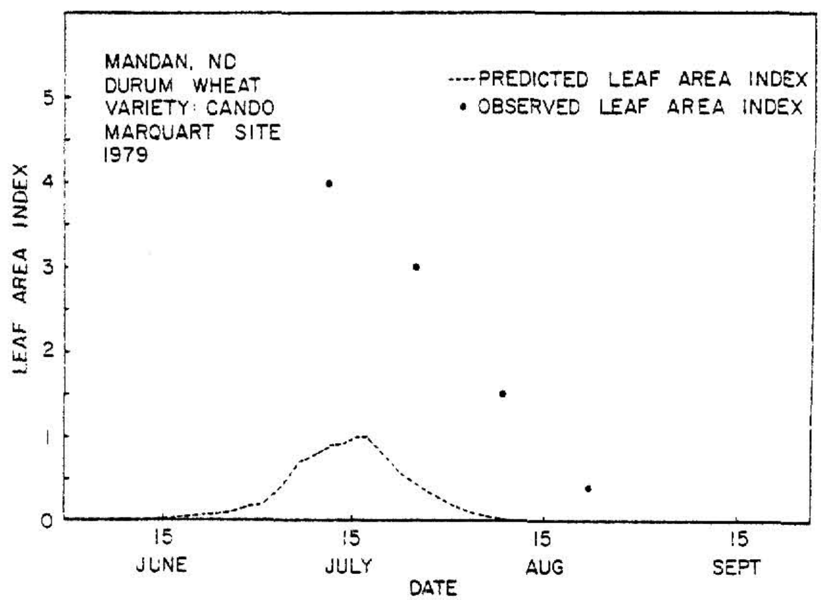

Fig. 20. Seasonal trends in observed and predicted LAI for the durum wheat test field from Mandan, North Dakota (1979).

predicted LAI for one field from each data set. In general the model failed to adequately match the higher observed LAI values after jointing.

The model did a better job of predicting LAI for fields in which soil moisture became limiting, especially as LAI was approaching a maximum. Such was the case in Vernon, Texas (Fig. 15) where Tam W-101 was planted. The model also preformed well in predicting LAI for the spring wheat grown in North Dakota (Fig. 19), which was grown under limiting soil moisture throughout the growing season.

The model did poorest in estimating LAI for the irrigated spring wheats grown at Phoenix, Arizona (Figs. 17-18). The observed average leaf area/leaf at maximum LAI was in excess of 30 cm^2 for both of the cultivars 'Anza' and 'Produra', which is almost three times as large as the maximum leaf area/leaf of the cultivars in the data set used to build the model. These large differences in average leaf area/leaf are probably due mostly to the fact that the irrigated spring wheats were grown under higher soil moisture conditions than those in the data set used to build the model. Unlike the irrigated spring wheats, the cultivars in the data sets used to build the model met with limiting soil moisture later in the growing season as LAI was reaching a maximum.

From this it can be seen that the main weakness of the model was an inability to adequately assess the effects of water and genotype on average leaf size. In order to model average leaf size properly, data on average leaf size as affected by a wide range of soil moisture conditions are needed. Differences among cultivars in final leaf size, as shown in Fig. 6, also indicate a need for a more cultivar-specific model.

SUMMARY

Estimates of leaf area index (LAI) were calculated from the daily estimate of tillers/plant from the tiller model as described in chapter 1, and by modeling the following remaining components of LAI: leaves/tiller, leaf area/leaf, and leaf area/plant. The model performed best when predicting LAI for independent data sets from fields in which soil moisture became limiting. Suggested improvements in the model included conducting experiments to assess the effects of water and genotype on average leaf size.

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APPENDIX A

LAI AND COMPONENTS OF LAI FOR WINTER WHEAT

Table A1. Components of LAI and LAI measurements for early planted Bezostaya 1, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.15	3.01	4.80	1.59	111	0.06
79/09/28	2.86	8.07	24.60	3.05	111	0.31
79/10/03	3.81	11.64	28.42	2.44	111	0.34
79/10/10	6.07	20.35	52.16	2.54	138	0.78
79/10/17	8.43	25.60	58.19	2.27	129	0.59
79/10/25	32.70	32.70	99.86	3.05	138	1.17
79/11/05	17.50	62.81	326.18	5.19	120	3.36
79/12/06	18.48	57.00	230.10	4.04	92	2.76
80/01/24	28.42	69.91	205.35	2.94	101	2.27
80/03/11	21.40	55.10	124.27	2.26	92	1.15
80/04/01	23.23	66.97	175.41	2.62	92	1.53
80/04/11	34.41	104.37	440.06	4.22	92	3.99
80/04/22	27.18	79.40	516.50	6.51	101	5.24
80/05/05	13.01	39.48	494.32	12.52	101	5.09
80/05/15	9.88	32.44	460.51	14.20	111	4.83
80/05/23	10.98	34.41	443.13	12.88	120	4.90
80/06/03	7.16	13.58	140.86	10.37	111	1.56
80/06/12	10.98	1.35	10.60	7.85	92	0.13
80/06/20	11.41	0.00	0.00	0.00	92	0.00

Table A2. Components of LAI and LAI measurements for early planted Bezostaya 1, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.09	3.25	7.67	2.36	120	0.09
79/09/28	3.50	8.42	22.56	2.68	129	0.25
79/10/03	5.42	15.43	52.00	3.41	129	0.56
79/10/10	8.70	23.03	77.32	3.36	148	1.08
79/10/17	11.25	38.09	152.00	3.99	101	1.99
79/10/25	14.97	48.46	210.60	4.35	120	2.98
79/11/05	18.24	60.90	306.86	5.04	101	3.69
79/12/06	25.33	89.75	250.58	2.79	120	2.27
80/01/24	27.84	71.20	219.54	3.08	111	2.22
80/03/11	26.33	70.00	149.08	2.13	55	0.83
80/04/01	32.54	102.60	356.77	3.48	74	2.58
80/04/11	27.83	95.50	143.75	1.51	83	1.04
80/04/22	28.03	69.14	510.79	7.39	120	5.86
80/05/05	36.33	110.17	978.57	8.88	65	5.53
80/05/15	20.50	74.25	928.92	12.51	74	6.86
80/05/23	12.63	49.83	721.03	14.60	74	5.33
80/06/03	15.38	42.38	690.96	16.30	74	5.10
80/06/12	15.33	5.25	37.35	7.11	83	0.32
80/06/20	12.80	0.00	0.00	0.00	65	0.00

Table A3. Components of LAI and LAI measurements for early planted Centurk, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.00	2.50	1.77	0.71	166	0.03
79/09/28	3.40	9.13	15.06	1.65	166	0.26
79/10/03	4.89	11.72	16.43	1.40	166	0.27
79/10/10	4.55	11.16	15.42	1.38	166	0.26
79/10/17	11.21	26.02	40.26	1.55	120	0.49
79/10/25	13.02	35.84	61.98	1.73	166	1.03
79/11/05	21.78	60.42	201.65	3.34	129	2.60
79/12/06	28.19	66.65	117.28	1.76	120	1.39
80/01/24	37.44	80.06	180.09	2.25	120	2.22
80/03/11	25.00	68.28	108.19	1.58	138	1.48
80/04/01	27.03	108.74	207.26	1.91	111	2.19
80/04/11	29.58	89.42	297.51	3.33	138	4.07
80/04/22	20.19	55.50	303.59	5.47	148	4.48
80/05/05	15.47	48.74	371.44	7.62	138	5.09
80/05/15	10.00	32.88	280.09	8.52	138	3.89
80/05/23	17.48	50.76	368.78	7.27	101	3.50
80/06/03	9.78	20.93	96.57	4.61	129	1.25
80/06/12	9.13	0.00	0.00	0.00	129	0.00
80/06/20	8.79	0.00	0.00	0.00	129	0.00

Table A4. Components of LAI and LAI measurements for early planted Centurk, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.00	2.30	2.00	.87	138	0.03
79/09/28	3.58	10.03	16.15	1.61	166	0.27
79/10/03	6.65	15.65	32.86	2.10	148	0.48
79/10/10	8.72	25.57	39.95	1.56	148	0.56
79/10/17	31.00	53.33	70.41	1.32	166	1.17
79/10/25	20.37	54.74	121.18	2.21	148	1.85
79/11/05	21.96	64.39	215.61	3.35	157	3.71
79/12/06	24.63	69.38	223.38	3.22	148	3.30
80/01/24	30.95	72.35	134.79	1.86	138	1.81
80/03/11	27.57	74.89	132.16	1.76	111	1.43
80/04/01	26.12	81.98	202.69	2.47	120	2.43
80/04/11	19.35	75.58	262.27	3.47	111	2.90
80/04/22	21.41	63.76	387.71	6.08	138	5.36
80/05/05	12.98	48.16	385.43	8.00	148	5.77
80/05/15	15.09	45.80	419.22	9.15	101	4.31
80/05/23	9.74	29.05	157.74	5.43	166	2.55
80/06/03	17.68	33.64	73.75	3.93	120	1.10
80/06/12	13.75	0.00	0.00	0.00	111	0.00
80/06/20	10.36	0.00	0.00	0.00	120	0.00

Table A5. Components of LAI and LAI measurements for early planted Eagle, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.00	2.51	2.86	1.14	175	0.05
79/09/28	3.34	9.08	20.16	2.22	157	0.32
79/10/03	6.81	16.63	45.54	2.74	148	0.67
79/10/10	8.26	23.48	46.54	1.98	157	0.74
79/10/17	13.13	37.58	96.50	2.57	120	1.16
79/10/25	17.75	48.44	144.75	2.99	148	2.14
79/11/05	19.00	53.06	215.75	4.07	148	3.18
80/12/06	25.64	74.71	197.47	2.64	129	2.55
80/01/24	26.90	44.26	137.07	3.10	101	1.40
80/03/11	23.86	65.56	116.98	1.76	148	1.82
80/04/01	30.36	91.50	211.11	2.31	129	2.72
80/04/11	48.48	145.70	460.87	3.16	83	3.76
80/04/22	24.04	59.06	339.98	5.76	120	3.95
80/05/05	15.55	44.58	284.45	6.38	157	4.63
80/05/15	11.83	36.50	302.99	8.30	92	4.05
80/05/23	11.29	29.43	172.72	5.87	129	2.23
80/06/03	8.14	12.33	30.49	2.47	175	0.53
80/06/12	9.22	0.00	0.00	0.00	157	0.00
80/06/20	11.10	0.00	0.00	0.00	185	0.00

Table A6. Components of LAI and LAI measurements for early planted Eagle, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.00	3.05	3.91	1.28	148	0.06
79/09/28	2.89	8.30	35.12	4.23	138	0.50
79/10/03	4.31	11.25	18.10	1.61	148	0.27
79/10/10	6.50	18.11	35.93	1.98	166	0.60
79/10/17	9.21	22.45	32.87	1.46	166	0.53
79/10/25	13.51	21.81	38.07	1.75	138	0.54
79/11/05	23.35	60.28	164.71	2.73	129	2.13
79/12/06	16.05	40.87	100.75	2.47	148	1.49
80/01/24	21.44	51.56	115.43	2.24	148	1.70
80/03/11	29.55	76.69	130.15	1.70	157	2.05
80/04/01	32.93	96.33	168.91	1.75	157	2.65
80/04/11	23.34	69.38	204.09	2.94	157	3.10
80/04/22	24.06	65.99	418.96	6.35	138	5.87
80/05/05	9.49	28.95	191.02	6.60	203	3.90
80/05/15	11.83	36.50	302.99	8.30	138	4.05
80/05/23	14.03	37.70	119.42	3.17	74	0.86
80/06/03	8.13	7.51	15.17	2.02	129	0.19
80/06/12	7.94	0.00	0.00	0.00	148	0.00
80/06/20	8.63	0.00	0.00	0.00	129	0.00

Table A7. Components of LAI and LAI measurements for early planted Newton, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.06	3.09	5.40	1.75	175	0.09
79/02/28	2.88	8.09	14.80	1.83	175	0.26
79/10/03	4.11	11.22	19.05	1.70	157	0.30
79/10/10	4.78	14.22	23.71	1.67	166	0.39
79/10/17	7.88	17.97	30.84	1.72	175	0.52
79/10/25	9.49	29.17	67.29	2.31	166	1.12
79/11/05	12.37	35.50	84.98	2.39	157	1.32
79/12/06	17.44	44.75	114.82	2.57	148	1.69
80/01/24	18.77	47.33	111.01	2.35	129	1.47
80/03/11	18.25	51.30	94.87	1.85	120	1.04
80/04/01	20.61	71.70	168.50	2.35	148	2.39
80/04/11	19.15	56.02	148.53	2.65	138	2.10
80/04/22	13.92	38.85	229.03	5.90	129	2.96
80/05/05	9.48	31.64	181.21	5.73	120	2.10
80/05/15	11.01	30.91	311.69	10.08	148	4.40
80/05/23	7.66	16.09	110.06	6.84	157	1.66
80/06/03	7.25	9.44	65.08	6.89	148	0.96
80/06/12	6.30	0.00	0.00	0.00	157	0.00
80/06/20	6.48	0.00	0.00	0.00	148	0.00

Table A8. Components of LAI and LAI measurements for early planted Newton, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.10	3.00	4.49	1.50	185	0.08
79/09/28	3.43	9.18	17.40	1.90	185	0.32
79/10/03	4.74	13.30	26.15	1.97	175	0.46
79/10/10	5.16	16.00	27.57	1.72	166	0.46
79/10/25	10.19	30.17	90.29	2.99	157	1.39
79/11/05	12.25	34.94	100.58	2.88	148	1.48
79/12/06	15.51	54.35	132.99	2.45	148	1.92
80/01/24	20.14	51.97	136.63	2.63	138	1.91
80/03/11	15.19	38.86	70.44	1.81	148	1.04
80/04/01	14.38	50.83	118.41	2.33	166	1.96
80/04/11	22.41	74.66	253.23	3.39	111	2.80
80/04/22	19.13	56.50	266.17	4.71	129	3.49
80/05/05	13.59	37.54	301.49	8.03	157	4.71
80/05/15	9.95	32.04	351.40	10.97	148	5.19
80/05/23	9.90	27.90	160.55	5.75	157	2.52
80/06/03	7.33	12.62	81.64	6.47	148	1.15
80/06/12	8.33	0.00	0.00	0.00	157	0.00
80/06/20	9.59	0.00	0.00	0.00	157	0.00

Table A9. Components of LAI and LAI measurements for early planted Tam W-101, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.06	3.13	4.84	1.55	157	0.07
79/09/28	3.66	10.06	19.62	1.95	157	0.30
79/10/03	6.69	17.82	38.84	2.18	157	0.61
79/10/10	7.28	19.61	34.73	1.77	166	0.58
79/10/17	11.19	35.23	87.41	2.48	138	1.17
79/10/25	15.47	37.15	81.07	2.18	175	1.44
79/11/05	22.00	68.73	177.84	2.59	111	1.96
79/12/06	24.07	67.50	249.85	3.70	129	3.23
80/01/24	27.58	61.58	131.30	2.13	111	1.45
80/03/11	25.07	65.20	141.64	2.17	111	1.51
80/04/01	18.39	62.28	196.32	3.15	138	2.68
80/04/11	21.60	78.90	371.32	4.71	120	4.20
80/04/22	12.95	52.86	290.08	5.49	120	3.24
80/05/05	10.46	39.00	346.91	8.90	129	4.62
80/05/15	11.00	39.83	386.00	9.69	110	4.27
80/05/23	8.90	30.52	332.36	10.89	83	2.69
80/06/03	8.22	11.61	77.86	6.71	120	1.29
80/06/12	8.99	0.00	0.00	0.00	157	0.00
80/06/20	8.39	0.00	0.00	0.00	166	0.00

Table A10. Components of LAI and LAI measurements for early planted Tam W-101, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/09/19	1.00	2.76	2.70	0.98	148	0.04
79/09/28	3.14	8.36	12.90	1.54	129	0.17
79/10/03	6.21	16.77	36.82	2.20	129	0.49
79/10/10	6.08	19.19	41.27	2.15	157	0.65
79/10/17	9.38	28.21	47.94	1.70	138	0.67
79/10/25	14.05	38.02	89.41	2.35	148	1.33
79/11/05	20.87	60.85	221.40	3.64	157	3.49
79/12/06	20.44	43.38	136.61	3.15	129	1.76
80/01/24	35.66	82.91	116.73	1.41	65	0.77
80/03/11	22.31	57.52	99.48	1.73	129	1.23
80/04/01	25.01	83.10	225.58	2.71	101	2.30
80/04/11	16.46	51.61	221.36	4.29	157	3.46
80/04/22	17.58	52.86	290.08	5.49	129	3.66
80/05/05	8.69	27.60	251.13	9.10	129	3.32
80/05/15	9.07	30.85	267.71	8.68	129	3.45
80/05/23	9.25	27.45	274.59	10.00	83	2.23
80/06/03	8.38	11.61	77.86	6.71	166	1.29
80/06/12	9.31	0.00	0.00	0.00	111	0.00
80/06/20	7.73	0.00	0.00	0.00	148	0.00

Table A11. Components of LAI and LAI measurements for late planted Bezostaya 1, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.10	2.90	1.38	120	0.04
79/11/26	1.21	3.39	4.67	1.38	148	0.07
79/12/06	1.80	4.46	3.90	0.87	138	0.05
80/03/11	4.57	10.00	5.38	0.54	129	0.07
80/04/01	7.90	21.35	21.42	1.00	111	0.24
80/04/11	12.78	33.57	47.91	1.43	129	0.62
80/04/22	10.30	33.25	106.64	3.21	102	1.06
80/05/05	9.49	32.64	312.60	9.58	138	4.27
80/05/15	5.33	19.41	253.52	13.06	120	3.12
80/05/23	6.19	18.69	299.53	16.03	157	4.56
80/06/03	7.54	21.87	295.00	13.49	65	1.88
80/06/12	4.89	2.78	32.15	11.56	129	0.53
80/06/20	5.00	0.00	0.00	0.00	111	0.00

Table A12. Components of LAI and LAI measurements for late planted Bezostaya 1, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.73	2.51	0.92	148	0.04
79/11/26	1.35	3.77	4.59	1.22	148	0.07
79/12/06	1.50	4.34	4.29	0.99	129	0.05
80/03/11	2.91	7.16	2.52	0.35	111	0.03
80/04/01	4.14	12.85	12.28	0.96	129	0.16
80/04/11	6.19	19.50	34.65	1.78	111	0.32
80/04/22	7.75	22.16	91.23	4.12	138	1.24
80/05/05	6.67	25.83	209.17	8.10	111	2.32
80/05/15	6.38	22.64	298.84	13.20	111	3.13
80/05/23	4.02	12.34	177.83	14.41	120	2.22
80/06/03	4.63	12.05	168.45	13.98	102	1.65
80/06/12	3.19	3.11	34.53	11.10	120	0.33
80/06/20	4.32	0.00	0.00	0.00	102	0.00

Table A13. Components of LAI and LAI measurements for late planted Centurk, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.50	1.12	0.45	185	0.02
79/11/26	1.58	4.31	3.90	0.90	157	0.06
79/12/06	1.14	5.08	2.56	0.50	111	0.03
80/03/11	5.28	12.55	7.31	0.58	166	0.12
80/04/01	12.04	34.79	37.57	1.08	138	0.50
80/04/11	12.93	38.86	67.99	1.75	157	1.11
80/04/22	13.28	30.57	89.05	2.91	157	1.40
80/05/05	7.82	25.27	138.28	5.47	157	2.12
80/05/15	4.57	14.88	111.50	7.49	157	1.74
80/05/23	5.04	12.11	79.19	6.54	138	1.06
80/06/03	4.43	6.29	30.16	4.79	129	0.39
80/06/12	4.43	0.00	0.00	0.00	120	0.00
80/06/20	4.63	0.00	0.00	0.00	120	0.00

Table A14. Components of LAI and LAI measurements for late planted Centurk, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.72	2.50	0.92	166	0.04
79/11/26	1.66	4.27	3.53	0.83	166	0.06
79/12/06	1.55	3.93	2.43	0.62	148	0.04
80/03/11	4.28	9.45	3.64	0.39	138	0.05
80/04/01	4.54	16.09	14.79	0.92	175	0.25
80/04/11	8.16	21.76	34.72	1.60	148	0.53
80/04/22	8.53	24.07	61.57	2.56	166	0.97
80/05/05	10.00	29.43	140.22	4.76	148	1.86
80/05/15	4.20	11.44	70.86	6.18	157	1.09
80/05/23	3.94	8.88	68.67	7.73	166	1.14
80/06/03	3.31	7.51	34.87	4.64	138	0.48
80/06/12	3.34	0.00	0.00	0.00	175	0.00
80/06/20	3.59	0.00	0.00	0.00	148	0.00

Table A15. Components of LAI and LAI measurements for late planted Eagle, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2	LAI
79/11/12	1.00	2.91	2.84	0.98	175	0.05
79/11/26	1.44	4.63	5.44	1.17	157	0.08
79/12/06	1.06	4.69	3.54	0.75	148	0.05
80/03/11	4.89	12.16	6.69	0.55	166	0.11
80/04/01	10.00	29.67	24.48	0.83	166	0.41
80/04/11	8.83	27.55	43.34	1.57	166	0.72
80/04/22	12.19	31.75	94.51	2.98	166	1.60
80/05/05	6.69	15.23	91.25	5.99	166	1.52
80/05/15	3.41	8.04	60.75	7.56	157	0.95
80/05/23	3.83	7.22	27.34	3.79	175	0.49
80/06/03	3.59	4.78	17.18	3.59	157	0.28
80/06/12	3.24	0.00	0.00	0.00	166	0.00
80/06/20	3.02	0.00	0.00	0.00	184	0.00

Table A16. Components of LAI and LAI measurements for late planted Eagle, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.25	2.58	1.15	175	0.05
79/11/26	1.22	3.50	2.95	0.84	166	0.05
79/12/06	1.11	4.61	3.12	0.68	166	0.05
80/03/11	3.45	8.90	3.88	0.44	185	0.07
80/04/01	3.40	12.30	9.36	0.76	185	0.17
80/04/11	8.39	22.39	28.93	1.29	166	0.48
80/04/22	7.84	21.02	49.44	2.35	157	0.79
80/05/05	5.79	17.41	73.91	4.25	157	1.15
80/05/15	3.91	14.04	81.97	5.84	175	1.41
80/05/23	2.76	6.63	21.18	3.19	175	0.38
80/06/03	3.64	3.85	24.86	6.46	138	0.34
80/06/12	2.69	0.00	0.00	0.00	175	0.00
80/06/20	3.24	0.00	0.00	0.00	157	0.00

Table A17. Components of LAI and LAI measurements for late planted Newton, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /plant (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.15	2.98	3.28	1.10	175	0.06
79/11/26	2.26	6.35	7.25	1.14	166	0.12
79/12/06	3.13	6.94	5.29	0.76	148	0.08
80/03/11	5.55	14.08	8.64	0.61	175	0.15
80/04/01	11.21	38.67	46.21	1.19	175	0.81
80/04/11	16.00	37.53	70.87	1.89	157	1.08
80/04/22	11.47	30.45	146.54	4.81	175	2.59
80/05/05	5.32	18.54	133.53	7.20	203	2.69
80/05/15	7.30	21.70	257.96	11.80	148	3.44
80/05/23	5.40	13.90	113.46	8.16	185	0.25
80/06/03	5.07	7.21	64.73	8.98	129	0.83
80/06/12	6.24	0.00	0.00	0.00	157	0.00
80/06/20	4.11	0.00	0.00	0.00	185	0.00

Table A18. Components of LAI and LAI measurements for late planted Newton, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/plant)	Plant density ($plants/m^2$)	LAI
79/11/12	1.00	2.55	2.52	0 .99	166	0 .04
79/11/26	1.50	3.95	4.41	1.12	185	0 .08
79/12/06	1.22	4.84	4.30	0.89	175	0 .08
80/03/11	4.49	11.36	7.41	0.65	185	0 .14
80/04/01	9.12	24.72	25.43	1.03	157	0 .40
80/04/11	7.48	23.73	37.81	1.59	138	0 .53
80/04/22	5.85	15.90	54.71	3.44	185	1.01
80/05/05	5.52	17.27	87.88	5.09	157	1.38
80/05/15	4.27	12.56	116.12	9.25	166	1.92
80/05/23	4.19	12.03	91.75	7.63	166	1.52
80/06/03	3.50	6.72	44.83	6.67	166	0.74
80/06/12	3.60	0.00	0.00	0.00	157	0.00
80/06/20	2.18	0.00	0.00	0.00	203	0.00

Table A19. Components of LAI and LAI measurements for late planted Tam W-101, rep. 1.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.79	3.37	1.21	138	0.04
79/11/26	1.51	3.89	5.43	1.40	166	0.09
79/12/06	1.93	5.14	5.16	1.00	129	0.07
80/03/11	4.63	10.21	6.69	0.66	138	0.09
80/04/01	9.11	30.47	37.81	1.24	138	0.56
80/04/11	8.33	28.03	55.91	1.99	138	0.72
80/04/22	9.08	27.28	89.31	3.27	101	0.93
80/05/05	5.99	15.62	151.32	9.69	157	2.23
80/05/15	6.15	16.21	160.60	9.91	129	2.10
80/05/23	5.62	11.31	135.94	12.20	138	1.89
80/06/03	6.45	10.09	95.02	9.42	120	1.07
80/06/12	3.94	0.38	1.11	2.97	148	0.01
80/06/20	4.63	0.00	0.00	0.00	129	0.00

Table A20. Components of LAI and LAI measurements for late planted Tam W-101, rep. 2.

Date	Tillers /plant	Leaves /plant	Leaf area /plant (cm^2/plant)	Leaf area /leaf (cm^2/leaf)	Plant density (plants/m^2)	LAI
79/11/12	1.00	2.07	2.65	1.28	129	0.03
79/11/26	1.00	3.13	4.97	1.59	148	0.07
79/12/06	1.44	4.25	4.04	0.95	138	0.06
80/03/11	3.92	9.13	6.80	0.74	175	0.12
80/04/01	7.28	21.12	18.90	0.89	194	0.37
80/04/11	8.93	24.30	37.24	1.53	157	0.57
80/04/22	12.35	36.53	117.24	3.21	175	1.99
80/05/05	9.28	25.78	199.93	7.76	166	3.32
80/05/15	6.63	15.57	167.75	10.77	148	2.48
80/05/23	7.42	24.07	258.27	10.73	129	3.34
80/06/03	6.48	15.58	165.37	10.61	157	2.53
80/06/12	7.20	0.00	0.00	0.00	120	0.00
80/06/20	6.39	0.00	0.00	0.00	154	0.00

APPENDIX B

SOIL MOISTURE DEPLETION PATTERNS

FOR WINTER WHEAT

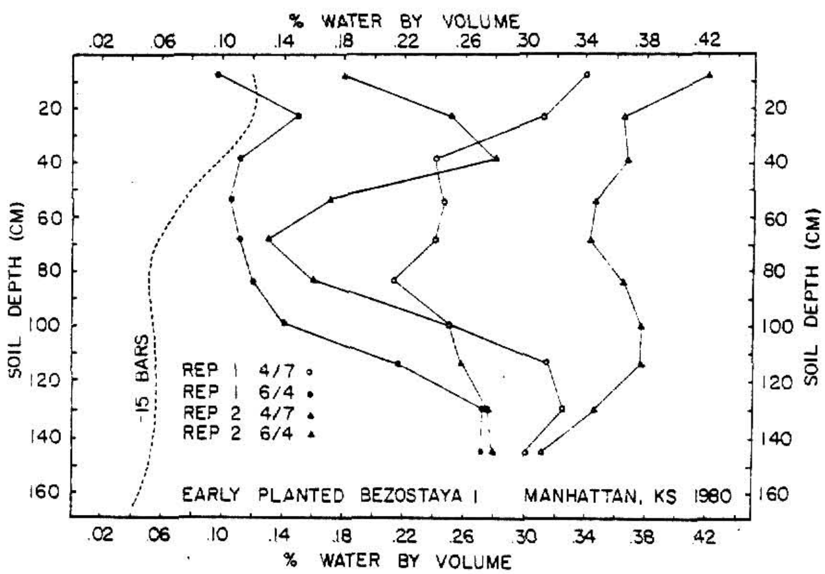

Fig. 1. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for early planted Bezostaya 1, rep. and 2.

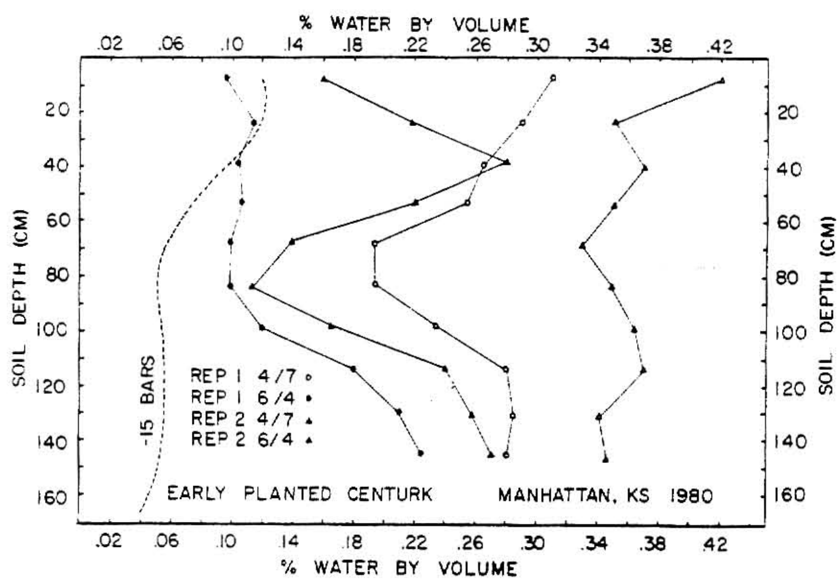

Fig. 2. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for early planted Centurk, rep. 1 and 2.

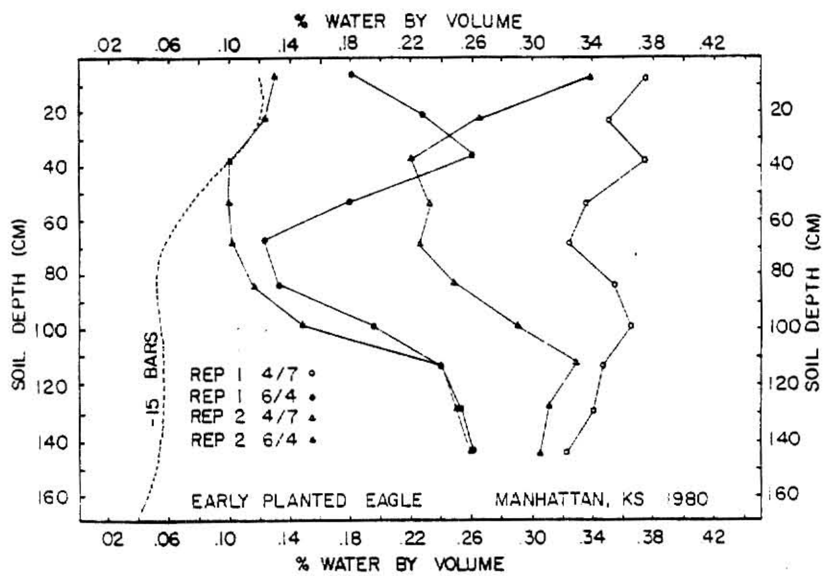

Fig. 3. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for early planted Eagle, rep. 1 and 2.

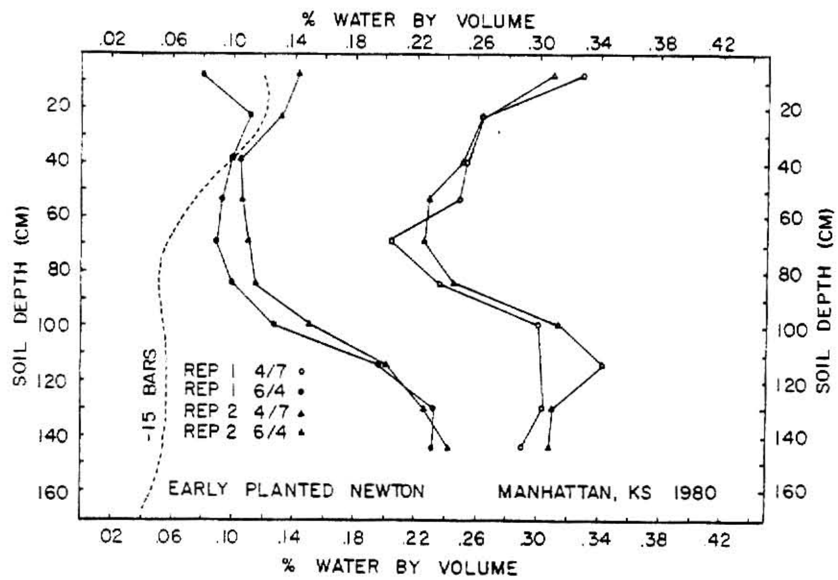

Fig. 4. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for early planted Newton, rep. 1 and 2.

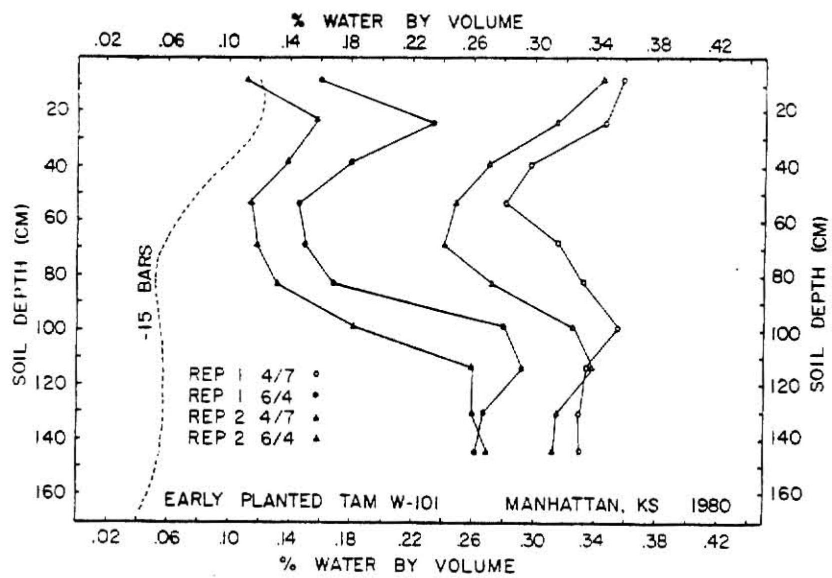

Fig. 5. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for early planted Tam W-101, rep. 1 and 2.

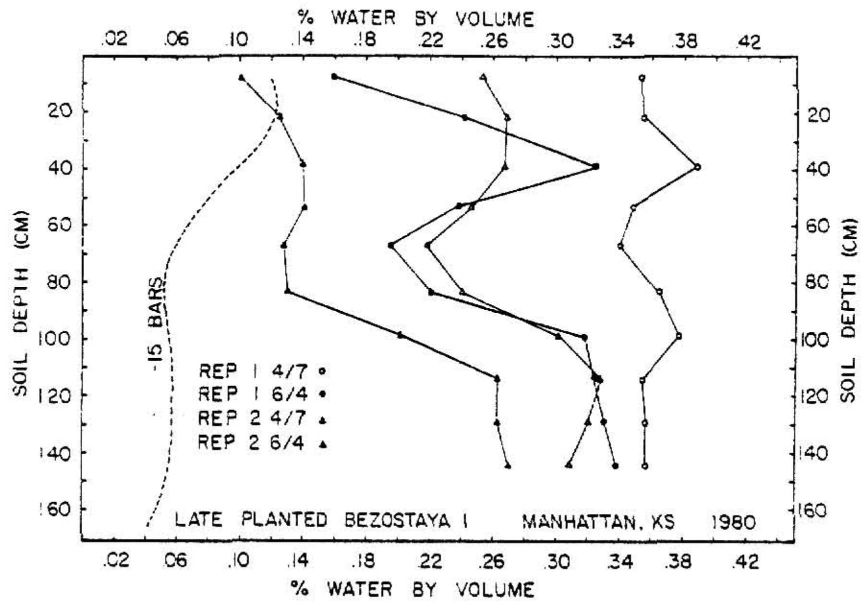

Fig. 6. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for late planted Bezostaya 1, rep. 1 and 2.

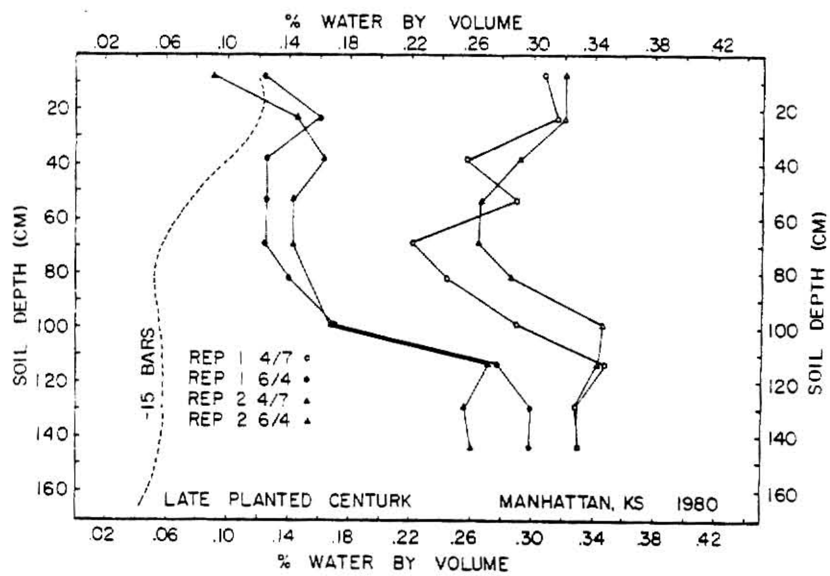

Fig. 7. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for late planted Centurk, rep. 1 and 2.

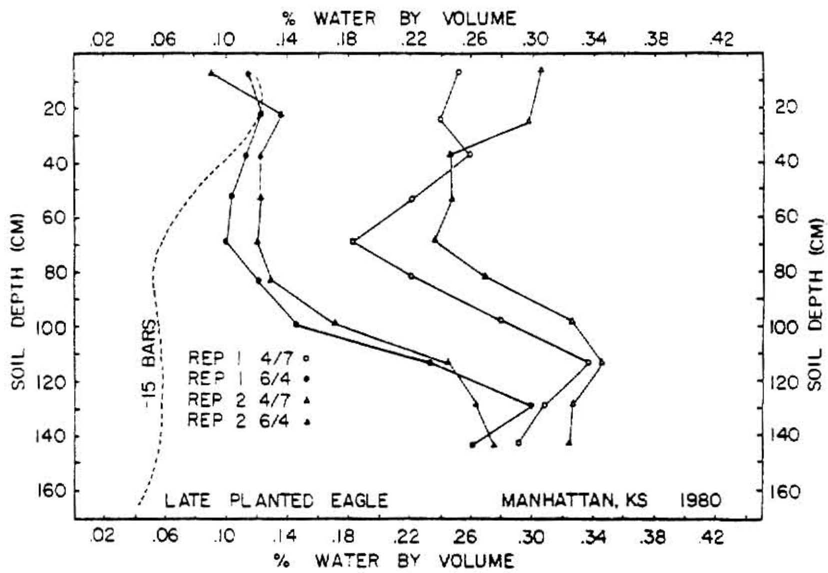

Fig. 8. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for late planted Eagle, rep. 1 and 2.

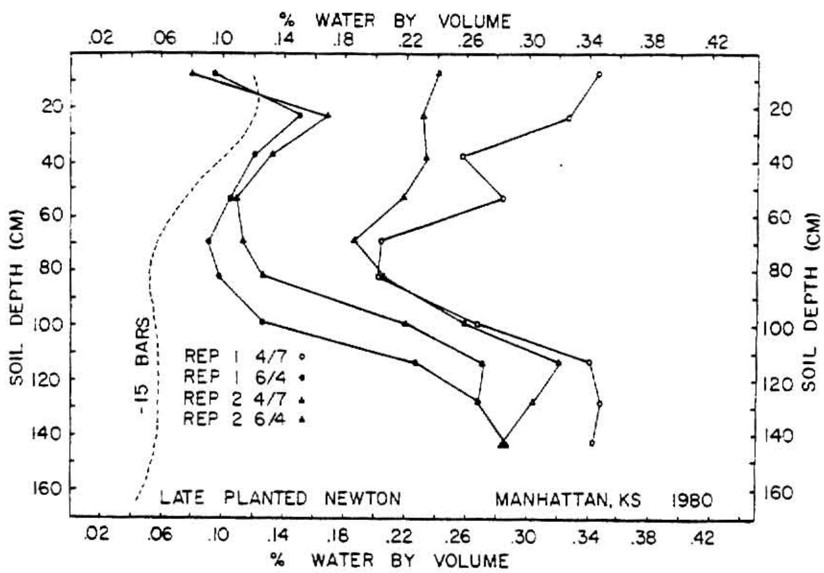

Fig. 9. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for late planted Newton, rep. 1 and 2.

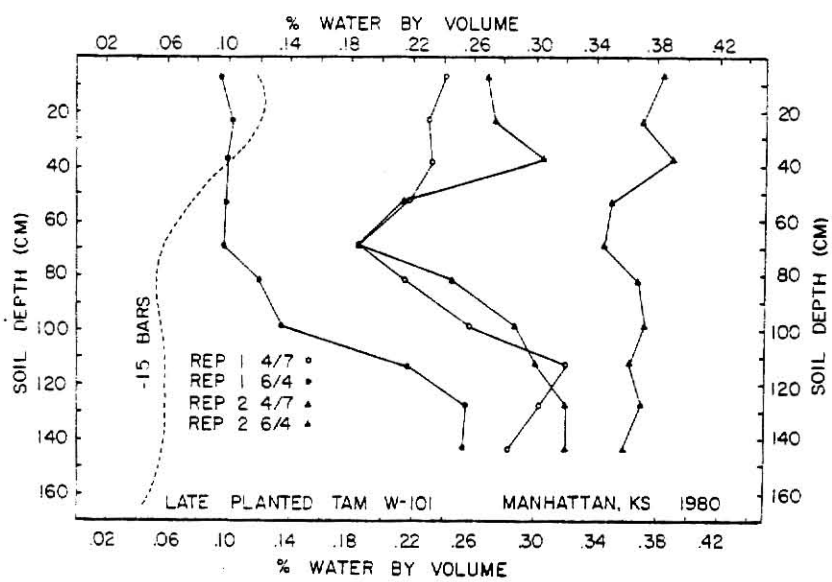

Fig. 10. Soil moisture depletion patterns from 7 April (4/7) to 4 June (6/4) for late planted Tam W-101, rep. 1 and 2.

APPENDIX C

OBSERVED VALUES OF TILLERS/PLANT AND LAI FOR DATA SETS USED IN MODEL TESTS

Table C1. Observed values of tillers/plant and LAI for the winter wheat test fields from Vernon, Texas (1979-80).

Date	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
12/10/79	2.28		1.68		2.25		2.28		1.55		2.83	
12/20/79	3.23		2.30		2.98		3.38		2.20		4.08	
01/17/79	4.33		2.53		3.90		3.83		3.33		5.03	
02/02/80	5.73	0.23	3.20	0.21	4.50	0.20	4.68	0.35	3.55	0.16	5.98	0.28
02/21/80	4.85		2.85		4.18		4.48		3.10		4.68	
03/04/80	4.28	0.26	3,25	0.20	3.73	0.14	5.33	0.45	3.70	0.14	4.90	0.32
03/18/80	3.58	0.43	3.05	0.29	3.95	0.54	4.03	1.30	3.65	0.79	4.38	0.70
04/02/80	3.17	0.67	2.16	0.47	3.37	0.89	3.87	1.40	2.84	0.60	3.51	0.80
04/14/80	3.63	1.27	1.99	0.50	3.41	1.39	3.08	1.50	2.48	0.73	3.36	1.29
04/29/80	2.91	1.43	1.85	1.10	2.46	0.98	2.62	1.88	1.94	1.24	2.63	1.36
05/14/80	2.35	0.63	1.53	0.76	1.91	0.81	2.10	1.11	1.83	0.76	2.09	1.05

Table C1 (cont.) Observed values of tillers/plant and LAI for the winter wheat test fields from Vernon, Texas (1979-80).

	Plot 7		Plot 8		Plot 9		Plot 10		Plot 11		Plot 12	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
12/10/79	4.25		1.70		1.95		2.28		1.98		2.45	
12/20/79	4.58		2.28		3.05		2.55		3.38		2.80	
01/17/80	6.88		4.38		4.15		3.95		5.68		4.60	
02/04/80	6.78	0.66	4.45	0.19	3.78	0.27	4.05	0.23	5.48	0.29	4.73	0.30
02/21/80	6.03		5.15		3.55		4.45		6.08		5.33	
03/03/80	5.80	0.45	5.55	0.29	4.13	0.36	4.15	0.34	5.08	0.28	5.43	0.25
03/18/80	4.48	0.67	4.75	0.68	3.90	0.92	4.23	1.07	4.88	0.93	4.25	0.84
04/02/80	3.71	1.06	3.79	1.17	3.37	1.22	3.89	1.68	4.27	1.13	4.33	1.66
04/14/80	3.71	1.01	3.79	1.09	3.37	1.45	3.05	1.53	4.24	1.31	4.08	1.84
04/29/80	2.47	1.44	2.71	1.41	2.63	2.02	2.45	1.72	2.93	2.48	3.08	2.30
05/14/80	2.23	1.23	2.60	0.68	2.28	1.65	1.94	1.01	2.63	1.20	2.58	0.96

Table C2. Observed values of tillers/plant and LAI for the winter wheat test fields from Bushland, Texas (1979-80).

	Plot 1		Plot 2		Plot 3		Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
12/18/79	1.83		2.80		2.67		1.90		2.50		1.90	
01/11/80	2.30		1.47		3.13		1.93		3.10		2.40	
02/25/80	5.80	0.29	2.77	0.21	3.27	0.29	4.33	0.31	5.10	0.12	5.10	0.12
03/10/80	4.87		3.70		3.17		3.77		3.87		3.80	
03/24/80	3.43	0.13	5.63	0.17	4.33	0.24	4.33	0.13	4.53	0.09	5.03	0.13
04/07/80	3.97	0.53	4.20	0.33	4.20	0.34	2.17	0.25	4.40	0.39	4.07	0.12
04/21/80	3.11	0.56	1.46	0.31	3.15	0.68	2.41	0.43	2.77	0.44	3.42	0.69
04/28/80	2.70		2.25		4.16		3.03		3.23		4.83	
05/05/80	4.67	1.76	4.06	1.78	5.31	1.75	4.25	1.49	3.70	1.19	4.72	2.06
05/20/80	4.66	2.50	4.64	3.17	4.56	3.07	3.67	2.39	5.29	3.29	4.94	2.87
05/30/80	4.39	2.69	4.40	3.12	3.41	2.45	3.73	2.57	5.90	4.32	4.88	3.06
06/10/80	4.14	2.09	4.09	2.60	3.55	2.34	3.81	1.88	3.97	2.69	4.71	1.37

Table C2 (cont.). Observed values of tillers/plant and LAI for the winter wheat test fields from Bushland, Texas (1979-80).

Date	Plot 7 Tillers /plant	Plot 7 LAI	Plot 8 Tillers /plant	Plot 8 LAI	Plot 9 Tillers /plant	Plot 9 LAI	Plot 10 Tillers /plant	Plot 10 LAI	Plot 11 Tillers /plant	Plot 11 LAI	Plot 12 Tillers /plant	Plot 12 LAI
12/18/79	2.03		1.53		2.20		2.63		2.17		2.57	
01/11/80	4.57		2.07		1.83		2.93		3.77		2.97	
02/25/80	5.90	0.23	5.63	0.25	3.07	0.39	4.77	0.36	2.90	0.14	5.73	0.11
03/10/80	6.27		5.33		7.27		6.47		4.20		3.70	
03/24/80	4.87	0.29	2.97	0.08	6.10	0.25	6.53	0.28	5.60	0.42	4.93	0.20
04/07/80	3.90	0.32	2.60	0.22	7.20	0.44	4.90	0.13	4.43	0.30	5.20	0.25
04/21/80	4.36	0.87	4.96	1.01	2.49	0.51	3.88	0.48	2.68	0.48	5.63	1.15
04/28/80	3.81		4.78		3.42		6.65		5.82		4.97	
05/05/80	6.19	2.05	5.47	2.40	5.58	3.00	5.77	1.09	5.63	2.05	4.79	2.11
05/20/80	6.93	4.63	4.47	3.26	4.69	2.92	6.35	3.38	5.66	3.23	4.38	2.06
05/30/80	5.74	3.92	5.03	3.34	5.23	2.98	4.61	3.22	4.89	3.06	5.53	3.29
06/10/80	5.60	2.80	5.97	2.88	4.70	3.03	5.70	1.96	5.21	2.68	6.37	2.95

Table C3. Observed values of tillers/plant and LAI for the spring wheat (variety: Anza) test fields from Phoenix, Arizona (1977-78).

	Plot 1		Plot 2		Plot 3			Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
01/05/78	1.00	0.03	1.00	0.04	1.00	0.03	01/06/78	1.00	0.03	1.00	0.04	1.00	0.03
01/09/78	1.00	0.04	1.00	0.06	1.00	0.05	01/10/78	1.00	0.07	1.00	0.06	1.00	0.06
01/12/78	1.00	0.05	1.20	0.07	1.00	0.05	01/13/78	1.00	0.06	1.30	0.09	1.00	0.09
01/16/78	1.20	0.15	1.00	0.08	1.30	0.10	01/17/78	2.20	0.12	2.00	0.16	2.00	0.12
01/19/78	2.20	0.11	2.50	0.19	1.80	0.13	01/20/78	2.20	0.11	2.00	0.15	2.30	0.13
01/23/78	2.50	0.18	2.70	0.24	3.00	0.25	01/24/78	2.80	0.20	2.20	0.21	3.30	0.26
01/26/78	1.70	0.08	2.20	0.18	2.80	0.20	01/27/78	2.80	0.20	3.70	0.26	2.70	0.19
01/30/78	3.70	0.32	3.80	0.41	4.00	0.42	01/31/78	4.50	0.49	4.20	0.55	4.30	0.41
02/02/78	4.20	0.44	5.50	0.67	5.50	0.95	02/03/78	5.00	0.70	5.20	0.64	5.00	0.67
02/06/78	4.50	0.49	5.80	0.75	6.00	0.92	02/07/78	7.00	1.11	7.20	1.21	5.70	1.08
02/09/78	6.70	1.46	5.80	1.48	5.20	1.39	02/10/78	8.20	1.99	5.50	1.80	5.20	1.59
02/13/78	5.70	1.15	6.20	1.82	5.70	1.86	02/14/78	7.80	2.72	6.70	2.46	5.30	2.44
02/16/78	5.70	1.79	9.20	3.18	7.00	3.05	02/17/78	4.80	2.60	5.20	2.07	6.20	2.48
02/21/78	5.30	1.92	5.20	2.41	5.80	3.26	02/22/78	8.00	4.08	5.30	2.89	6.30	2.55
02/13/78	4.80	2.46	6.00	2.71	4.20	2.57	02/24/78	7.20	4.32	6.80	4.97	6.50	3.13

Table C3 (cont.). Observed values of tillers/plant and LAI for the spring wheat (variety: Anza) test fields from Phoenix, Arizona (1977-78).

Date	Plot 1 Tillers /plant	Plot 1 LAI	Plot 2 Tillers /plant	Plot 2 LAI	Plot 3 Tillers /plant	Plot 3 LAI	Date	Plot 4 Tillers /plant	Plot 4 LAI	Plot 5 Tillers /plant	Plot 5 LAI	Plot 6 Tillers /plant	Plot 6 LAI
02/27/78	6.80	5.31	5.70	4.37	4.70	3.82	02/28/78	7.50	6.20	5.20	4.12	5.00	4.36
03/02/78	5.30	4.96	5.30	4.17	4.30	5.03	03/03/78	5.80	5.72	3.70	3.91	4.50	2.68
03/06/78	6.20	4.74	5.80	5.10	5.80	4.97	03/07/78	5.20	6.12	4.20	4.96	5.70	4.16
03/09/78	5.80	6.13	5.20	5.93	6.30	6.97	03/10/78	5.00	6.70	5.00	5.63	5.00	4.49
03/13/78	5.20	5.71	5.00	7.04	5.50	6.47	03/14/78	4.80	7.09	4.80	7.30	5.30	8.50
03/16/78	4.20	5.36	5.50	7.83	6.50	7.87	03/17/78	6.30	9.14	4.50	6.54	4.30	5.18
03/20/78	4.70	6.05	5.70	7.38	4.20	6.68	03/21/78	4.80	7.38	5.00	9.18	4.00	5.02
03/23/78	4.30	7.23	3.80	6.16	4.00	7.04	03/24/78	4.20	7.87	3.30	7.09	3.30	5.34
03/27/78	4.30	7.23	4.00	5.24	3.50	4.68	03/28/78	2.80	4.79	4.20	7.04	2.50	2.48
03/30/78	3.50	7.49	3.50	5.45	2.80	4.41	03/31/78	3.20	5.42	3.50	5.38	3.00	3.66
04/03/78	4.30	7.73	3.30	5.54	3.50	5.65	04/04/78	3.50	5.11	2.70	3.83	2.00	2.38
04/06/78	3.80	6.52	3.20	4.39	3.00	4.53	04/07/78	2.70	3.42	2.30	2.79	1.80	1.74
04/10/78	3.80	6.35	2.70	3.39	3.50	4.22	04/11/78	3.50	5.82	2.30	2.47	2.00	0.85
04/13/78	3.80	6.54	2.80	2.55	2.70	2.24	04/14/78	2.30	3.14	2.30	1.52	3.50	3.14
04/17/78	3.50	5.40	3.20	1.77	3.00	2.40	04/18/78	2.80	3.52	2.00	.96	3.00	2.83

Table C3 (cont.). Observed values of tillers/plant and LAI for the spring wheat (variety: Anza) test fields from Phoenix, Arizona (1977-78).

	Plot 1		Plot 2		Plot 3			Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
04/20/78	3.20	5.41	3.30	2.88	3.30	3.98	04/21/78	2.30	2.29	3.00	0.82	2.70	2.01
04/24/78	3.00	4.38	2.70	1.69	3.20	1.85	04/25/78	3.80	2.56	2.80	0.03	3.20	1.99
04/26/78	3.20	4.36	2.50	1.95	2.30	2.28	04/27/78	3.20	2.00	2.50	0.07	3.20	0.85
05/01/78	4.00	4.40	2.50	0.40	3.00	0.54	05/02/78	3.30	1.16	3.00	0.00	2.50	0.00
05/04/78	2.30	2.13	3.30	0.88	4.00	0.58	05/05/78	2.20	0.87	2.00	0.00	2.50	0.00
05/08/78	2.20	1.12	3.70	0.00	2.70	0.00	05/09/78	3.80	0.05	4.00	0.00	3.30	0.00
05/11/78	3.50	1.60	4.00	0.00	2.50	0.00	05/12/78	3.70	0.00	2.80	0.00	2.20	0.00

Table C4. Observed values of tillers/plant and LAI for the spring wheat (variety: Produra) test fields from Phoenix, Arizona (1977-78).

	Plot 1		Plot 2		Plot 3			Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
01/05/78	1.00	0.03	1.00	0.04	1.00	0.03	01/06/78	1.00	0.03	1.00	0.04	1.00	0.03
01/09/78	1.00	0.05	1.20	0.04	1.80	0.08	01/10/78	1.30	0.06	1.30	0.06	1.30	0.05
01/12/78	1.50	0.07	1.30	0.06	1.30	0.06	01/13/78	1.30	0.07	1.80	0.10	1.30	0.05
01/16/78	1.50	0.08	1.80	0.10	2.50	0.12	01/17/78	2.70	0.12	2.00	0.10	2.00	0.08
01/19/78	2.30	0.13	2.80	0.20	3.00	0.14	01/20/78	3.00	0.21	2.70	0.15	2.20	0.11
01/23/78	1.50	0.06	2.30	0.15	3.30	0.19	01/24/78	3.50	0.21	2.50	0.15	3.70	0.22
01/26/78	3.50	0.22	3.80	0.22	3.30	0.19	01/27/78	3.30	0.23	3.50	0.32	2.70	0.11
01/30/78	4.00	0.31	4.80	0.48	4.80	0.45	01/31/78	5.30	0.41	5.30	0.56	5.20	0.38
02/02/78	5.80	0.63	5.20	0.53	5.00	0.46	02/03/78	8.00	0.91	7.30	0.95	6.20	0.55
02/06/78	5.80	0.76	5.00	0.74	8.70	1.20	02/07/78	6.30	0.84	6.50	1.32	7.50	0.82
02/09/78	5.80	1.24	7.00	1.35	5.80	1.17	02/10/78	6.00	1.21	5.70	1.68	7.20	1.12
02/13/78	8.20	2.46	8.00	1.98	6.70	1.61	02/14/78	8.00	2.37	7.30	2.32	7.20	1.55
02/16/78	7.20	1.80	5.00	1.36	6.80	1.82	02/17/78	6.50	2.36	7.00	2.28	6.00	1.12
02/21/78	5.80	2.21	7.00	2.40	8.50	3.32	02/22/78	6.80	3.09	8.80	3.67	5.80	1.36
02/23/78	4.80	2.68	6.20	2.68	6.30	2.17	02/24/78	7.30	4.51	6.50	3.05	5.50	2.01

Table C4 (cont.). Observed values of tillers/plant and LAI for the spring wheat (variety: Produra) test fields from Phoenix, Arizona (1977-78).

	Plot 1		Plot 2		Plot 3			Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
02/27/78	5.30	4.63	7.50	3.28	5.50	2.66	02/28/78	7.80	5.33	5.70	4.13	7.70	3.71
03/02/78	5.70	4.66	6.00	4.42	4.50	2.96	03/03/78	5.20	3.67	6.00	5.39	6.30	3.41
03/06/78	6.00	5.29	6.20	5.71	4.80	4.24	03/07/78	6.20	5.27	6.00	5.13	5.00	3.94
03/09/78	7.80	8.08	5.00	5.17	5.00	5.61	03/10/78	5.80	6.51	5.50	5.81	6.50	5.22
03/13/78	4.80	6.46	5.70	7.62	6.20	7.93	03/14/78	7.30	8.96	6.00	7.90	5.30	5.72
03/16/78	4.70	7.12	5.00	6.03	5.20	6.11	03/17/78	6.30	7.51	4.00	5.60	5.20	5.05
03/20/78	5.20	8.20	6.00	9.26	4.20	6.13	03/21/78	5.70	7.39	3.00	4.20	3.70	3.84
03/23/78	4.30	6.74	3.80	4.90	4.70	6.37	03/24/78	5.30	7.59	3.30	4.95	3.70	4.48
03/27/78	4.50	7.61	4.50	7.03	4.70	7.72	03/28/78	4.30	6.93	4.20	7.55	4.20	5.08
03/30/78	4.50	7.34	4.70	6.74	3.50	4.37	03/31/78	3.30	4.63	3.70	5.42	4.30	4.49
04/03/78	4.00	6.22	4.30	4.43	4.50	6.53	04/04/78	2.50	2.58	3.50	4.13	3.00	3.27
04/06/78	4.00	7.06	3.00	3.15	4.20	5.83	04/07/78	2.60	2.72		3.00		2.74
04/10/78	3.20	4.68	2.50	2.20	3.70	3.76	04/11/78	2.70	2.60	3.20	3.21	2.30	1.45
04/13/78	3.80	6.24	3.20	1.50	2.70	3.47	04/14/78	2.70	2.56	3.00	1.02	3.00	1.88
04/17/78	4.50	6.33	2.80	.82	3.20	2.96	04/18/78	3.50	3.58	3.50	.68	3.20	1.91

Table C4 (cont.). Observed values of tillers/plant and LAI for the spring wheat (variety: Produra) test fields from Phoenix, Arizona (1177-78).

	Plot 1		Plot 2		Plot 3			Plot 4		Plot 5		Plot 6	
Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI	Date	Tillers /plant	LAI	Tillers /plant	LAI	Tillers /plant	LAI
04/20/78	2.30	3.19	3.50	0.70	2.80	3.67	04/21/78	3.30	3.48	3.00	0.32	3.80	2.22
04/24/78	3.70	5.94	3.00	0.28	3.00	2.91	04/25/78	4.00	1.60	3.70	0.04	3.80	1.76
04/26/78	4.00	5.42	3.70	0.78	4.00	3.48	04/27/78	3.30	1.29	4.20	0.00	4.20	0.57
05/01/78	4.20	4.41	2.80	0.00	4.30	1.22	05/02/78	3.00	0.42	3.50	0.00	2.80	0.00
05/04/78	3.00	1.53	3.70	0.00	3.50	0.28	05/05/78	3.20	0.39	3.80	0.00	2.80	0.00
05/08/78	4.20	0.89	3.50	0.00	3.50	0.00	05/09/78	3.30	0.00	3.00	0.00	2.80	0.00
05/11/78	2.70	0 .13	3.70	0.00	2.70	0.00	05/12/78	3.50	0.00	4.00	0.00	2.70	0.00

Table C5. Observed values of tillers/plant and LAI for the spring (variety: Waldron) and durum (variety: Cando) wheat test fields from Mandan, North Dakota (1979).

Spring wheat			Durum wheat		
Date	Tillers/plant	LAI	Date	Tillers/plant	LAI
06/13/79	1.04	0.18	06/26/79	3.30	
06/28/79	2.70	0.68	07/11/79	4.20	0.84
07/10/79	2.50	0.27	07/25/79	2.80	0.48
07/25/79	1.06	0.00	08/08/79	2.70	0.03
08/07/79	1.09		08/22/79	2.60	0.00
08/14/79	1.50		09/05/79	2.90	

APPENDIX D

FORTRAN PROGRAM OF DAILY GROWTH MODEL FOR WINTER WHEAT

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C
C
C                      KSU PHOTOSYNTHESIS MODEL (PHOTO)
C
C--------> (           DECLARATION OF VARIABLES                    ) <---------
C
      COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNCFF,
     $ YLNC,YLAPP,JSDATE(6),IT2,IT3,T5,T6,TFACT
      COMMON /W2VAR/     IX            ,CCT(12,2)      ,BETAP(12,2)    ,
     .    CCYT(12,2)    ,PC(12,2)      ,ALPHAP(12,2)  ,
     .    RMAXT(12,2)   ,RMAXY(12,2)   ,RMINT(12,2)    ,SDMAXT(12,2)   ,
     .    SDMAXY(12,2)  ,SDMINT(12,2)  ,
     .    ALPHAR(12,2)  ,BETAR(12,2)   ,CCYT2(12,2)    ,AMNDFR(12,2)   ,
     .    AMXDFR(12,2)  ,
     .    AX            ,BX            ,CX             ,AN             ,
     .    BN            ,CN            ,LAT            ,C
      REAL KSWAT(31),TNO(31),LNC(31),LAPL(31),LAPP(31),JLAI(31),
     $     TUTILL(31),TULEAF(31),STGAM(21)/'EMER','GENC','E   ','JOIN',
     $'TING','    ','BOOT','ING ','    ','HEAD','ING ','    ','SOFT',
     $'-DOU','GH  ','RIPE','    ','    ','DOUB','LE R','IDGE'/,
     $ LAIMX,MTNOPP
      INTEGER DATE,T4FLAG,PDATE(20),USELAI,JPLTDY(5),NSTGDY(5),JULDY(6)
C
      REAL            MOCNT     ,MONTL2(3,14),PDEN(20),NCSUM(9)
      INTEGER         KI        ,IRDATE(30),INITOT(3),INDATE   ,
     *    SMDATE(31),SMCHK   ,NOSM      ,SMRUN     ,NEXTSM
      REAL THE30, R, KS30,TVP,VPG,STG(6),GVP
      INTEGER*2 PARRAY(125,52),SYM
      INTEGER*2 IB(9)/'1','2','3','4','5','0',' ','.','X'/
      INTEGER*4      JIDY(50) ,NSTGOT,PUNYLD
      REAL*4 YY(50)
      REAL     CDM      ,CV                        ,CL       ,DLAI     ,DM       ,
     *DMTR     ,DRESP   ,ET        ,ETED     ,FALLRT   ,GROSPH   ,
     *HSTX25   ,INTL    ,INVAL(6),IRRIG      ,KS       ,KYLD     ,
     *LAI      ,LAIMAX  ,LAT       ,
     *LATC     ,LATM    ,MAXT      ,MFLOCP   ,MINT     ,MULT     ,MXH2O    ,
     *NCE      ,NRESP   ,PLAI      ,PNTEMP   ,PUNCHK   ,
     *RAINEW   ,RAINUL  ,SMVAL(31,5),T       ,TACC     ,TAU      ,TDAY     ,
     *TEC      ,THETI   ,TRESP     ,T2       ,T3       ,
     $TSUM2,TSUM1,HSTN
      REAL  BTOTL(14),                BTSTL(7,19),
     *    COEF(6,8),                  CRDFMT(20),
     *    FRMT(20),
     *    IRR(30),
     *    KAY(6)/1.0,2.8,2.7,3.0,4.0,5.0/,
     *    KVAL1(5)/.1,.5,.4,2*0.0/          ,
     *    KVAL2(5)/.05,3*.25,.2/,
     *    LB(7)/'PT -','EM -','JT -','BT -','HD -','SD -','RP->'/,
     *    LAI10(99),      LVAL(5)/50.,250.,2*300.,600./,
     *    MONTL(12,14),        YDARAY(50),
     *    NCARAY(7),           OBHGHT(9),      THEMAX(5),      THEMIN(5),
     *    THEVAL(5),      TOTL(9)/9*0.0/,      TVAL(5),
     *    UB(7)/'EM','JT','BT','HD','SD','RP','  '/,
     *    ZVAL(5)/50.,250.,2*300.,600./
C
C
      INTEGER  BMS      ,BMT      ,TYPCK    ,WETHCK   ,CELCHK   ,CENCHK   ,
     *CLOCK    ,CROP     ,DAY      ,DAYT     ,DECK     ,DISK/10/,DLAICK   ,
     *FIELDS   ,FLAG     ,FLAGL    ,FLORUN   ,HOCHK    ,ICOUNT   ,IFLAG    ,
     *II       ,IRRCHK   ,K        ,NODECK   ,NOFLDS   ,NCSMPL   ,PDAY     ,
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     *PMO      ,PREVK    ,RFLG     ,SGSA     ,SGSB     ,FEEKCK   ,WSIMCK   ,
     *SPCCHK   ,START    ,STGCHK   ,STRISP   ,YEAR     ,YR       ,STRSCK   ,
     .BSDT(3)  ,ESDT(3)  ,BSCATE   ,
     *CAL(12)/31,28,31,30,31,30,31,31,30,31,30,31/,      CD(5)/5*0/,
     *    ICAY(30),       IMO(30),       IYR(30),       SCLK(7),
     *    SDATE(9)/9*0/,SDAY(7),      SMC(7),       SPDATE(9),     SYR(7),
     *     TITLE(20),ID(2)     ,STGYR(6) ,STGMO(6) ,STGDY(6)
      REAL KWT,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5
      LOGICAL*1 JOINT
C
C--------> ( NODECK IS THE NUMBER OF DIFFERENT CARD DECKS THAT ARE   ) <---------
C--------> ( TO BE RUN THROUGH THE MODEL.                            ) <---------
C
      READ (5,107) NODECK, WETHCK
      READ(5,109) ((COEF(I,J),J=1,8),I=1,6)
      IF (WETHCK .NE. 1) GO TO 4
           READ (5,135) PD
           READ (5,135) ALPHAP, BETAP, ALPHAR, BETAR, AMNDFR, AMXDFR
           READ (5,135) RMAXY, RMAXT, RMINT, SDMAXY, SDMAXT, SDMINT,
     .          CCYT, CCT, CCYT2, AX, BX, CX, AN, BN, CN
           WRITE (6,907)
           WRITE (6,910)
           WRITE (6,911) PD, ALPHAP, BETAP, ALPHAR, BETAR, AMNDFR,
     .          AMXDFR, RMAXY
           WRITE (6,910)
           WRITE (6,912) RMAXT, RMINT, SDMAXY, SDMAXT, SDMINT, CCYT,
     .          CCT, CCYT2
           WRITE (6,913) AX, BX, CX, AN, BN, CN
    4 DO 219 DECK=1,NODECK
      REWIND DISK
      DO 1 I=1,7
    1 SDATE(I) = 00
      NSTGDT = 0
      DO 2 I=1,6
           STGYR(I) = 0
           STGMO(I) = 0
           STGDY(I) = 0
    2 STG(I) = 0.
      READ(5,107) NOFLDS,FLDRUN,CELCHK,CENCHK,SPCCHK,STGCHK,HDCHK,
     $          LINCHK,DLAICK,PUNCHK,TYPCK,WSIMCK,PUNYLD,MMCK
C
C--------> ( IF STAGE DATES ARE KNOWN FOR PLANTING, EMERGENCE,       ) <---------
C--------> (   JOINTING, BOOTING, HEADING, SOFTDOUGH, AND RIPE,      ) <---------
C--------> (   THEN STGCHK = 01 AND THE DATES WILL BE READ IN IN     ) <---------
C--------> (   ORDER, IN THE FORMAT:  YRMODY YRMODY ,ETC.            ) <---------
C--------> ( OTHERWISE STGCHK = 00 .                                 ) <---------
C
           IF (STGCHK .NE. 0) READ (5,125) (SDATE(I),I=1,7)
      NDYYR=365
      IF(MOD(KYR,4).EQ.0) NDYYR=366
      IF(STGCHK.EQ.0) GO TO 3
      KYR=INT(SDATE(1)/10000.)
      DO 50 I=1,6
      KYR=INT(SDATE(I)/10000.)
      KMO=INT(((SDATE(I)/10000.)-KYR)*100.)
      KDY=INT(((SDATE(I)/100.)-(KYR*100.+KMO))*100.)
      KDY=KDY+1
      CALL JULIAN(CAL,KYR,KMO,KDY,JULDY(I))
   50 CONTINUE
      DO 53 I=1,5
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      IF(JULCY(I+1).LT.JULDY(I)) JULCY(I+1)=JULDY(I+1)+NOYYR
      NSTGDY(I)=JULDY(I+1)-JULCY(I)
   55 CONTINUE
C
C--------> (      PUNCH THE FIRST 2 CARDS OF THE YIELD DECK OF DATA    ) <--------
C
    3 IF (PUNCHK .NE. 0) WRITE (7,107) NOFLDS,HDCHK,STGCHK,WSIMCK
      IF (PUNCHK .NE. 0 .AND. STGCHK .EQ. 1) WRITE(7,125) (SDATE(I),
     *             I=1,7)
      READ(5,900) LATD,LATM,C
      LAT = LATD + (LATM/60)
      READ (5,100) CRDFMT
    9 IF (DLAICK .EQ. 1) GO TO 11
      READ (5,CRDFMT) SR,MAXT,MINT,DVP,RAIN
      GO TO 12
   11 READ (5,CRDFMT) SR,MAXT,MINT,(LAI10(I),I=1,NOFLDS),DVP,RAIN
C
C--------> (  A BLANK CARD IS NEEDED TO SEPERATE THE DATA READ ONTO ) <---------
C--------> ( DISK AND THE DATA READ DURING EXECUTION                ) <---------
C
   12 IF (SR .LE. 0.0) GO TO 10
      IF (MAXT .GE. MINT) GO TO 331
         TEMP = MAXT
         MAXT = MINT
         MINT = TEMP
C
C--------> ( IF THE TEMPERATURES ARE IN DEGREES F, THEN CELCHK = 1  ) <--------
C--------> ( AND CONVERSION TO CELSIUS IS NECESSARY.                ) <---------
C
  331 IF (CELCHK .EQ. 0) GO TO 333
      MAXT=(MAXT-32.0)*5./9.
      MINT=(MINT-32.0)*5./9.
C
C--------> (   IF THE PRECIPITATION IS IN INCHES, THEN CENCHK = 01   ) <---------
C--------( AND CONVERSION FROM INCHES TO CENTIMETERS IS NECESSARY  )----
C
  333 IF (CENCHK .EQ. 1) RAIN = RAIN*2.54
      IF(MMCK.EQ.1) RAIN=RAIN/10.
C
C--------> (   THE RAIN VALUE IS USED TO ESTABLISH THE END OF EACH   ) <--------
C--------> ( RECORD.                                                 ) <--------
C
      IF (DLAICK .EQ. 1) GO TO 13
      WRITE (DISK,106) SR,MAXT,MINT,DVP,RAIN
      GO TO 9
   13 WRITE (DISK,106) SR,MAXT,MINT,(LAI10(I),I=1,NOFLDS),DVP,RAIN
      GO TO 9
   10 IF (WSIMCK .EQ. 0) GO TO 19
         CALL ERRSET(208,256,-1,1)
         READ (5,136) BSDT, ESDT, SR, MAXT, MINT, RAIN
         ME = ESDT(2) + (ESDT(1) - BSDT(1)) * 12
         MI = BSDT(2)
         YR = BSDT(1)
         BSDATE = BSDT(1) * 10000 + BSDT(2) * 100 + BSDT(3)
         DVP = 0.00
         IF (DLAICK .EQ. 0) GO TO 15
         DO 14 I = 1, NOFLDS
   14       LAI10(I) = 0.
   15    MO = BSDT(2) - 1
         CALL TIME(ITIME)
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         IX = (((1068 - ITIME) / 2) * 2 + 1
         I = BSDT(3)
         CALL JULIAN (CAL, YR, MI, I, JDATE)
         JDATE = JDATE - 1
         IF (JDATE .EQ. 0) JDATE = 365
         AMXMXT = SIN ((JDATE - AX) * .017214 ) * BX + CX
         SDIFFX = AMXMXT - MAXT
         DO 18 I = MI, ME
              MO = MO + 1
              IF (MO .LE. 12) GO TO 16
                   MO = MO - 12
                   YR = YR + 1
 16           NODAYS = CAL(MO)
              IF (MO .EQ. 2 .AND. MOD(YR,4) .EQ. 0) NODAYS = 29
              IF (MO .EQ. ESDT(2) .AND. YR .EQ. ESDT(1))NODAYS=ESDT(3)
              IDY = 1
              IF (MO .EQ. BSDT(2) .AND. YR .EQ. BSDT(1)) IDY = BSDT(3)
              DO 18 J = IDY, NODAYS
                   CALL JULIAN(CAL, YR, MO, J, JJDAY)
                   CALL CLMGN2(MO,JJDAY,SR,MAXT,MINT,RAIN,SDIFFX)
                   MAXT = (MAXT - 32.0) * 5./9.
                   MINT = (MINT - 32.0) * 5./9.
                   RAIN = RAIN * 2.54
                   IF (CLAICK .EQ. 1) WRITE (DISK, 106) SR, MAXT, MINT,
                        (LAI(LO(K),K=1,NCFLDS),DVP,RAIN
 18                IF (CLAICK .NE. 1) WRITE (DISK,106) SR, MAXT, MINT,
                        DVP, RAIN
 19 ENDFILE DISK
    DO 219 FIELDS=1,FLDRUN
    REWIND DISK
C
C---------> (              INITIALIZE THE VARIABLES.               ) <---------
C
    R=.75
    MGCNT=1
    DO 8 I=1,14
      DO 8 J=1,3
 8      MONTL2(J,I)=0.0
    KI=0
    JOINT = .FALSE.
    LAI = 0.0
    ZVAL(1) = 50.0
    ZVAL(2) = 250.0
    ZVAL(3) = 300.0
    ZVAL(4) = 300.0
    ZVAL(5) = 600.0
    KVAL2(1) = .05
    KVAL2(2) = .25
    KVAL2(3) = .25
    KVAL2(4) = .25
    KVAL2(5) = .2
    KVAL1(1) = .1
    KVAL1(2) = .5
    KVAL1(3) = .4
    KVAL1(4) = 0.
    KVAL1(5) = 0.
    KAY(1) = 1.
    KAY(2) = 2.8
    KAY(3) = 2.7
    KAY(4) = 3.
```

```
      KAY(5) = 4.
      KAY(6) = 5.
      LVAL(1) = 50.
      LVAL(2) = 250.
      LVAL(3) = 300.
      LVAL(4) = 300.
      LVAL(5) = 600.
      DO 20 I=1,7
   20 NCARAY(I) = 0.
      DO 21 I=1,9
      CBHOWT(I) = 0.0
      SPDATE(I) = 00
   21 TCTL(I) = 0.0
      DO 22 I=1,14
   22 BTCTL(I) = 0.
      DO 23 I=1,5
   23 CD(I) = 0.
      TGDD = 0.0
      II=1
      RAINDL=0.0
      EST=0.0
      ET=0.0
      CCUNT=2.0
      DAYT=0
      TACC=0.0
      K = 1
      KS=1.0
      KWT=0.0
      CUMKW1=0.0
      CUMKW2=0.0
      CUMKW3=0.0
      CUMKW4=0.0
      CUMKW5=0.0
      BMT=0.0
      T2=0.0
      TAL=0.0
      CV=3.0
      DT=60.
      HSTX25 = 0.0
      RFLG=0
      CLOCK=0
      ICOUNT=0
      PNTEMP=15.0
      DO 204 J=1,7
      SYP(J)=0
      SMC(J)=0
      SDAY(J)=0
  204 SCLK(J)=0
      SYM=IB(9)
      DO 38 I=1,125
      DO 41 J=1,52
   41 PARRAY(I,J)=IB(7)
   38 PARRAY(I,51)=IB(8)
      PARRAY(3,51)=IB(6)
      PARRAY(3,41)=IB(1)
      PARRAY(3,31)=IB(2)
      PARRAY(3,21)=IB(3)
      PARRAY(3,11)=IB(4)
      PARRAY(3,1)=IB(5)
      PARRAY(5,52)=IB(6)
```

```
      PARRAY(30,52)=IB(1)
      PARRAY(55,52)=IB(2)
      PARRAY(80,52)=IB(3)
      PARRAY(105,52)=IB(4)
      CCVER=C.
      NO=1
      SLCPP=0.
      JIDY(1) = 400
      YY(1)=C.
      YLAI=0.
      PCA=0.
      NX=0
      IZ=1
      PCLAI=0.
      YAVE=0.
      NOSMPL=1
      START=0
      INTL=0.0
      GRCSPH=0.0
      ORESP=C.0
      NRESP=0.0
      TRESP=0.0
      NCF=0.C
      OMTR=0.0
      CM=0.0
      COM=0.0
      PLAI=0.0
      FLAGL=C
      LAIMAX=1.0
      PTMIN=15.0
      DO 203 J=1,12
      DO 203 I=1,14
  203 MONTL(J,I)=0.0
      DO 211 J=1,7
      DO 211 I=1,19
  211 BTSTL(J,I)=0.0
      HSTN = 0.0
      DO 200 I = 1,15
          SMDATE(I) = 0
          DO 200 J = 1,5
  200             SMVAL(I,J) = 0.00
      NEXTSM = 1
      DO 660 I=1,6
      JSDATE(I)=999999
  660 CONTINUE
      T1=0.
      TT2=0.
      TT3=0.
      T4=0.
      T5=0.
      T6=C.
      DO 661 I=1,31
      TUTILL(I)=0.
      JLAI(I)=0.
  661 CONTINUE
      ILAST=9
      LAIMX=C.
      TFACT=1.0
      T4FLAG=0
      NPDEN=1
```

```
      CBMTS=C.0
      TSUM1=0.0
      TSUM2=0.0
      DRFLAG=0.0
      CO 59 I=1,9
        NCSUM(I)=0.0
  59  CONTINUE
C
C--------> (  READ IN EACH FIELDS' PARAMETER CARDS.                    ) <---------
C
      READ (5,100,END=1000) TITLE
      READ(5,100)FRMT
      READ (5,102) MXH2C,TV,TIN,T5,U,ALPHA,FALLRT,CNST,X5,MULT
      READ(5,108) THEVAL,THEMAX,THEMIN
      READ (5,107) MO,DAY,YR,PMC,PDAY,LMO,INITOT
      INDATE = INITOT(3) * 10000 + INITCT(1) * 100 + INITOT(2)
      CC 205 J = 1,5
 205      INVAL(J) = THEVAL(J)
      INVAL(6) = TIN
C
C--------> (  JULIAN IS A SUBROUTINE THAT CONVERTS A DATE IN          ) <---------
C--------> ( STANDARD, MC DY YR , FCRMAT INTO THE EQUIVALENT JULIAN  ) <---------
C--------> ( CAY.  THE JULIAN CAY IS RETURNED IN JJDAY.               ) <---------
C
      CALL JULIAN(CAL,YR,PMO,PCAY,JJDAY)
      JPLTDY(1)=JJDAY
      CO 614 I=2,5
      JPLTDY(I)=JJDAY+(I-1)*100
      IF(JPLTDY(I).GT.365) JPLTCY(I)=JPLTDY(I)-365
      IF(JPLTDY(I).GT.365) JPLTDY(I)=JPLTDY(I)-365
 614  CCNTINUE
      NPLTEM=JULDY(1)-JJDAY
      JPLOT=JJCAY
      LYCH=YR
      READ(5,132) CROP,FEEKCK,IRRCHK,ID,STRSCK,SMCHK,LGROCK,JLAICK,
     $       LSELAI,CNYLC,CFYLD,KYLD
      IF(LGRCCK.EQ.1) READ(5,615) PLDEN
 615  FCRMAT(F10.2)
      PDEN(1)=PLDEN
      PCATE(1)=10000*YR+100*PMC+PDAY
C
C--------> (                READ IN OBSERVED HEADWEIGHTS               ) <---------
C--------> (    THE MAXIMUM NUMBER OF HEACWT SAMPLES IS 3.             ) <---------
C
      IF ( HCCHK .NE. 00)
     * READ (5,130) NOSMPL,(SPCATE(I),CBHCWT(I),I=1,NOSMPL)
      I = NOSMPL
  5   OBHOWT(I+1)=OBHOWT(I) * 10.0
      SPDATE(I+1) = SPDATE(I)
      I = I-1
      IF (I .NE. 0) GO TC 5
      CBHCWT(1) = 0.0
      SPCATE(1) = 00
      IF (CLAICK .EQ. 1) GO TO 35
      IF (LINCHK.EQ.00) GO TO 31
C
C--------> (  READ IN THE OBSERVED LAI PCINTS, WHERE;                 ) <---------
C--------> (       JIDY : JULIAN CAY,    YY : LAI VALUE               ) <---------
C--------> (   THE MAXIMUM NUMBER OF PCINTS IS 46.                     ) <---------
C
```

```
      READ(5,101)NPTS,(JIDY(I),YY(I),I=1,NPTS)
  101 FORMAT(I2,11X,6(I4,F6.2),5(/,8(I4,F6.2)))
   35 MFLOCP = THEMAX(1) * 1500
C
C--------> (          OUTPUT THE HEADING PAGE.                      ) <---------
C
      WRITE (6,103)TITLE
      IF (WSIMCK .EQ. 1) WRITE (6,908) BSDATE
      WRITE (6,104)MXH2O,TV,TIN,T5,U,ALPHA,FALLRT,CNST,X5,MFLOCP,MLLT
      WRITE (6,105) THEVAL,THEMAX,THEMIN,LATD,LATM,FRMT
      IF (PUNCHK .NE. 0) WRITE (6,128)
      IF (STRSCK .EQ. 01) WRITE (6,134)
      IF (WSIMCK .EQ. 1) WRITE (6,137) BSDT(2), BSDT(3), BSDT(1)
      IF (WETHCK .EQ. 0 .AND. WSIMCK .NE. 0) WRITE (6,138)
      IF(LINCHK.EQ.1) WRITE(6,802) (JIDY(I),YY(I),I=1,NPTS)
  802 FORMAT('0',T64,'LAI',/,50(/,T59,I3,' . . . ',F4.2))
C
C--------> (  THE JULIAN DATE IS CORRECTED TO DAYS FROM PLANTING.   ) <---------
C
      IIDAY=365
      YRCH=0.
      IF(MOD(1900+LYCH,4).EQ.0)IIDAY=366
      DO 17 I=1,NPTS
      IF(JIDY(I).LT.JPLDT)YRCH=1.
   17 JIDY(I)=JIDY(I)+YRCH*IIDAY-JPLDT
   31 NPTDAY=JIDY(1)
      PTLAI=YY(1)
C
C--------> (  IF THE CARDS ARE IN THE WRONG ORDER OR IF THE FIELD    ) <---------
C--------> ( DATA STARTING DATE AND PLANTING DATE ARE REVERSED ON    ) <---------
C--------> ( THE INPUT CARDS, THESE TWO TEST STATEMENTS SHOULD       ) <---------
C--------> ( PREVENT UNWANTED EXECUTION AND OUTPUT.                  ) <---------
C
      IF ( MXH2O .LT. 10 ) GO TO 219
      IF ( (MO.GT.PMO) .OR. (MO.EQ.PMO.AND.DAY.GT.PDAY) ) GO TO 219
      THETI=TIN
      TI=TIN
      YEAR=YR
      LDAY=DAY
      IF(LMO.LE.MO)LMO=LMO+12
      MMO=MO
      MMM=MO
      ALPHAV=1.44
      GO TO (301,302,303,304),CROP
  302 ALPHAV=1.71
      GO TO 301
  303 ALPHAV=1.56
      CV=1.35
      DT=189.
      GO TO 301
  304 ALPHAV=1.74
  301 IF (CROP .EQ. 1) READ (5,121) SGSA,SGSB
      IF(IRRCHK.EQ.0) GO TO 359
C
C--------> (  READ IN THE IRRIGATION DATES AND WATER AMOUNTS.        ) <---------
C
      READ(5,120)(IMO(I),IDAY(I),IYR(I),IRR(I),I=1,IRRCHK)
      DO 350 I = 1, IRRCHK
  350 IRDATE(I) = IYR(I)*10000 + IMO(I)*100 + IDAY(I)
      J=IRRCHK-I
```

```
C
C--------> (    AND THE NUMBER OF OBSERVATIONS, THE DATE OF THE       ) <---------
C--------> (    OBSERVATION, AND THE STAGE NUMBER WILL BE READ IN     ) <---------
C--------> (    IN THE FORMAT:  NO YRMODY STG. YRMODY STG. , ETC.     ) <---------
C--------> (    ONLY 6 STAGE NUMBERS MAY BE READ IN PER DECK.         ) <---------
C--------> ( IF FEEKES' STAGE NUMBERS ARE KNOWN, THEN FEEKCK = 01     ) <---------
C
  359      IF (FEEKCK .EQ. 1) READ (5,126) NSTGDT,(STGYR(I),STGMO(I),
     *                 STGDY(I),STG(I),I=1,NSTGDT)
      IF (SMCHK .NE. 0) READ (5,129) NOSM,SMRUN,(SMDATE(I),(SMVAL(I,J),
     *                 J=1,5),I=1,NOSM)
      FLAG = 0
      IF (T5.GE.X5)FLAG=1
C
C--------> (  OUTER LOOP OF FIELD ANALYSIS.                            ) <---------
C
C
C--------> (    IF SUMMARY PAGE ONLY IS WANTED, SPDCHK = 01           ) <---------
C--------> ( ONLY THE SUMMARY PAGE WILL BE PRINTED FOR EACH FIELD.    ) <---------
C
      IF(IRRCHK.NE.O .OR. LINCHK.EQ.1 .OR. SMCHK.EQ.1) WRITE(6,800)
 800  FORMAT('1')
      IF(IRRCHK.GT.O) WRITE(6,801) (IMO(I),IDAY(I),IYR(I),IRR(I),
     $    I=1,IRRCHK)
 801  FORMAT('0',T58,'IRRIGATION (CM)',/,25(/,T55,2(I2,'/'),I2,
     $        ' . . . ',F5.2))
      IF(SMCHK.EQ.1) WRITE(6,803)  (SMDATE(I),(SMVAL(I,J),J=1,5),
     $                                     I=1,NOSM)
 803  FORMAT('0',T59,'SOIL MOISTURE',/,40(/,T50,I6,' . . . ',5F5.2))
      IF(USELA(.NE.0) GO TO 206
      DO 231 I=1,NPTS
        YY(I)=0.0
 231  CONTINUE
 206 IF (SPDCHK .NE. 00) GO TO 208
      WRITE (6,103) TITLE
      IF (WSIMCK .EQ. 1) WRITE (6,908) BSDATE
      WRITE(6,110)
 208 LIM=CAL(MMO)
      IF(MMO.EQ.2.AND.MOD((YR+1),4).EQ.0) LIM=29
      DO 207 JJJ=LDAY,LIM
      IF(MMO.EQ.1.AND.JJJ.EQ.1) YEAR=YEAR+1
      DATE = (10000*YEAR)+(100*MMO)+JJJ
      IF (DATE .NE. INDATE) GO TO 216
      DO 209 J = 1,5
 209       THEVAL(J) = INVAL(J)
      THETT = INVAL(6)
      TI    = INVAL(6)
 216 IF (SMCHK .EQ. 0) GO TO 218
      IF (DATE .NE. SMDATE(NEXTSM) .OR. NEXTSM .GT. SMRUN) GO TO 218
      DO 217 I = 1,5
 217       THEVAL(I) = SMVAL(NEXTSM,I)
      NEXTSM = NEXTSM + 1
C
C--------> (  DAYLIT CALCULATES THE DAYLIGHT FOR THE DAY.              ) <---------
C
 218 CALL DAYLIT(MMO,JJJ,LAT,DL)
C
      IF (CLAICK .EQ. 1) GO TO 36
      READ (DISK,FRMT,ERR=207,END=332) SR,MAXT,MINT,DVP,RAIN
      GO TO 40
```

```
   36 REAC (DISK,FRMT,ERR=207,END=332) SR,MAXT,MINT,LAI,DVP,RAIN
        SYM = IB(8)
C
C-------> (  A2 IS THE BMTS LAI.  PDA IS THE A2 OF THE PREVIOUS DAY) <---------
C
   40 IF (MMC.EQ.PMO.AND.JJJ.EC.PDAY) BMT=1
      IF(CATE.GT.PDATE(1) .AND. DATE.LE.SDATE(1))
     $ OBMTS=OBMTS+1./NPLTEM
      IF(CATE.GT.SDATE(1) .AND. DATE.LE.SDATE(2))
     $CBMTS=CBMTS+1./NSTGDY(1)
      IF(DATE.GT.SDATE(2) .AND. DATE.LE.SDATE(3))
     $ CBMTS=CBMTS+.7/NSTGDY(2)
      IF(DATE.GT.SDATE(3) .AND. DATE.LE.SDATE(4))
     $ CBMTS=OBMTS+.3/NSTGDY(3)
      IF(DATE.GT.SDATE(4) .AND. DATE.LE.SDATE(5))
     $ OBMTS=OBMTS+1./NSTGDY(4)
      IF(DATE.GT.SDATE(5) .AND. DATE.LE.SDATE(6))
     $ CBMTS=CBMTS+1./NSTGDY(5)
      IF(STGCHK.EQ.0) OBMTS=TACC
      IF(ORFLAG.EQ.1. .OR. OBMTS.LT.1.83) GC TO 7
      ORFLAG=1.0
      SYR(7)=YEAR
      SMO(7)=MMO
      SDAY(7)=JJJ
      CALL JULIAN(CAL,YEAR,MMO,JJJ,JULDR)
      CALL JULIAN(CAL,SYR(1),SMO(1),SDAY(1),JEM)
      IF(JEM.GT.JULDR) JULDR=JULDR+NDYYR
      SCLK(7)=JULDR-JEM
    7 CONTINUE
      THE30=THEVAL(1)*50+THEVAL(2)*250
      THE30=THE30-(THEMIN(1)*50+THEMIN(2)*250)
      KS30=THE30/((THEMAX(1)*50+THEMAX(2)*250)-(THEMIN(1)*50+THEMIN(2)*
     $ 250))
      IF (BMT .NE. 1) GO TO 39
      PREVK=K
C
C-------> (  CLUKER IS A BIOMETEUROLOGICAL TIME SCALE SUBROUTINE,   ) <---------
C-------> ( USED ONLY TO CALCULATE THE BMTS FOR WHEAT.              ) <---------
C
      CALL CLOKER (COEF,MINT,MAXT,DL,TOAY,K,MULT,TACC,CLOCK,MMO,JJJ,
     *              YEAR,SYR,SMO,SDAY,SCLK,ICOUNT,RFLG,KAY,
     *              JOINT,SDATE,PDA)
C
C     THE FOLLOWING STATEMENTS (THRU LABEL 600) CALL JEFF'S LAI MODEL'S
C     SUBROUTINES AT THE APPROPRIATE TIMES DURING THE GROWING SEASON.
C     THESE SUBROUTINES ARE CALLED ONLY IF LGROCK (LEAF GROW
C     CHECK) IS EQUAL TO 1 .
C
      IF(DATE.LT.JSDATE(1) .OR. LGROCK.EQ.0) GO TO 600
      PREVT1=T1
      IF(DATE.GE.JSDATE(1) .AND. T1.LT.230.) CALL EMRG(MAXT,MINT,KS3C,
     $KSWAT,TNO,LNO,LAPP,LAPL,JLAI,TUTILL,TULEAF,JJJ)
      IF(PREVT1.GE.230. .AND. CBMTS.LT.1.83)
     $ CALL STG2(MAXT,MINT,KS3C,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,TUTILL,
     $ TULEAF,JJJ)
      IF(OBMTS.GE.1.83 .AND. DATE.LT.JSDATE(2))
     $ CALL CRDG(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,TUTILL,
     $ TULEAF,JJJ)
      IF(DATE.GE.JSDATE(2) .AND. DATE.LT.JSDATE(3)) CALL JNT(MAXT,
     $ MINT,KS30,KSWAT,TNO,LAC,LAPP,LAPL,JLAI,TUTILL,TULEAF,JJJ)
```

```
      IF(DATE.EQ.JSDATE(3)) T4=C.
      IF(DATE.GE.JSDATE(3) .AND. T4.LT.511.) CALL BOOT(MAXT,MINT,
     $ KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,TOTILL,TULEAF,JJJ,OBMTS)
      IF (CLAICK .EC. 1) GO TO 33
 600  IF(JLAICK.EQ.0) GO TO 630
      LAI=JLAI(JJJ)
      IF(DATE.GT.JSDATE(3) .AND. T4.GE.511.) LAI=0.0
      IF(DATE.GE.JSDATE(5)) LAI=0.0
      IF(NX.NE.NPTDAY .OR. IZ.GT.NPTS .OR. YY(IZ).EQ.0.0 .OR.
     $ DATE.LT.JSDATE(1))  GC TC 630
      IF(DATE.GE.JSDATE(5)) GO TO 630
      JLAI(JJJ)=YY(IZ)
      LAI=YY(IZ)
      IF(OBMTS.LT.1.83) PLOEN=JLAI(JJJ)/(LAPP(JJJ))
      IF(OBMTS.GE.1.83) PLOEN=JLAI(JJJ)/(LAPL(JJJ)*LNO(JJJ))
      NPOEN=NPOEN+1
      POEN(NPOEN)=PLOEN
      PDATE(NPOEN)=DATE
 630  A2=TACC-1
      IF(TACC.GE.3.)A2=8.25-2.*TACC
      IF(A2.LE.0.)A2=0.
      IF(TACC.GT.4.)A2=0.
      YLAI=YLAI+A2-POA
      POA=A2
      IF(NPTDAY.EQ.NX)GO TO 32
C
C---------> (  CLAI CALCULATES LAI VALUES FOR DAYS WITHOUT OBSERVED  ) <---------
C---------> ( POINTS.                                                ) <---------
C
      CALL CLAI(NPTDAY,YLAI,POLAI,SLCPP,NX,PTLAI,TACC)
C
      GC TC 30
   32 YLAI=PTLAI
      IZ=IZ+1
      IF(IZ.LE.NPTS)GC TC 34
      YY(IZ)=0.
      JIDY(IZ) = 400
   34 PTLAI=YY(IZ)
      NPTDAY=JIDY(IZ)
C
C---------> (  SLOPP IS THE SLOPE TO THE NEXT OBSERVED POINT ON THE  ) <---------
C---------> ( LAI CURVE.                                             ) <---------
C
      SLOPP=(YLAI-PTLAI)/FLOAT(NX-NPTDAY)
      SYM=(8I6)
   30 IF(YLAI.LE.0.)YLAI=0.
      POLAI=YLAI
      IF(JLAICK.NE.1) LAI=YLAI
   33 NX=NX+1
      COVER = LAI/CV
C
C---------> (  YAVE IS THE AVERAGE LAI FOR FOUR DAYS, WHICH IS USED  ) <---------
C---------> ( IN THE LAI PLOT.                                       ) <---------
C
      YAVE=YAVE+LAI/4
      IF(NO.NE.4)GC TO 37
      IH=(YAVE+.05)/.1
      YAVE=0.
      IF(IH.GT.50)IH=50
C
```

```
C--------> (  PARRAY IS THE ARRAY THAT CONTAINS THE PLOT OF THE LAI ) <---------
C--------> ( CURVE.                                                 ) <---------
C
      PARRAY(NX/4+4,51-IH)=SYM
      SYM=IB(9)
      NC=0
   37 NC=NC+1
   39 IF(CCVER.GT.0.0) DAYT=DAYT+1
      IF(CCVER.GT.1.0) CCVER=1.CO
      IF (DAYT .GT. DT .AND. CCVER .LT. .4) COVER = .4
      IFLAG=0
      IF(IRRCHK.EQ.0) GO TO 361
C
C--------> (  THIS IF STMNT. CHECKS TO SEE IF THE CURRENT DAY COR-  ) <---------
C--------> ( RESPONDS TO ONE OF THE DAYS THE FIELD WAS IRRIGATED.   ) <---------
C
      IF (IRDATE(II) .NE. DATE) GO TO 361
      RAIN=RAIN+IRR(II)
      IFLAG=1
      IRRIG=IRR(II)*10.
      II=II+1
  361 RAIN=RAIN*10.0
      RAINEW=RAIN+RAINOL
      RAINOL=RAIN
      IF (RAINEW.LT.6.0) GO TO 311
      FLAG=0
      EST=0.0
      COUNT=2.0
  311 TMP=(3*MAXT+MINT)/4.0
      SSD=DELTA(TMP)
C
C--------> (  POTEVA CALCULATES POTENTIAL EVAPORATION.              ) <---------
C
      CALL POTEVA(LAI, CROP ,RN,SR,ALPHA,SSD,EO,DAYT)
C
      TI=TI-ET+RAIN
      IF(TI.GE.MFLDCP) TI=MFLDCP
      TAVAIL=THETT-(TV*1500)
      KS=TAVAIL/(FALLRT*MXH2O)
      IF (STPSCK .EQ. 01) KS = 1.0
      IF (KS.GT.1) KS=1.
      IF (KS.LT.0.0) KS=0.0
C
C--------> (  IF THE POTENTIAL EVAPORATION IS ZERO, ALL EVAPORATION ) <---------
C--------> ( SHOULD BE ZERO.                                        ) <---------
C
      IF (EO.GT.0.0) GO TO 317
      EO=0.0
      ES=0.0
      T =0.0
      T2=0.0
      A=0.0
      GO TO 325
C
C--------> (  TRANS CALCULATES TRANSPIRATION.                       ) <---------
C
  317 CALL TRANS(MXH2O,KS,LAI,T,ALPHA,RN,SSD,TAU,ALPHAV,
     *DRY, CROP ,T2,TGDD,TACC,FALLRT)
C
C--------> (  EVAP CALCULATES SOIL EVAPORATION.                     ) <---------
```

```
C
      CALL EVAP(FLAG,LAI,RN,EST,ES,U,CNST,COUNT,SSD,DRY,COVER,DAYT,TAU,
     * CROP)
C
C--------> (  ADV CALCULATES ADVECTION.                          ) <---------
C
      CALL ADV( CROP ,MAXT,KS,T ,A)
C
      IF(MAXT.GE.-3.0) GO TO 325
      ES=0.0
      A=0.0
  325 IF(KS.LT.1.0) A=0.0
      T2=T2+A
      T3=T2*KS
C
C--------> (  THE NEXT STATEMENTS WERE ADDED TO INCLUDE          ) <---------
C--------> ( DAILY TVP(DELTA E) VALUES.                          ) <---------
C
      TVP=0
      VPG=ESTAR(MAXT)-ESTAR(MINT)
      IF (TVPCK .NE. 1 .OR. TVPCK .EQ. 1 .AND. DATE .GE. BSDATE)
     .    GO TO 330
      VPG=R*(ESTAR(MAXT)-ESTAR(MINT))+ESTAR(MINT)-DVP
 330  IF(VPG.GT.0) TVP=T3/VPG
      IF(TVP.GT..4) TVP=.4
      ET=T3+ES
C
      CALL DISTR(T3,TVAL,KVAL1,KVAL2,LAI,JCINT)
C
      RUNOFF=0.0
      DRAIN=0.0
C
      CALL DAY1 (THEVAL,ZVAL,DRAIN,CD,THEMAX)
C
      IF (RAIN.EQ.0.)GO TO 401
      IF (IFLAG .NE. 1) GO TO 367
      RAIN=RAIN-IRRIG
C
      CALL DAYO(THEVAL,RAIN,ZVAL,RUNOFF,CD,THEMAX)
C
      CALL DAY2(THEVAL,IRRIG,ZVAL,RUNOFF,CD,THEMAX)
C
      RAIN=RAIN+IRRIG
      GO TO 401
C
  367 CALL DAYO(THEVAL,RAIN,ZVAL,RUNOFF,CD,THEMAX)
C
  401 CALL MOIST (THEVAL,ES,TVAL,ZVAL,THEMIN)
C
      IF(EC.NE.0.0) GO TO 405
      TEC=0.0
      ETEC=0.0
      GO TO 406
  405 TEC=T3/EC
      ETEC=ET/EC
  406 THETT=0
      DO 201 J=1,5
  201 THETT=(THEVAL(J)*LVAL(J))+THETT
      GO TO (407,402,403,219) ,CROP
C
```

```
  402 CALL JIM(LAI,PLAI,INTL,GRCSPH,TRESP,NCE,DM,CDM,SR,START,KS)
C
      GO TO 404
  403 DLAI=LAI+.025
      IF(DLAI.GT.4.62) DLAI=4.62
      INTL=5.21*SR*DLAI**.3296
C
      CALL SYED(FLAGL,LAI,PLAI,K,TACC,GRCSPH,SR,MAXT,DRESP,CDM,
     $DL,NRESP,NCE,DM,MINT,PTMIN,LAIMAX,KS,ILAI,TSTR1,TSTR2,TSTR,STRESS,
     .STGCHK,SDATE(6),DATE,
     $KWT,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5)
C
      TRESP=CRESP+NRESP
      GO TO 404
C
  407 CALL SCRGPH(DAYT,MAXT,MINT,PTMIN,SGSA,SGSB,INTL,SR,LAI,GROSPH,
     *CRESP,CL,CDM,NCE,NRESP,DM,PLAI,LAIMAX,FLAGL,PNTEMP,KS)
C
      TRESP=CRESP+NRESP
  404 IF(T3.EQ.0.0) GO TO 335
      DMTR=DM/T3
      GO TO 336
  335 DMTR=0.0
  336 PTMIN=MINT
C
C---------> (   DAILY VALUES ARE PRINTED OUT IN THIS SECTION.          ) .---------
C
      TEMP1=TACC
      IF(STGCHK.NE.0) TACC=OBMTS
      IF (SPCCHK .EQ. 00) WRITE (6,111) MMO,
     *                     JJJ,SR,MAXT,MINT,RAIN,LAI,T3,EO,ET,INTL,
     *GROSPH,DRESP,NRESP,TSTR ,NCE,DMTR,TVP,CDM,TACC,THETT,KS,KS30
      TACC=TEMP1
C
      IF (MOCNT.GT.12) GO TO 220
      MONTL(MMO,1)=MONTL(MMO,1)+SR
      MONTL(MMO,2)=MONTL(MMO,2)+RAIN
      MONTL(MMO,3)=MONTL(MMO,3)+T3
      MONTL(MMO,4)=MONTL(MMO,4)+EO
      MONTL(MMO,5)=MONTL(MMO,5)+ET
      MONTL(MMO,6)=MONTL(MMO,6)+INTL
      MONTL(MMO,7)=MONTL(MMO,7)+GROSPH
      MONTL(MMO,8)=MONTL(MMO,8)+DRESP
      MONTL(MMO,9)=MONTL(MMO,9)+NRESP
      MONTL(MMO,10)=MONTL(MMO,10)+TRESP
      MONTL(MMO,11)=MONTL(MMO,11)+NCE
      MONTL(MMO,12)=MONTL(MMO,12)+DMTR
      MONTL(MMO,13)=MONTL(MMO,13)+TVP
      MONTL(MMO,14)=CDM
      GO TO 221
 220  MONTL2(KI,1)=MONTL2(KI,1)+SR
      MONTL2(KI,2)=MONTL2(KI,2)+RAIN
      MONTL2(KI,3)=MONTL2(KI,3)+T3
      MONTL2(KI,4)=MONTL2(KI,4)+EO
      MONTL2(KI,5)=MONTL2(KI,5)+ET
      MONTL2(KI,6)=MONTL2(KI,6)+INTL
      MONTL2(KI,7)=MONTL2(KI,7)+GROSPH
      MONTL2(KI,8)=MONTL2(KI,8)+DRESP
      MONTL2(KI,9)=MONTL2(KI,9)+NRESP
      MONTL2(KI,10)=MONTL2(KI,10)+TRESP
```

```
      MCNTL2(KI,11)=MONTL2(KI,11)+NCE
      MCNTL2(KI,12)=MONTL2(KI,12)+DMTR
      MCNTL2(KI,13)=MONTL2(KI,13)+TVP
      MCNTL2(KI,14)=CDM
  221 BMS=K
      IF(RFLG.EQ.1) BMS=BMS+1
      BTSTL(BMS,1)=BTSTL(BMS,1)+GROSPH
      BTSTL(BMS,2)=BTSTL(BMS,2)+TRESP
      BTSTL(BMS,3)=BTSTL(BMS,3)+NCE
      BTSTL(BMS,4)=BTSTL(BMS,4)+DMTR
      BTSTL(BMS,5)=CDM
      BTSTL(BMS,6)=BTSTL(BMS,6)+T3
      BTSTL(BMS,7)=BTSTL(BMS,7)+ET
      BTSTL(BMS,8)=BTSTL(BMS,8)+TED
      BTSTL(BMS,9)=BTSTL(BMS,9)+ETEC
      BTSTL(BMS,10)=BTSTL(BMS,10)+KS
      BTSTL(BMS,11)=BTSTL(BMS,11)+T2
      BTSTL(BMS,12)=BTSTL(BMS,12)+SR
      BTSTL(BMS,13)=BTSTL(BMS,13)+INTL
      BTSTL(BMS,14)=BTSTL(BMS,14)+TVP
      IF(CBMTS.GE.2.3 .AND. CBMTS.LT.3.0 .AND. TSTR1.GT.25.)
     $      TSUM1=TSUM1+TSTR1
      IF(CBMTS.GE.2.3 .AND. CBMTS.LT.3.0) TSUM2=TSUM2+TSTR1
      IF (BMS .EQ. 5) HSTX25 = HSTX25 + (MAXT - 25)
      IF (BMS .EQ. 5 .AND. MINT .LT. 0.) HSTN = HSTN + MINT
      IF(HCCHK.EQ.0) GO TO 62
      NSMPL=NOSMPL+1
      DO 60 I=2,NSMPL
        IF(DATE.GE.SPDATE(I) .AND. DATE.LE.JSDATE(6))
     $   NCSUM(I)=NCSUM(I)+NCE
   60 CONTINUE
   62 NCARAY(BMS)=NCARAY(BMS) + NCE
      PLAI=LAI
  207 CONTINUE
  332 IF(SPDCHK.EQ.0.AND.MCCNT.LE.12)WRITE(6,112) (MCNTL(MMO,J),J=1,9),
     .(MONTL(MMO,J1),J1=11,13)
      IF(SPDCHK.EQ.0.AND.MCCNT.GT.12)WRITE(6,112) (MCNTL2(KI,J),J=1,9),
     .(MCNTL2(KI,J1),J1=11,13)
      IF(LGRCCK.NE.1 .OR. T4FLAG.NE.0 .OR. DATE.LT.JSDATE(1)) GO TO 799
C
C     THE FOLLOWING STATEMENTS (THRU LABEL 799) PRINT THE VALUES
C     COMPUTED BY JEFF'S LAI MODEL FOR EACH DAY OF EVERY MONTH OF THE
C     SEASON FOR WHICH THE LAI MODEL WAS CALLED. PRINTING IS ONLY DONE
C     IF LGRCCK (LEAF GROW CHECK) IS EQUAL TO 1 .
C
      WRITE(6,778) PMO,PDAY,YR
  778 FORMAT('1',T58,'LAI-TILLER MODEL',/,T55,'PLANTING DATE: ',I2,'/',
     $        I2,'/',I2,3X,//,T12,'DATE      ',
     $ 'TILL/PLANT     LVS/PLANT     LA/PLANT(CM**2)      LA/LEAF(CM**2)',
     $ '     LAI      TUTILL      TULEAVES      KSWAT',/)
      DO 770 I=LDAY,LIM
      IF(TUTILL(I).LE.0.) GO TO 770
        DO 775 J=1,7
        IK=3*J-2
        IL=3*J
        IF(SYR(J).EQ.YEAR .AND. SMO(J).EQ.MMO .AND. SDAY(J).EQ.I)
     $      WRITE(6,776) (STGNM(L),L=IK,IL)
  776     FORMAT(' ',T53,'***** ',3A4,' *****')
  775   CONTINUE
        WRITE(6,777) MMO,I,YEAR,TMD(I),LNO(I),LAPP(I),LAPL(I),JLAI(I),
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     $                 TUTILL(I),TULEAF(I),KSWAT(I)
 777     FORMAT(' ',I10,2(I2,'/'),I2,F9.2,F14.2,F15.2,F19.2,F13.2,F5.2,
     $           F11.2,F9.2)
      TUTILL(I)=0.
 770  CONTINUE
      IF(DATE.GE.JSDATE(3) .AND. T4.GT.511.) T4FLAG=1
 799  MMO=MMO+1
      IF(MMO.GT.12) MMO=MMO-12
      LDAY=1
      IF (MMM.EQ.LMO) GO TO 999
      MOCNT=MOCNT+1
      IF (MOCNT.GT.12) KI=KI+1
      MMM=MMM+1
      GO TO 206
 999  WRITE(6,103) TITLE
      IF (WSIMCK .EQ. 1) WRITE (6,308) BSDATE
C
C--------> (  YPHIL IS DR. PHIL RASMUSSEN'S YIELD EQUATION.  IT IS  ) <--------
C--------> ( BU/ACRE.  THE .9 CONVERTS IT FROM A 10% MOISTURE BASE, ) <--------
C--------> ( TO DRY WEIGHT ON A WET WEIGHT BASIS.                   ) <--------
C
      YPHIL=(2.856*0.9)*BTSTL(2,8)**.172*(BTSTL(3,8)+BTSTL(4,8))**.104*
     1BTSTL(5,8)**.646
      WRITE (6,133) CNYLD,CFYLD,KYLD,YPHIL
      WRITE(6,113)
      MMO=MO
      ITERMO = LMO
      IF (LMO-MO .GT. 12) ITERMO = MO+11
      DO 212 MMM=MO,ITERMO
      WRITE(6,114) MMO,MONTL(MMO,2),MONTL(MMO,5),MONTL(MMO,7),
     *MONTL(MMO,10),MONTL(MMO,11),MONTL(MMO,12),MONTL(MMO,14),
     *MONTL(MMO,13)
      TOTL(1)=TOTL(1)+MONTL(MMO,2)
      TOTL(2)=TOTL(2)+MONTL(MMO,5)
      TOTL(3)=TOTL(3)+MONTL(MMO,7)
      TOTL(4)=TOTL(4)+MONTL(MMO,10)
      TOTL(5)=TOTL(5)+MONTL(MMO,11)
      TOTL(6)=TOTL(6)+MONTL(MMO,12)
      TOTL(7)=TOTL(7)+MONTL(MMO,13)
      MMO=MMO+1
  212 IF(MMO.GT.12) MMO=1
      IF (LMO-MO .LE. 12) GO TO 213
      L=LMO-(MO+11)
      DO 223 KI=1,L
      WRITE(6,114) MMO,MONTL2(KI,2),MONTL2(KI,5),MONTL2(KI,7),
     *MONTL2(KI,10),MONTL2(KI,11),MONTL2(KI,12),MONTL2(KI,14),
     *MONTL2(KI,13)
      TOTL(1)=TOTL(1)+MONTL2(KI,2)
      TOTL(2)=TOTL(2)+MONTL2(KI,5)
      TOTL(3)=TOTL(3)+MONTL2(KI,7)
      TOTL(4)=TOTL(4)+MONTL2(KI,10)
      TOTL(5)=TOTL(5)+MONTL2(KI,11)
      TOTL(6)=TOTL(6)+MONTL2(KI,12)
      TOTL(7)=TOTL(7)+MONTL2(KI,13)
      MMO=MMO+1
      MMO = MMO + 1
  223 IF (MMO .GT. 12) MMO = 1
  213 WRITE(6,115) (TOTL(J),J=1,7)
      WRITE(6,116)
      DO 214 J=1,NMS
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      WRITE(6,117) LB(J),UB(J),(BTSTL(J,M),M=1,14)
      DO 214 M=1,14
  214 BTOTL(M)=BTOTL(M)+BTSTL(J,M)
      WRITE(6,118)(BTOTL(M),M=1,4),(BTOTL(M),M=6,14)
      IF (SCLK(5) .EQ. 00) SCLK(5) = CLOCK
      WRITE(6,901) TSUM2,HSTN,TSUM1 ,HSTX25
C
C--------> (    DO YIELD CALCULATIONS ONLY FOR WHEAT.                  ) <---------
C
      IF (CROP .NE. 3) GO TO 1320
      WRITE (6,103) TITLE
      IF (WSIMCK .EQ. 1) WRITE (6,908) BSDATE
      WRITE (6,133) CNYLD, CFYLD, KYLD, YPHIL
      DO 215 I = 1, 50
  215   YDARAY(I) = 0.00
C
      CALL CYIELD(NCARAY,SCLK,HOCHK,SPDATE,CBHOWT,YDARAY,CAL,
     $             SYR,SMO,SDAY,NCSMPL,TSUM2,HSTN,TSUM1,HSTX25,
     $BTSTL(6,5),KWT,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5,NCSUM)
C
      WRITE(6,119) KAY(1),SCLK(1),SMO(1),SDAY(1),SYR(1),SCLK(7),
     $SMO(7),SDAY(7),SYR(7),(KAY(I),SCLK(I),SMO(I),SDAY(I),SYR(I),I=2,6)
      IF (FEEKCK .EQ. 1) WRITE (6,127) (STGMO(I),STGDY(I),STGYR(I),
     *                    STG(I),I=1,NSTGDT)
      WRITE(6,636) PDEN(1),PDATE(1)
  636 FORMAT('0','PLANT DENSITY THROUGH SEASON(PLANTS/CM**2):',//,
     $       ' INITIAL DENSITY:',F6.4,'  ON',I7,'   NOTE:',
     $        ' DATES ARE IN YRMODY FORMAT')
      IF(JLAICK.EQ.1 .AND. LINCHK.EQ.1 .AND. USELAI.EQ.1) WRITE(6,635)
     $                                     (PDEN(I),PDATE(I),I=2,NPDEN)
  635 FORMAT(' ','CHANGED TO ',F5.4,'  ON',I7,/,40(' CHANGED TO ',
     $      F5.4,'  ON',I7,/))
C
C--------> (  THESE CARDS ARE PUNCHED TO BE RUN THROUGH THE SEPERATE) <---------
C--------> ( YIELD GENERATION MODEL FOR GETTING STATISTICS ON THE    ) <---------
C--------> ( YIELDS THAT ARE CALCULATED.                             ) <---------
C
      IF (PUNCHK .EQ. 0) GO TO 1320
      WRITE (7,100) TITLE
      IF (WSIMCK .EQ. 1) WRITE (7,125) BSDATE
      WRITE (7,909) CNYLD,CFYLD,KYLD,YPHIL,ID
      WRITE (7,903) (NCARAY(I),I=1,7)
      WRITE(7,904) (SCLK(I),SYR(I),SMO(I),SDAY(I),I=1,6)
      WRITE(7,905) TSUM2,HSTN,TSUM1,HSTX25,BTSTL(6,5)
  905 FORMAT (5F10.1)
      ISMPL = NCSMPL + 1
      IF (HOCHK .NE. 0)
     *     WRITE (7,130) (SMPL,(SPDATE(I),CBHOWT(I),I=1,ISMPL)
 1320 YDARAY(1)=CNYLD
      YDARAY(2)=CFYLD
      YDARAY(3)=KYLD
      YDARAY(4)=YPHIL
      WRITE(6,915) NOFLDS,FLDRUN,CELCHK,CENCHK,SPOCHK,STGCHK,HOCHK,
     .                LINCHK,DLAICK,PUNCHK,TVPCK ,WSIMCK,PUNYLD,CROP ,
     .                FEEKCK,IRRCHK,STRSCK,SMCHK,LGROCK,JLAICK,USELAI
  915 FORMAT ('-',T45,'  LISTING OF CHECKS  ',//,' NOFLDS =',I3,
     .'   FLDRUN =',I3,'  CELCHK =',I3,
     .'   CENCHK =',I3,'  SPOCHK =',I3,'  STGCHK =',I3,'  HOCHK   =',I3,
     .'   LINCHK =',I3,'  DLAICK =',I3,'  PUNCHK =',I3,//,
     . '  TVPCK  =',I3,'  WSIMCK =',I3,'  PUNYLD =',I3,'  CROP    =',I3,
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    .'  FEEKCK =',I3,'  IRRCHK =',I3,'  STRSCK =',I3,'  SMCHK  =',I3,
    $'  LGRCCK =',I3,'  JLAICK =',I3,//,'  USELAI =',I3)
     IF(PLNYLD.EQ.1) WRITE(7,919) ID,(YCARAY(I),I=1,50)
919  FORMAT(/,2A4,F6.2,9F7.2,4(/,7X,10F7.2))
     WRITE(6,1321)((PARRAY(I,J),I=1,125),J=1,52)
1321 FORMAT('1',52(/,' ',125A1))
     WRITE(6,918) (JPLTOY(I),I=1,5)
918  FORMAT('0',T4,I3,T29,I3,T54,I3,T79,I3,T104,I3)
 219 CONTINUE
 100 FORMAT (20A4)
 102 FORMAT (5F10.0,4F5.0,5X,F5.0)
 103 FORMAT('1',//,20X,'MODEL SYS.PHOTC-81.2 ',20A4)
 104 FORMAT('-',19X,'MAXIMUM AVAILABLE WATER (MM)...................',
    *  F10.4,//,20X,'THETA SUB V (15 BAR)...........................',
    *  F10.4,//,20X,'THETA INITIAL IN 5 FT. PROFILE (MM)............',
    *  F10.4,//,20X,'THETA SUB 5 CM. LAYER..........................',
    *  F10.4,//,20X,'U (MM).........................................',
    *  F10.4,//,20X,'ALPHA (P-1)....................................',
    *  F10.4,//,20X,'FALLRT.........................................',
    *  F10.4,//,20X,'SOIL CONSTANT (MM DAY TO -1/2).................',
    *  F10.4,//,20X,'X SUB 5 (INIT.WATER CONTENT IN 5 CM. LAYER,WT..',
    *  F10.4,//,20X,'FIELD CAPACITY.................................',
    *  F10.4,//,20X,'OMTS MULTIPLIER................................',
    *  F10.4)
 105 FORMAT ('0',19X,'THE INITIAL LAYER VALUES USED ARE .............',
    * 5(',',1X,F4.2),//,20X,
    * 'THE MAXIMUM LAYER VALUES USED ARE..............',
    * 5(',',1X,F4.2),//,20X,
    * 'THE MINIMUM LAYER VALUES USED ARE .............',
    *5(',',1X,F4.2),//,20X,
    * 'THE LATITUDE USED .............................',
    *2(1X,F3.0),//,20X,
    * 'THE INPUT FORMAT USED ..........', 20A4)
 106 FORMAT ( F6.1,2(F6.2),10(F5.2)
 107 FORMAT ( 20(I2,1X))
 108 FORMAT (15F5.0)
 109 FORMAT (8E10.4)
 110 FORMAT('-',33X,'TRAN  POT.  TOT.  INT.   GROSS   DAY    NIGHT  ',
    *'TOT.',21X,'CUM',/,' MO DAY  SR  MXT  MNT  RAIN  LAI  EVAP  EVAP',
    *'  EVAP  LIGHT  PHOTC   RESP   RESP   TSTR   NCE  DM/TR    TVP   ',
    *'DM  OMTS  THETA   KS  KS20',/,
    *'         (LYS) (C)  (C)  (MM)          (MM)',
    *'  (MM)  (MM) ME/CMCM --------(MG/((DM**2)/DAY))--------',
    *'        (MM/MB)(MG/CM2)     (MM)',/,'+',130('_'),/)
 111 FORMAT(' ',I2,I3,F6.0,2F5.0,F5.1,F5.2,3F6.2,F7.0,
    .                   5F7.1,F6.1,F6.3,F6.1,F5.2,F7.1,F6.2,F5.2)
 112 FORMAT('0TOT.',F7.0,11X,F4.0,7X,F4.0,F6.0,F5.0,F9.0,3F7.0,7X,F7.0,
    .                F6.0,F6.3)
 113 FORMAT(///,1X,18X,'TOTAL     GROSS',36X,'CUM',/,11X,
    *'RAIN      EVAP     PHOTO      TOT.RESP       NCE  DM/TRAN       DM',
    *9X,'TVP',
    */,1X,' MONTH     (MM)                    ','****(MG/((DM**2)/DAY))****',
    *12X,'(MG/(CM**2))',' (MM/MB)',/,'+',97('_'),/)
 114 FORMAT(' ',I4,5X,F5.1,4X,F5.1,2X,F7.1,5X,F8.1,1X,F7.1,4X,F7.1,
    *3X,F6.1,8X,F6.3)
 115 FORMAT('0','  TOT.',4X,F4.0,4X,F5.0,3X,F6.0,6X,F7.0,2X,
    *F6.0,4X,F5.0,16X,F7.3)
 116 FORMAT(//,' ',11X,'GROSS',31X,'CUM     TRAN     TOT.       RATIO',
    *'     RATIO     RATIO    POT.',15X,'INT.',/,' ',11X,'PHOTO  TOT.',
    *'RESP      NCE  DM/TRAN      DM     EVAP(2) EVAP(2) T3/E0(2) ',
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     *'ET/EO(2) T3/T2(2) TRAN(2)     SR       LIGHT',
     *'     TVP',/,' ',' BMTS      ',
     *'***(MG/((DM**2)/DAY))***',9X,'(MG/(CM**2))',51X,'(LYS)    ',
     *'(NE/CMCM) (MM/MB)',/,'+',123('_'),/)
 117 FORMAT(' ',A4,A2,F10.1,3F9.1,F9.1,F10.2,F8.2,3F9.2,
     .          F8.2,F9.0,F10.0,F8.3)
 118 FORMAT('0','  TOT.',F10.0,3F9.0,F18.0,F8.0,3F9.0,
     .          F8.0,F9.0,F10.0,F8.3)
 119 FORMAT('-EMERGENCE DATE   (FEEKES= 1.0  BMTS=',F4.2,'  DAYS=',I3,
     1 ') ....',I3,2('/',I2),/,
     $' DOUBLE RIDGE      (FEEKES= 5.0  BMTS=1.83  DAYS=',I3,
     $') ....',I3,2('/',I2),/,' JOINTING DATE     (FEEKES= 6.0  BMTS=',
     2 F4.2,'  DAYS=',I3,') ....',I3,2('/',I2),/,' BOOTING DATE      ',
     3 '(FEEKES=10.0  BMTS=',F4.2,'  DAYS=',I3,') ....',I3,2('/',I2),
     4 /,' HEADING DATE      (FEEKES=10.1  BMTS=',F4.2,'  DAYS=',I3,
     5 ') ....',I3,2('/',I2),/,' SOFT DOUGH DATE (FEEKES=11.2  BMTS=',
     6 F4.2,'  DAYS=',I3,') ....',I3,2('/',I2),/,' RIPE DATE         ',
     7 '(FEEKES=11.3  BMTS=',F4.2,'  DAYS=',I3,') ....',I3,2('/',I2))
 120 FORMAT(8(3I2,F4.2))
 121 FORMAT(I3,1X,I3)
 122 FORMAT(//,' ',19X,'IRRIGATION DATA',///,20X,'  DATE  ',12X,
     *       'AMOUNT (CM)',//)
 123 FORMAT(' ',19X,I2,'/',I2,'/',I2,16X,F5.2)
 125 FORMAT (7(I6,1X))
 126 FORMAT (I2,6(I3,I2,I2,F6.2))
 127 FORMAT (/,'-','OBSERVED FEEKES'' STAGE NUMBERS:',6(/,' ',
     *       I5,2('/',I2),F10.2))
 128 FORMAT ('-',19X,'NOTE:  CARDS WERE PUNCHED FOR THIS FIELD.')
129   FORMAT(2I2,3(I6,5F3.2),10(/,T5,3(I6,5F3.2)))
 130 FORMAT (I2,T6,5(1X,I6,F6.1),/,6(1X,I6,F6.1))
132   FORMAT(2(I2,1X),T10,I2,1X,2A4,5I3,T63,3F6.2)
 133 FORMAT ('0',11X,'CORRECTED NET YIELD =>',F6.2,
     * '  CORRECTED FARMER''S YIELD =>',F6.2,
     * '  KSU AVG. YIELD =>',F6.2,'  PHIL''S YIELD =>',F6.2)
 134 FORMAT ('0',20X,'NOTE:  KS SET EQUAL TO 1.0',//)
 135 FORMAT (8F10.4,/,4F10.4)
 136 FORMAT (3I2,T11,3I2,T21,4F10.1)
 137 FORMAT ('0',20X,'NOTE:  WEATHER VARIABLES WERE SIMULATED ',
     .      'STARTING ON THE DATE:  ',2(I2,'/'),I2)
 138 FORMAT ('-',10X,'*** ERROR ***  WEATHER PARAMETERS FOR THE',
     .      ' WEATHER SIMULATION WERE NOT READ, SIMULATION WILL BE ',
     .      'WRONG      *****')
 900 FORMAT (2F3.0,2F5.0)
901   FORMAT('0',' SUM OVER BMTS=2.3 TO BMTS=3.0 OF AVG. DAILY TEMP:  ',
     $      F10.1,/,
     1               '  SUM OF HD - SD TMIN LESS THAN 0:',F10.1,/,
     $'  SUM OVER BMTS=2.3 TO BMTS=3.0 OF AVG. DAILY TEMP >25 DEGREES',
     $'  CELSIUS:  ',
     3   F10.1,/,'  SUM OF HD - SD TMAX-25:',F10.1)
 903 FORMAT (7F10.1)
 904 FORMAT (6(I4,2X,3I2))
 907 FORMAT ('1',T52,'WEATHER SIMULATION PARAMETERS')
 908 FORMAT (' ',T46,'WEATHER WAS SIMULATED BEGINNING ON:',I8)
 909 FORMAT (4F6.2,2X,2A4)
 910 FORMAT ('-',T11,'JAN.',T21,'FEB.',T31,'MAR.',T41,'APR.',
     .  T51,'MAY',T61,'JUNE',T71,'JULY',T81,'AUG.',T91,'SEPT.',T101,
     .  'OCT.',T111,'NOV.',T121,'DEC.')
 911 FORMAT ('OPD     ',/,'   DRY',12F10.4,/,'   WET',12F10.4,/,
     .          ' ALPHAP',/,'   DRY',12F10.4,/,'   WET',12F10.4,/,
     .          ' BETAP ',/,'   DRY',12F10.4,/,'   WET',12F10.4,/,
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     .          'OALPHAR',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' BETAR ',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' AMNOFR',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' AMXDFR',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' RMAXY ',/,'    DRY',12F10.4,/,'    WET',12F10.4)
  912 FORMAT (' RMAXT ',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' RMINT ',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' SDMAXY',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' SDMAXT',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' SDMINT',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' CCYT  ',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' CCT   ',/,'    DRY',12F10.4,/,'    WET',12F10.4,/,
     .          ' CCYT2 ',/,'    DRY',12F10.4,/,'    WET',12F10.4)
  913 FORMAT ('1 A B C (X N): ',6F10.4)
 1000 RETURN
      END
      SUBROUTINE EMRG(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,
C
C     SUBROUTINE EMRG COVERS THE PERIOD OF TIME FROM EMERGENCE TO THE
C     BEGINNING OF TILLERING. IT IS ROUGHLY EQUIVALENT TO STAGE ONE OF
C     THE FEEKES SCALE: ONE SHOOT, A NUMBER OF LEAVES CAN BE ADDED.
C     230 THERMAL UNITS ARE NEEDED TO COMPLETE THIS STAGE.
C
     $                    TUTILL,TULEAF,J)
      REAL MAXT,MINT,KS30,KSWAT(31),TNO(31),
     $     LNO(31),LAPP(31),LAPL(31),JLAI(31),TUTILL(31),TULEAF(31),
     $ LAIMX,MTNOPP
      COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
     $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
      CALL SUMTU(MAXT,MINT,KS30,KSWAT,J,T1)
      TNO(J)=1.
      LNO(J)=.0120622*TT2
      IF(T1.GT.230.) LNO(J)=2.775*TNO(J)
      LAPP(J)=1.014345*LNO(J)**1.209577*TFACT
      LAPL(J)=0.
      IF(LNO(J).GT.0.) LAPL(J)=LAPP(J)/LNO(J)
C
C     LAI IS BASED ON TOTAL LEAF AREA PER PLANT WHICH IS CALCULATED
C     FROM TOTAL NUMBERS OF LEAVES PER PLANT AND IS LIMITED BY
C     COLD TEMPERATURES.
C
      JLAI(J)=LAPP(J)*PLDEN
      ILAST=1
      IF(T1.GT.230.) TT2=100.
      TUTILL(J)=TT2
      TULEAF(J)=TT3
      IF(JLAI(J).GT.LAIMX) LAIMX=JLAI(J)
      RETURN
      END
      SUBROUTINE STG2(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,
     $                    TUTILL,TULEAF,J)
C
C     SUBROUTINE STG2 COVERS THE PERIOD OF VEGATATIVE GROWTH UP TO
C     DOUBLE RIDGE.
C
      REAL MAXT,MINT,KS30,KSWAT(31),TNO(31),
     $     LNO(31),LAPP(31),LAPL(31),JLAI(31),TUTILL(31),TULEAF(31),
     $ MTNOPP,LAIMX
      COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
     $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
```

```
      CALL SUMTU(MAXT,MINT,KS30,KSWAT,J,T)
C
C     TILLERS ARE ADDED AT A LINEAR RATE WITH THERMAL UNITS FOR THE
C     FIRST 200 THERMAL UNITS, THEN TILLERS ARE ADDED EXPONENTIALLY WITH
C     THERMAL UNITS.
C
      IF(TT2.LE.300.) TNO(J)=TT2/100.
      IF(TT2.GT.300.) TNO(J)=.7156*EXP(.004805*TT2)
      LNO(J)=2.775*TNO(J)
      LAPP(J)=1.014345*LNO(J)**1.209577*TFACT
      LAPL(J)=LAPP(J)/LNO(J)
C
C     LAI IS CALCULATED AS IN EMRG, FROM TOTAL LEAF AREA PER PLANT
C     WHICH IS CALCULATED FROM TOTAL NUMBER OF LEAVES PER PLANT.
C
      JLAI(J)=LAPP(J)*PLDEN
      TUTILL(J)=TT2
      TULEAF(J)=TT3
      ILAST=2
      YLAPL=LAPL(J)
      IF(JLAI(J).GT.LAIMX) LAIMX=JLAI(J)
      RETURN
      END
      SUBROUTINE DROG(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,
C
C     SUBROUTINE DROG COVERS THE PERIOD OF TIME FROM DOUBLE RIDGE
C     (TACC=1.83) UNTIL JOINTING.
C
     $                    TUTILL,TULEAF,J)
      REAL MAXT,MINT,KS30,KSWAT(31),TNO(31),
     $     LNO(31),LAPP(31),LAPL(31),JLAI(31),TUTILL(31),TULEAF(31),
     $ MTNOPP,LAIMX
      COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
     $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
      CALL SUMTU(MAXT,MINT,KS30,KSWAT,J,T)
      IF(ILAST.NE.2) GO TO 100
      YLAPL=YLAPL*(1./TFACT)
      IF(LAIMX.GE.1.6) TT3=10**(ALOG(YLAPL/.18531)/ALOG(10.)/.59362)+T
      IF(LAIMX.LT.1.6) TT3=10**(ALOG(YLAPL/.0168)/ALOG(10.)/.9512)+T
  100 IF(LAIMX.GE.1.6) LAPL(J)=.18531*TT3**.59362*TFACT
      IF(LAIMX.LT.1.6) LAPL(J)=.0168*TT3**.9512*TFACT
      IF(TT2.LE.300.) TNO(J)=TT2/100.
      IF(TT2.GT.300.) TNO(J)=.7156*EXP(.004805*TT2)
      LNO(J)=TNO(J)*2.775
      LAPP(J)=LAPL(J)*LNO(J)
C
C     LAI IS CALCULATED FROM TOTAL NUMBER OF LEAVES PER PLANT(LNO)
C     AND LEAF AREA PER LEAF (LAPL) WHICH INCREASES EXPONENTIALLY WITH
C     THERMAL UNITS.
C
      JLAI(J)=LNO(J)*LAPL(J)*PLDEN
      TUTILL(J)=TT2
      TULEAF(J)=TT3
      ILAST=3
      IF(JLAI(J).GT.LAIMX) LAIMX=JLAI(J)
      RETURN
      END
      SUBROUTINE  JNT(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,
     $                    TUTILL,TULEAF,J)
C
```

```
C      SUBROUTINE JNT COVERS THE PERIOD OF TIME FROM JOINTING UNTIL BOOT.
C
       REAL MAXT,MINT,KS30,KSWAT(31),TNO(31),
      $     LNO(31),LAPP(31),LAPL(31),JLAI(31),TUTILL(31),TULEAF(31),
      $  MTNOPP,LAIMX,MXTNO
       COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
      $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
       CALL SUMTU(MAXT,MINT,KS30,KSWAT,J,T)
       IF(ILAST.EQ.4) GO TO 100
C
C      ON THE FIRST DAY OF JOINTING FINAL TILLER NUMBERS ARE CALCULATED
C      FROM TODAY'S MAXIMUM TILLER NUMBERS.  TILLERS ARE SHED WITH
C      THERMAL UNITS FOR 640 THERMAL UNITS.
C
       TNO(J)=.7156*EXP(.004805*TT2)
       MXTNO=TNO(J)*PLDEN*10000.
       FTNOSM=3.598*MXTNO**.701
       FTNOPP=FTNOSM/(PLDEN*10000.)
       MTNOPP=MXTNO/(PLDEN*10000.)
       SLOPE=-1*(ALOG(MTNOPP)-ALOG(FTNOPP))/640.
       T5=T
       GO TO 101
 100   IF(T5.LT.640.) TNO(J)=MTNOPP*EXP(SLOPE*T5)
       IF(T5.GE.640.) TNO(J)=FTNOPP
 101   LNO(J)=2.775*TNO(J)
       IF(LAIMX.GE.1.6) LAPL(J)=.18531*TT3**.59362*TFACT
       IF(LAIMX.LT.1.6) LAPL(J)=.0168*TT3**.9512*TFACT
       LAPP(J)=LAPL(J)*LNO(J)
C
C      LAI IS BASED ON TOTAL NUMBER OF LEAVES PER PLANT (LNO) AND AVERAGE
C      LEAF AREA PER LEAF (LAPL) USED IN SUBROUTINE UROG.
C
       JLAI(J)=LNO(J)*LAPL(J)*PLDEN
       TUTILL(J)=TT2
       TULEAF(J)=TT3
       ILAST=4
       RETURN
       END
       SUBROUTINE BOOT(MAXT,MINT,KS30,KSWAT,TNO,LNO,LAPP,LAPL,JLAI,
      $                  TUTILL,TULEAF,J)
C
C      SUBROUTINE BOOT COVERS THE TIME FROM BOOTING UNTIL ALL LEAVES
C      ARE DEAD.
C
       REAL MAXT,MINT,KS30,KSWAT(31),TNO(31),
      $     LNO(31),LAPP(31),LAPL(31),JLAI(31),TUTILL(31),TULEAF(31),
      $ MTNOPP,LAIMX
       COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
      $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
       CALL SUMTU(MAXT,MINT,KS30,KSWAT,J,T)
       IF(ILAST.EQ.5) GO TO 100
       T4=0.
       IF(LAIMX.GE.1.6) BTLAPL=.18531*TT3**.59362*TFACT
       IF(LAIMX.LT.1.6) BTLAPL=.0168*TT3**.9512*TFACT
       IF(T5.LT.640.) BTTNO=MTNOPP*EXP(SLOPE*T5)
       IF(T5.GE.640.) BTTNO=FTNOPP
       BTLNO=2.775*BTTNO
       BTLAPP=BTLAPL*BTLNO
       LAPL(J)=BTLAPL
       LAPP(J)=BTLAPP
```

```
      LNC(J)=BTLNO
      TNC(J)=BTTNO
      GC TC 200
 100  IF(T5.LT.640.) TNO(J)=MTNOPP*EXP(SLOPE*T5)
      IF(T5.GE.640.) TNO(J)=FTNOPP
C
C     VALUES FOR LEAF AREA PER LEAF (LAPL), LEAVES PER PLANT (LNO),
C     AND LEAF AREA PER PLANT (LAPP) DECREASE LINEARLY WITH THERMAL
C     UNITS FOR 511 THERMAL UNITS WHEN THEY ALL REACH ZERO.
C
      IF(T4.GT.511.) T4=511.
      LAPL(J)=-1*BTLAPL*T4/511. + BTLAPL
      LNC(J)=BTLNO*(-1)*T4/511. +BTLNO
      LAPP(J)=-1*BTLAPP*T4/511.+BTLAPP
 200  JLA(J)=LAPL(J)*LNO(J)*PLDEN
      TUTILL(J)=TT2
      TULEAF(J)=TT3
      ILAST=5
      RETURN
      END
      SUBROUTINE SUMTU(MAXT,MINT,KS30,KSWAT,J,T)
C
C     SUBROUTINE SUMTU CALCULATES ACCUMULATED THERMAL UNITS THAT DRIVE
C     THE OTHER SUBROUTINES.
C
      REAL MAXT,MINT,LAIMX,T,KS30,KSWAT(31),MTNOPP
      COMMON /AREA1/T1,T4,LAIMX,PLDEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNOPP,
     $ YLNO,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
      TX=MAXT
      IF(MAXT.GT.30.) TX=30.
      T=(TX+MINT)/2.
      IF(T.LT.0.) T=0.
      IF(MINT.LT.0.) T=T/2.
      IF(LAIMX.LT.1.6) CFACT=1.
      IF(LAIMX.GE.1.6) CFACT=7.81*LAIMX**(-6.62)
      IF(CFACT.LT..01) CFACT=.01
      IF(KS30.GT..20) KSWAT(J)=1.
      IF(KS30.LE..20) KSWAT(J)=1.30*KS30+.8
      T1=T1+T
C
C     TT2 DRIVES TILLERING AND LEAF PRODUCTION PER PLANT.
C     TT2 IS LIMITED BY INTER AND INTRA PLANT COMPETITION (CFACT)
C     AND BY WATER STRESS (KSWAT).
C
      TT2=TT2+T*CFACT*KSWAT(J)
      TT3=TT3+T
      T4=T4+T
      T5=T5+T
      T6=T6+T
      IF(MINT.LE.-3.) TF1=.995
      IF(MINT.LE.-3. .AND. LAIMX.LE.1.0) TF1=.99
      IF(MINT.GT.-3.) TF1=1.
      IF(T6.GE.40.) TF2=1.05
      IF(T6.LT.40.) TF2=1.
      IF(T6.GE.40.) T6=0.
C
C     TFACT REDUCES LEAF AREA PER PLANT DURING STG2 AND LEAF AREA PER
C     LEAF DURING DRDG BY 1% OR .5% DEPENDING ON MAXIMUM LAI ON DAYS
C     WHEN TEMPERATURE DROPS BELOW -3 DEGREES CELCIUS. TFACT ALSO BEGINS
C     TO REPAIR THIS DAMAGE BY .5% AFTER EVERY 40 THERMAL UNITS (T6).
```

```
C
      TFACT=TFACT*TF1*TF2
      IF(TFACT.GT.1.) TFACT=1.
      IF(TFACT.LT..1) TFACT=.1
      RETURN
      END
C
C----------( COMPUTATION OF DAY LENGTH )---------------------------
C
      SUBROUTINE DAYLIT (MMC,JJJ,LAT,DL)
C
      REAL PI/3.141593/,ARG1,ARG2,DL,LAT,DC
      INTEGER MON,JJJ,MMC
C
      MON=MMC
      ARG1=(PI/180.)*LAT
      IF (MON.LT.3) MON = MON + 12
      DC=MON*30.6+JJJ-91.3
      ARG2=0.0172*DC-1.95
      IF (LAT.LE.40.) DL = 12.14+(3.37*TAN(ARG1))*COS(ARG2)
      IF (LAT.GT.40.) DL=12.25+(1.6164+1.7643*(TAN(ARG1))**2)*COS(ARG2)
      RETURN
      END
      SUBROUTINE DAYO(THEVAL,RAIN,ZVAL,RUNOFF,CD,THEMAX)
C
C               SUBROUTINE TO CONTROL A RAIN.
C
C     .....
      DIMENSION THEVAL(5),ZVAL(5),THEMAX(5)
      INTEGER CD(5)
      IF(RAIN.GT.25.4) GO TO 3
      R=RAIN
      RUNOFF=0.0
      GO TO 4
    3 R=25.4*(RAIN/25.4)**.75
      RUNOFF=RAIN-R
    4 DO 5 I=1,2
      CK=(.5-THEVAL(I))*ZVAL(I)
      IF (R.LT.CK) GO TO 6
      THEVAL(I)=.5
      CD(I)=2
      R=R-CK
 5    CONTINUE
      RUNOFF=R+RUNOFF
      GO TO 7
    6 THEVAL(I)=THEVAL(I)+(R/ZVAL(I))
      IF (THEVAL(I).GT.THEMAX(I)) CD(I)=2
 7    RETURN
      END
C     .....
C
      SUBROUTINE DAY1(THEVAL,ZVAL,DRAIN,CD,THEMAX)
C
C               SUBROUTINE TO CONTROL DRAINAGE.
C
C     .....
      INTEGER CD(5)
      DIMENSION THEVAL(5),ZVAL(5),TADD(5),THEMAX(5),ADD(5)
      DRAIN=0.0
      DO 4 I=1,5
```

```
      TADD(I)=0.0
      TADD(I)=DRAIN/ZVAL(I)
      TCK=THEVAL(I)+TADD(I)
      IF (TCK.LE..5) GO TO 1
      DRAIN=(TCK-.5)*ZVAL(I)
      ADD(I)=TADD(I)-(DRAIN/ZVAL(I))
      GO TO 2
1     DRAIN=0.0
      ADD(I) = TADD(I)
2     IF (THEVAL(I).LE.THEMAX(I)) GO TO 4
      IF (CD(I).LT.2) GO TO 4
3     DRAIN=(THEVAL(I)-THEMAX(I))*ZVAL(I)+DRAIN
      THEVAL(I)=THEMAX(I)
      CD(I)=C
4     CONTINUE
      DO 6 I=2,5
      IF (TADD(I).EQ.0) GO TO 6
      THEVAL(I)=THEVAL(I)+ADD(I)
      IF (THEVAL(I) .GT. THEMAX(I)) CD(I)=2
      IF (THEVAL(I).GT..5) THEVAL(I)=.50
6     CONTINUE
      RETURN
      END
      SUBROUTINE DAY2(THEVAL,IRRIG,ZVAL,RUNOFF,CD,THEMAX)
      DIMENSION THEVAL(5),ZVAL(5),THEMAX(5)
      REAL IRRIG
      INTEGER CD(5)
      R=IRRIG
      DO 1 I=1,3
      CK=(.5-THEVAL(I))*ZVAL(I)
      IF(R.LT.CK) GO TO 2
      THEVAL(I)=.5
      CD(I)=2
      R=R-CK
    1 CONTINUE
      RUNOFF=R+RUNOFF
      GO TO 3
    2 THEVAL(I)=THEVAL(I)+R/ZVAL(I)
      IF(THEVAL(I).GT.THEMAX(I)) CD(I)=2
    3 RETURN
      END
C     .....
      FUNCTION DELTA(T)
C     .....
      DELTA=((.1554166E-1)*T)-((.5E-5)*(T**3))+((.1E-6)*(T**4))
     * +.404082/3
      RETURN
      END
      FUNCTION ESTAR(TT)
      REAL TT
C
C------(REF: MURRAY, F.W.  1967. ON THE COMPUTATION OF SATURATION)------
C------(VAPOR PRESSURE.  J. APPL. METEOR.  6:203-204)------------------
C
      ESTAR = 6.1078*EXP((17.269*TT)/(TT+237.3))
      RETURN
      END
C     .....
C     .....
      SUBROUTINE EVAP(FLAG,LAI,RN,EST,ES,U,CNST,COUNT,SSD,DRY,COVER,
```

```
     1DAYT,TAU,SOYSCR)
C
C                SUBROUTINE:  CALCULATION OF SOIL EVAP.
C
C      .....
      REAL LAI,MRNS
      INTEGER FLAG,DAYT,SOYSCR
      GO TO (2,6,6,5),SOYSCR
C
C               FOR SOYBEAN AND WHEAT
C
    6 IF (COVER.GT.LAI) TAU=.352
      GO TO 2
C
C               FOR CORN
C
    5 TAU=EXP(-.399*DRY+0.1438)
      IF (LAI.LE.0.38) TAU=1
      IF (DAYT.GT.90.AND.LAI.LT.3.67) TAU=.270
C
C                SWITCH AS TO WHICH SOIL EVAPORATION FORMULA
C                TO USE
C
    2 IF (FLAG-1) 1,3,3
    1 ES=TAU*SSO*RN/58.3
      EST=EST+ES
      IF (EST.LE.U) GO TO 4
      FLAG=2
      ES=ES*0.6
      GO TO 4
    3 ES=CNST*(SQRT(COUNT)-SQRT(COUNT-1.0))
      COUNT=COUNT+1.0
    4 MRNS=TAU*RN/58.3
      IF (MRNS.LT.ES) ES=MRNS
      RETURN
      END
      FUNCTION GAMMAD(ALPHA,BETA,MO,J,IX,U)
      DIMENSION ALPHA(12,2), BETA(12,2)
      INTEGER IX
      REAL U
      Z=0.0
      K=ALPHA(MO,J)
      F=K
      IF (K) 303,303,301
  301 PROD=1.0
      DO 302 L=1,K
      CALL RANDUM(IX,U)
  302 PROD=PROD*U
      Z=-ALOG(PROD)
  303 D=ALPHA(MO,J)-F
       IF (D)  308,308,304
  304 A=1.0/D
      B=1.0/(1.0-D)
      L=1
  305 CALL RANDUM(IX,U)
C
C  THIS SECTION OF CODE MODIFIED THE CALCULATION OF X TO AVOID UNDERFLOW WHEN
C        U WAS RAISED TO THE A POWER.  IF THE VALUE OF U ** A WAS TOO SMALL,
C        ZERO WAS USED.
C
```

```
      UA = -50 / ALOG10(U)
      X = 0.
      IF (A .LT. UA) X = U ** A
      CALL RANDUM(IX,U)
C
C  THIS SECTION OF CODE MODIFIED THE CALCULATION OF Y TO AVOID UNDERFLOW WHEN
C        U WAS RAISED TO THE B POWER.  IF THE VALUE OF U ** B WAS TOO SMALL,
C        ZERO WAS USED.
C
      UB = -50 / ALOG10(U)
      Y = X
      IF (B .LT. UB) Y = U ** B + X
      IF (Y-1.0) 307,307,306
  306 L=L+2
      GO TO 305
  307 W=X/Y
      CALL RANDUM(IX,U)
      Y = -ALOG(U)
      GAMMAD=(Z+W*Y)*BETA(MO,J)+0.005
      RETURN
  308 GAMMAD=Z*BETA(MO,J)+0.005
      RETURN
      END
C
C
      SUBROUTINE HFUNC (II,BASET,HUNITS)
      COMMON /CLIMAT/ TEMPMX(367),TEMPMN(367),TMFAC(8)
      IF (TEMPMX(II).GT.BASET) GO TO 20
      HUNITS=0.
      GO TO 80
20    IF (TEMPMN(II).LT.BASET) GO TO 40
      HUNITS=(TEMPMN(II)+TEMPMX(II))/2.-BASET
      GO TO 80
40    HUNITS=0.
C
      DO 60 J=1,8
         HTEMP=TEMPMN(II)+(TEMPMX(II)-TEMPMN(II))*TMFAC(J)
         IF (HTEMP.LE.BASET) HTEMP=BASET
         HUNITS=HUNITS+HTEMP-BASET
60    CONTINUE
      HUNITS=HUNITS/8.
80    RETURN
      END
C
C
      SUBROUTINE JIM(LAI,PLAI,INTL,GRCSPH,TRESP,NCE,DM,CDM,SR,START,KS)
      REAL LAI,SR,PLAI,INTL,GRCSPH,TRESP,NCE,DM,CDM,KS
      REAL PAR,PCTINT,ARG
      INTEGER START
      IF(LAI.EQ.0.0) GO TO 99
      START=1
      PAR=11.3*SR
      IF(LAI.GE.PLAI) GO TO 1
      ARG=10*LAI
      PCTINT=8.31*ALOG(ARG)+63.6
      GO TO 10
    1 IF(LAI.LE.2.7) GO TO 2
      IF(LAI.LE.5.2) GO TO 3
      PCTINT=95.
      GO TO 10
```

```
    2 PCTINT=32.9*LAI+.46
      GO TO 10
    3 PCTINT=1.27*LAI+88.4
   10 INTL=PAR*PCTINT*.01
      IF((LAI.GE.PLAI.OR.LAI.GT.3.5).OR.INTL.GT.5150.) GO TO 20
      GROSPH=(5.91E-17*INTL**5.056)*KS
      GO TO 30
   20 GROSPH=(.715*INTL**.728)*KS
   30 TRESP=.24*GROSPH+4.455
      IF(TRESP.LT.0.0) TRESP=0.0
      NCE=GROSPH-TRESP
      DM=.007*NCE
      CDM=CDM+DM
      GO TO 100
   99 IF(START.EQ.0) GO TO 100
      INTL=0.0
      GROSPH=0.0
      TRESP=0.0
      NCE=0.0
      DM=0.0
  100 RETURN
      END
C
C
      SUBROUTINE JULIAN(ICAL,IYR,IPMO,IPDAY,JJDAY)
C
C            SUBROUTINE JULIAN
C------> I THIS TAKES ITS PARAMETERS: IPMO IPDAY AND IYR AND   I <------
C------> ICONVERTS IT TO JULIAN DAYS, RETURNED IN JJDAY        I <------
C
C            VARIABLE DESCRIPTION:
C              ICAL      AN ARRAY OF 12 NUMBERS CORR. TO MONTH DAYS
C               IADD     VARIABLE CONTAINING:
C                                     1   FOR LEAP YEAR EXTRA DAY
C                                     0   NOT LEAP YEAR, NO EXTRA DAY
C
      DIMENSION ICAL(12)
      K=IPMO-1
      JJDAY=0
      IF (K .EQ. 0) GO TO 12
      DO 1 I=1,K
      JJDAY=JJDAY+ICAL(I)
    1 CONTINUE
   12 JJDAY=JJDAY+IPDAY
      IADD=0
      IF (MOD(IYR,4) .EQ. 0) IADD=1
      IF (IPMO .GT. 2) JJDAY=JJDAY+IADD
      RETURN
      END
      SUBROUTINE POTEVA(LAI,CFLAG,RN,SR,ALPHA,SSD,EO,DAYT)
C
C--------(SUBROUTINE TO CALCULATE POT. EVAP.)-------------------------
C
      REAL LAI
      INTEGER CFLAG,DAYT
C
      IF(CFLAG.EQ.1) GO TO 14
      IF(CFLAG.EQ.2) GO TO 2
      IF(CFLAG.EQ.3) GO TO 3
C
```

```
C              FOR CORN AND SORGHUM
C
      TLAI=LAI
 14   IF(LAI.GE.3.) TLAI=3.
      RN=.855*SR-104-40*(TLAI/3.)**2
      GO TO 4
C
C              FOR SOYBEANS
C
 2    IF(LAI.LT.3.) RN=.7248*SR-50.11
      IF(LAI.GE.3.) RN=.8049*SR-135.97
      GO TO 4
C
C              FOR WHEAT
C
 3    RN=.8678*SR-163.56
      IF(DAYT.LE.168)RN=.9593*SR-213.10
      IF(DAYT.GT.202)RN=.9258*SR-157.42
    4 EC=ALPHA*SSD*RN/58.3
      RETURN
      END
C
C
      SUBROUTINE RANDUM(IX,U)
      IX = IX * 65539
      IF (IX .LT. 0) IX = IX + 2147483647 + 1
      U = IX
      U= U * .4656613E-9
      RETURN
      END
C
C
      REAL FUNCTION SFAC(C1,C3,C5)
      C4=1.0
      IF (C1.LT.C3) GO TO 20
      SFAC=C4
      RETURN
20    SFAC=C1*(C4-C5)/C3+C5
      RETURN
      END
C
      SUBROUTINE SORGPH(DAYT,MAXT,MINT,PTMIN,SGSA,SGSB,INTL,SR,LAI,
     *GROSPH,DRESP,CL,CDM,NCE,NRESP,CM,PLAI,LAIMAX,FLAGL,PNTEMP,KS)
      REAL MAXT,MINT,PTMIN,INTL,SR,LAI,GROSPH,DRESP,CL,CDM,NCE,
     *NRESP,CM,PLAI,LAIMAX,KS
      REAL DTEMP,NTEMP,LM,TSTR,PNTEMP,LMLAI
      INTEGER SGSA,SGSB,DAYT,FLAGL
      DTEMP=(2*MAXT+PTMIN)/3
      NTEMP=(MAXT+2*MINT)/3
      LMLAI=LAI
      IF(LMLAI.GT.6.65) LMLAI=6.65
      IF(DAYT.EQ.0) GO TO 99
      LM=1.0
      IF(DAYT.LT.SGSA) GO TO 10
      IF(FLAGL.EQ.1) GO TO 12
      IF(LAI.LT.PLAI) GO TO 13
      GO TO 14
   13 LAIMAX=PLAI
      FLAGL=1
   12 LM=.75+.25*(LAI/LAIMAX)
```

```
   14 IF(DAYT.LT.SGSB) GO TO 20
      INTL=.1065*SR*(77.08+1.65*LMLAI)
      GROSPH=2000*(1-EXP(-.0000895*INTL))*KS
      GO TO 30
   20 INTL=.1065*SR*38.436*LMLAI**.486
      GROSPH=2000*(1-EXP(-.0000895*INTL))*KS
      GO TO 30
   10 INTL=.1065*SR*38.436*LMLAI**.486
      GROSPH=2000*(1-EXP(-.000059*INTL))*KS
   30 IF(MAXT.GT.33.) GO TO 16
      GO TO 17
   16 IF(MAXT.NE.MINT) GO TO 11
      TSTR=0.0
      GO TO 15
   11 TSTR=(MAXT-33)/((MAXT-.5*MINT-.5*PTMIN))
   15 GROSPH=GROSPH*(1-TSTR)
   17 DRESP=DL*(.011667*GROSPH+LM*COM*(.002955+.000128*DTEMP+.000067
     *        *DTEMP**2))*(-1)
      NRESP=(24-DL)*(.01167*(GROSPH+DRESP)+LM*COM*(.002955+.000128*
     *        NTEMP+.000067*NTEMP**2))*(-1)
      NCE=GROSPH+DRESP+NRESP
      DM=.0067*NCE
      COM=COM+DM
   99 PNTEMP=NTEMP
      RETURN
      END
C
      SUBROUTINE TOM(FLAGL,LAI,PLAI,K,TACC,GROSPH,SR,MAXT,DRESP,COM,
     *DL,NRESP,NCE,DM,MINT,PTMIN,LAIMAX,KS)
      REAL LAI,PLAI,TACC,GROSPH,SR,MAXT,DRESP,COM,DL,NRESP,NCE,DM,MINT,
     *DTEMP,NTEMP,LAIMAX,PTMIN,ILAI,KS
      REAL TC,TN,TSTR,TSTR1,TSTR2
      INTEGER FLAGL,K
      DTEMP=(2*MAXT+PTMIN+3*273.15)/3
      NTEMP=(MAXT+2*MINT+3*273.15)/3
      IF(MAXT.GT.23.) GO TO 20
      TC=23.
      TSTR1=1.
      GO TO 21
   20 TN=(PTMIN+MINT)/2
      IF (TN .GT. 23) TN = 23
      TC=MAXT
      IF(TN.LT.5.) TN=5.
      TSTR1=1-(MAXT-23.)/(MAXT-TN)
   21 IF(PTMIN.LT.5.) GO TO 22
      TSTR2=1.
      GO TO 23
   22 TSTR2=1-(5.-PTMIN)/(TD-PTMIN)
   23 ILAI=LAI
      IF (MAXT .LT. 5.0) TSTR2 = 0.0
      TSTR=TSTR1*TSTR2
      IF (FLAGL.EQ.1) GO TO 12
      IF(K.GE.3.AND.LAI.LT.PLAI) GO TO 11
      GO TO 12
   11 LAIMAX=PLAI
      FLAGL=1
   12 GO TO (1,2,3,3,4,4),K
    4 IF (LAI.GT.1.5) GO TO 13
      ILAI=ILAI+.3
      IF (TACC.GT.4.5) GO TO 14
```

```
      GC TC 2
   13 ILAI=ILAI+.3
    3 IF (LAI.LE.1.5) GO TO 2
      IF(ILAI.GT.4.62) ILAI=4.62
      GRCSPH=(1012-1012*EXP(-.0055*SR*.5739*ILAI**.3296))*KS*TSTR
      IF (TACC .GT. 3.0) GROSPH=(1012-1012*EXP(-.0055*SR*.95))*KS*TSTR
      GC TC 17
   14 GRCSPH=0.0
      GO TC 16
    2 IF (MAXT.LT.5.0) GO TO 18
      GC TC 19
   18 GRCSPH=0.0
      GO TO 17
   19 IF(ILAI.GT.4.62) ILAI=4.62
      GRCSPH=(440-440*EXP(-.0025*SR*.5739*(LAI**.3296))*KS
     *        *TSTR
      IF(TACC.GT.3.0)GROSPH=(440-440*EXP(-.0025*SR*.8*ILAI**.4))*KS
     1        *TSTR
   17 IF (FLAGL.EQ.1) GC TC 16
      DRESP=(-.27601-.014775*GRCSPH-.002329*CDM*(1+.0035087*DTEMP+
     *        .0001*DTEMP**2))*DL
      NRESP=(24-DL)*(-.27601-.014775*(GRCSPH+CRESP)-.002329*COM
     *        *(1+.003508 *NTEMP+.0001*NTEMP**2))
      GC TC 1
   16 DRESP=(-.27601-.014775*GROSPH-.002329*CDM*((LAI/LAIMAX)*
     *        (1+.0035087*DTEMP+.0001*DTEMP**2))*DL
      NRESP=(24-DL)*(-.27601-.014775*(GRCSPH+DRESP)-.002329*CDM*
     *        (ILAI/LAIMAX)*(1+.0035087*NTEMP+.0001*NTEMP**2))
    1 NCE=GRCSPH+DRESP+NRESP
      DM=NCE*.0067
      CDM=CDM+DM
      RETURN
      END
      SUBROUTINE TRANS(MXH2C,KS,LAI,T,ALPHA,RN,SSD,TAU,
     1ALPHAV,DRY,SOYSOR,T2,TGDD,TACC,FALLRT)
C
C               SUBROUTINE:  CALCULATICN CF TRANSPIRATION
C
C
C     .....
      REAL LAI,MXH2C,KS,T2,TGDC,TACC,FALLRT
      INTEGER SOYSOR
      GO TO (1,1,3,4),SCYSCR
C
C               FOR SORGHUM AND SCYBEAN
C
    1 TAU=EXP(-.398*LAI)
      IF (LAI-2.5) 53,51,51
C
C               FOR WHEAT
C
    3 TAU=EXP(-.737*LAI)
      IF (TACC.GT.3.OR.LAI.GE.1.25) GO TO 30
      GC TO 50
   30 IF (TACC.GT.4) GO TO 52
      GC TC 51
C
C               FOR CCRN
C
    4 CRY=LAI
      TAU=EXP(-.389*CRY+0.1438)
```

```
      IF (LAI .EQ. 0.0) TAU = 1.0
      IF (LAI .GT. 0. .AND. LAI .LT. .49) TAU = .95
      IF (LAI.GE.2.5.OR.TGDD.GE.1400.) GO TO 41
      GO TO 50
   41 IF (LAI.LT.2.5.AND.TGDD.GE.2000) GO TO 50
      GO TO 51
C
C
   50 T=KS*ALPHAV*(1.0-TAU)*SSD*RN/58.3
      GO TO 99
   51 T=KS*(ALPHA-TAU)*SSD*RN/58.3
      GO TO 99
   52 T=KS*ALPHAV*(1-(EXP(-.737*LAI)))*SSD*RN/58.3
      GO TO 99
   53 T=KS*ALPHAV*(1-(EXP(-.398*LAI)))*SSD*RN/58.3
C
C
   99 IF (KS.EQ.0.0) GO TO 98
      T2=T*1/KS
      GO TO 97
   98 T2=0.0
   97 RETURN
      END
C     .....
C        UPDATED VERSION OF CLOKER (V80.1   3/12/80)
C
C        PURPOSE      CALCULATE PART OF BIO-TIME TODAY,BAIER MODEL
C
C        DESCRIPTION OF PARAMETERS
C                 COEF:     COEFFICIENT TO CALCULATE TIME
C                 TN:       MIN TEMP
C                 TX:       MAX TEMP
C                 DL:       DAY LENGTH
C                 TACC:     TOTAL OF TIME PARTS
C                 TODAY:    TODAYS TIME PART
C                 K:        INDEX INTO COEF
C
      SUBROUTINE CLOKER(COEF,MINT,MAXT,DL,TDAY,K,MULT,TACC,CLOCK,MMC,
     *                  JJJ,YEAR,SYR,SMO,SDAY,SCLK,ICOUNT,
     *                  RFLG,KAY,JOINT,SDATE,PDA)
C     .....
      REAL COEF(6,8),TN,TX,DL,TDAY,MULT,TACC,KAY(6),MINT,
     $    MAXT,LAIMX,MTNOPP
      INTEGER K,CLOCK,MMO,JJJ,YEAR,SYR(6),SMO(6),SDAY(6),SCLK(6),
     *        ICOUNT,RFLG,DATE,SDATE(7)
      LOGICAL*1 JOINT
C
      COMMON /AREA1/T1,T4,LAIMX,PLOEN,ILAST,YLAPL,MTNOPP,SLOPE,FTNCFF,
     $ YLNC,YLAPP,JSDATE(6),TT2,TT3,T5,T6,TFACT
      DATE = (YEAR*10000) + (MMO*100) + JJJ
      TX=((9./5.)*MAXT)+32.
      TN=((9./5.)*MINT)+32.
C
C     FIND DAYLENGTH CONTRIBUTION TO BIO-TIME
C
      V1=COEF(K,2)*(DL-COEF(K,1))+COEF(K,3)*(DL-COEF(K,1))**2
      IF(V1.LT.0.) V1=0.0
C
C     FIND MAX TEMP CONTRIBUTION TO BIO-TIME
C
```

```
      V2=CCEF(K,5)*(TX-COEF(K,4))+CCEF(K,6)*(TX-COEF(K,4))**2
      IF (V2.LT.0.0.OR.TX.LT.23.64) V2=0.0
C
C       FIND MIN TEMP CONTRIBUTION TO BIO-TIME
C
      V3=CCEF(K,7)*(TN-COEF(K,4))+COEF(K,8)*(TN-COEF(K,4))**2
      IF(V3.LT.0.0) V3=0.0
C
C     TCDAYS CONTRIBUTICN TO BIC-TIME
C
      TDAY=V1*(V2+V3)
C
C               CUMMULATIVE SUMS FOR BMTS
C
      IF(K.EC.3.CR.K.EC.4) TDAY=TDAY*MULT
      TACC=TACC+TDAY
      CLCCK=CLOCK+1
      IF((MMC.GT.9.AND.MMO.LE.12).AND.TACC.GT.1.6) TACC=1.6
      IF (RFLG .EQ. 1) GO TO 111
      IF (K .EQ. 2) GO TC 20
      IF (SDATE(K) .EQ. DATE) GC TO 99
      IF (SDATE(K) .NE. 0) GO TC 111
      IF (TACC .GE. KAY(K)) GO TO 99
      GC TO 111
   20 IF (SDATE(K) .EQ. DATE) GC TO 40
      IF (SDATE(K) .NE. 0) GO TC 111
      IF (TACC .GE. 2.8) GC TO 40
      IF (TACC .GE. 1.95 .AND. TDAY .GE. 0.02) ICOUNT = ICOUNT+1
      IF (ICCUNT .NE. 10) GO TC 111
   40 KAY(K) = 2.0
      PDA = PDA - TACC + 2.
      TACC = 2.
      JCINT = .TRUE.
   99 IF (K .EQ. 6) RFLG = 1
       IF (SCATE(K) .NE. 0 .ANC. K .NE. 2) TACC = KAY(K)
      SYR(K)=YEAR
      SMC(K)=MMO
      SDAY(K)=JJJ
      SCLK(K)=CLOCK
      JSDATE(K)=10000*SYR(K)+100*SMO(K)+SDAY(K)
      CLCCK=0
      IF(K.LT.6) K=K+1
  111 RETURN
      ENC
      SUBROUTINE DISTR(T,TVAL,KVAL1,KVAL2,LAI,JCINT)
C
C               SUBROUTINE TC CALCULATE THE TRANSPIRATION IN EACH LAYER.
C
C     .....
      DIMENSION TVAL(5),KVAL1(5),KVAL2(5)
      REAL KVAL1,KVAL2,LAI
      LCGICAL*1 JOINT
      IF (LAI .GT. 1 .OR. JCINT) GC TO 3
      DO 2 I=1,5
 2    TVAL(I)=T*KVAL1(I)
      GC TO 5
 3    DC 4 I=1,5
 4    TVAL(I)=T*KVAL2(I)
    5 RETURN
      ENC
```

```
      SUBROUTINE MOIST (THEVAL,ES,TVAL,ZVAL,THEMIN)
C
C              TO CALCULATE THE SOIL MOISTURE CONTENT IN EACH LAYER
C
C     .....
      DIMENSION THEVAL(5),TVAL(5),ZVAL(5),THEMIN(5)
      REAL ELEFT1,ELEFT2,RMO,ES
      ELEFT1=ES
      IF (ELEFT1.EQ.0.0) GO TO 2
    1 DO 19 I=1,5
      IF (THEVAL(I).EQ..1) GO TO 19
      ELEFT2=ELEFT1/ZVAL(I)
      TCK=THEVAL(I)-ELEFT2
      IF (TCK.LT..1) GO TO 11
      THEVAL(I)=TCK
      GO TO 2
   11 ELEFT2=THEVAL(I)-.1
      ELEFT1=ELEFT1-(ELEFT2*ZVAL(I))
      THEVAL(I)=.1
   19 CONTINUE
C
C
    2 DO 29 I=1,4
      IF (TVAL(I).EQ.0.0) GO TO 29
      IF (THEVAL(I).LE.THEMIN(I)) GO TO 21
      TCK=THEVAL(I)-(TVAL(I)/ZVAL(I))
      IF (TCK.LT.THEMIN(I)) GO TO 22
      THEVAL(I)=TCK
      GO TO 29
   21 TVAL(I+1)=TVAL(I+1) + TVAL(I)
      TVAL(I)=0.0
      GO TO 29
   22 RMO=THEVAL(I)-THEMIN(I)
      TVAL(I+1)=TVAL(I+1)+(TVAL(I)-(RMO*ZVAL(I)))
      TVAL(I)=RMO*ZVAL(I)
      THEVAL(I)=THEMIN(I)
   29 CONTINUE
C
C
      THEVAL(5)=THEVAL(5)-(TVAL(5)/ZVAL(5))
C
      RETURN
      END
      SUBROUTINE ADV(SOYSOR,MAXT,KS,TR,A)
      REAL MAXT,MX,KS,TR,A
      INTEGER SOYSOR
      IF(KS.LT.1.) GO TO 9
      MX=MAXT
      GO TO (1,2,3,1),SOYSOR
C              SORGHUM AND CORN
    1 IF(MX.LE.33.) GO TO 9
      IF(MX.GT.37.) MX=37.
      A=.1*(MX-33.)*TR
      GO TO 99
C              SOYBEAN
    2 IF(MX.LE.32.) GO TO 9
      IF(MX.GT.36.) MX=36.
      A=.1*(MX-32.)*TR
      GO TO 99
C              WHEAT
```

```
 3 IF(MX.LE.27.) GO TO 9
   A = .1*TR
   GO TO 99
 9 A=0.0
99 RETURN
   END
   SUBROUTINE SYED(FLAGL,LAI,PLAI,K,TACC,GROSPH,SR,MAXT,DRESP,COM,
  .DL,NRESP,NCE,DM,MINT,PTMIN,LAIMAX,KS,ILAI,TSTR1,TSTR2,TSTR,STRESS,
  .STGCK,RPDATE,CKDATE,
  .KWT,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5)
   REAL LAI,PLAI,TACC,GROSPH,SR,MAXT,DRESP,COM,DL,NRESP,NCE,DM,MINT,
  .DTEMP,NTEMP,LAIMAX,PTMIN,ILAI,KS,WT,KWER,KWT
   REAL TC,TN,TSTR,TSTR1,TSTR2,STRESS
   REAL KWPO1,KWPO2,KWPO3,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5
   INTEGER FLAGL,K,STGCK,RPDATE,CKDATE
   WT = 0.0
   DTEMP=(2*MAXT+PTMIN+3*273.15)/3
   NTEMP=(MAXT+2*MINT+3*273.15)/3
   ILAI=LAI
   IF(KS .LT. 0.3)KS=0.3
   TSTR1 = (2*MAXT + MINT)/3
   IF (TSTR1 .GT. 0. .AND. TSTR1 .LE. 10.) TSTR = TSTR1 * .1
   IF (TSTR1 .GT. 10. .AND. TSTR1 .LE. 25.) TSTR = 1.0
   IF (TSTR1 .GT. 25. .AND. TSTR1 .LE. 35.) TSTR = (35.0-TSTR1)*.15
   IF (TSTR1 .LT. 0. .OR. TSTR1 .GT. 35.) TSTR = 0.0
   IF(TSTR .GT. 1.0) TSTR=1.0
   IF (TSTR.LE.KS) STRESS=TSTR
   IF (TSTR.GT.KS) STRESS=KS
   IF (FLAGL .EQ. 1) GO TO 15
   IF (FLAGL .EQ. 2) GO TO 1
   IF (K .GE. 3 .AND. LAI .LT. PLAI) GO TO 10
   GO TO 15
10 LAIMAX=PLAI
   FLAGL=1
15 GO TO (1,2,3,3,4,4),K
 4 ILAI=ILAI+.3
   IF (TACC .GE. 5.0 .AND. RPDATE .NE. 0) GO TO 20
   IF (TACC .GE. 5.0 .AND. RPDATE .EQ. 0) GO TO 25
   GO TO 3
25 GROSPH=0.0
   DRESP=0.0
   NRESP=0.0
   FLAGL=2
   ILAI=0.0
   GO TO 1
 3 IF (ILAI .GT. 5.0) ILAI=5.0
   IF (SR .GT. 750.0) SR=750.0
   GROSPH = .0875 * 9.07 * SR * .981 * (1-EXP(-.6831*ILAI)) * STRESS
   GO TO 30
20 IF (STGCK .EQ. 1 .AND. RPDATE .NE. CKDATE) GO TO 2
   GROSPH=0.0
   DRESP=0.0
   NRESP=0.0
   FLAGL=2
   ILAI=0.0
   GO TO 1
 2 IF (ILAI .GT. 5.0) ILAI=5.0
   IF (SR .GT. 750.0) SR=750.0
   GROSPH = .0875 * 9.07 * SR * .981 * (1-EXP(-.6831*ILAI)) * STRESS
30 IF (FLAGL .EQ. 1) GO TO 40
```

```
      DRESP=(-.27601-.014775*GROSPH-.002329*CDM*(1+.0035087*DTEMP+
     *        .0001*DTEMP**2))*DL
      NRESP=(24-DL)*(-.27601-.014775*(GROSPH+DRESP)-.002329*CDM
     *        *(1+.003508 *NTEMP+.0001*NTEMP**2))
      GO TO 1
   40 DRESP=(-.27601-.014775*GROSPH-.002329*CDM*(ILAI/LAIMAX)*
     *        (1+.0035087*DTEMP+.0001*DTEMP**2))*DL
      NRESP=(24-DL)*(-.27601-.014775*(GROSPH+DRESP)-.002329*CDM*
     *        (ILAI/LAIMAX)*(1+.0035087*NTEMP+.0001*NTEMP**2))
    1 NCE = GROSPH + DRESP + NRESP
      DM = NCE * .0067
      CDM = CDM + DM
C
C--------> ( KERNEL WEIGHT CALCULATIONS USING DAILY DRY MATTER.     ) <---------
C
      IF (K.GE.5 .AND.DM.GT.0.) GO TO 50
      GO TO 60
   50 KWER = .25
      WT = DM * .4
      IF (DM.LT.KWER) WT = KWER
      WT = WT + KWER
      KWT = KWT + WT
C
      KWPD1 = 6.-6.*EXP(-((DM/CDM)**.35)*CM)
      CUMKW1 = CUMKW1 + KWPD1
C
      KWPD1 = 6.-6.*EXP(-((DM/CDM)**.35)*CM)
      IF(KWPD1 .GT. 2.0)KWPD1=2.0
      IF (KWPD1 .LT. 0.5) KWPD1 = 0.5
      CUMKW2 = CUMKW2 + KWPD1
C
      KWPD1 = 6.-6.*EXP(-((DM/CDM)**.35)*DM)
      IF(KWPD1 .GT. 1.8)KWPD1=1.8
      IF (KWPD1 .LT. 0.5) KWPD1 = 0.5
      CUMKW3 = CUMKW3 + KWPD1
C
      KWPD1 = 6.-6.*EXP(-((DM/CDM)**.35)*DM)
      IF(KWPD1 .GT. 1.5)KWPD1=1.5
      IF (KWPD1 .LT. 0.5) KWPD1 = 0.5
      CUMKW4 = CUMKW4 + KWPD1
C
      KWPD1 = 6.-6.*EXP(-((DM/CDM)**.35)*DM)
      IF(KWPD1 .GT. 1.2)KWPD1=1.2
      IF (KWPD1 .LT. 0.5) KWPD1 = 0.5
      CUMKW5 = CUMKW5 + KWPD1
C
   60 RETURN
      END
      SUBROUTINE CLAI(NPTDAY,YLAI,PDLAI,SLOPE,NX,PTLAI,TACC)
      IF(NPTDAY.GT.130.OR.NX.LT.60)GO TO 34
      YLAI=PDLAI+SLOPE
   34 IF (NX .LT. 60 .OR. NX .GE. 86 .OR. NPTDAY .LE. 86) GO TO 36
   35 YLAI=PDLAI+(PDLAI-.06)/FLOAT(NX-86)
      IF(NPTDAY.LT.130.AND.YLAI.LT.PTLAI)YLAI=PDLAI+SLOPE
   36 IF(TACC.GT.3..AND.PTLAI.NE.0.)YLAI=PDLAI+SLOPE
      SLOPE=(YLAI-PTLAI)/(FLOAT(NX-NPTDAY))
C
C          THE SLOPE TO THE NEXT POINT IS ADJUSTED TO BE BETWEEN -1 TO +1.
C
      IF(SLOPE.GT..1)YLAI=PTLAI-.1*FLOAT(NPTDAY-NX)
```

```
      IF(SLOPE.LT.-.1)YLAI=PTLAI+.1*FLOAT(NPTDAY-NX)
      IF(TACC.GT.4..AND.PTLAI.EQ.0.)YLAI=0.
      RETURN
      END
      SUBROUTINE CLMGN2(MO,JDATE,SOLRAD,MAXTMP,MINTMP,PRECIP,SDIFFX)
      COMMON /W2VAR/      IX              ,CCT(12,2)      ,BETAP(12,2)     ,
     *    CCYT(12,2)    ,PD(12,2)       ,ALPHAP(12,2)   ,
     .    RMAXT(12,2)   ,RMAXY(12,2)    ,RMINT(12,2)    ,SDMAXT(12,2)    ,
     .    SDMAXY(12,2)  ,SDMINT(12,2),
     .    ALPHAR(12,2)  ,BETAR(12,2)    ,CCYT2(12,2)    ,AMNDFR(12,2),
     .    AMXDFR(12,2)  ,
     .    AX            ,BX             ,CX             ,AN              ,
     .    BN            ,CN             ,LAT            ,C
      REAL            NRN(2)    ,LAT, C
      REAL            MAXTMP    ,MINTMP
      S1 = SIN(LAT * .017453)
      C1 = COS(LAT * .017453)
      DEC = .4092 * SIN(.017202 * (JDATE - 82.2))
      RADV = 1.0001 + (.016723 * SIN(.017202 * (JDATE - 94.5)))
      S2 = S1 * SIN(DEC)
      C2 = C1 * COS(DEC)
      HAS = ARCOS(-S2/C2)
      A2 = 106. - LAT
      A1 = (90.93 * (S2 + C2) / (RADV*RADV)) - A2
      AMXRAD = (2. * (A1 * HAS + A2 * SIN(HAS))) / .2618 + C
C
C***********************************************************************
C*                    2.  DETERMINE IF DRY OR WET TODAY.               *
C***********************************************************************
C
      JY = 1
      IF (PRECIP.GE..001) JY=2
      CALL RANDUM(IX,U)
      IF (U.GT.PD(MO,JY)) GO TO 300
      JT = 1
      PRECIP=0.
      GO TO 350
C
C***********************************************************************
C* 3.  GENERATE INCHES OF PRECIPITATION FROM A GAMMA(ALPHA(J),BETA(J)) DISTRI- *
C* BUTION, BY THE METHOD OF JOHNK.  VALUES LESS THAN 0.01 ARE SET EQUAL TO
C* 0.001.  ALL OTHER VALUES ARE ROUNDED TO 2 DECIMAL PLACES.
C***********************************************************************
C
  300 JT = 2
      PRECIP=(AINT(GAMMAC(ALPHAP,BETAP,MO,JT,IX,U)*100.))/100.
      IF (PRECIP .LT. .01) PRECIP = . 001
C
C  THIS GETS A GAMMA VALUE WITH PARAMETERS; ALPHA=P , BETA=1
C  WHICH WILL BE A NUMBER FROM A BETA DISTRIBUTION.
C
  320 G1 = GAMMAC(ALPHAR, 1, MO, JT, IX, U)
C
C  THIS GETS A GAMMA VALUE WITH PARAMETERS; ALPHA=Q, BETA=1
C  WHICH WILL BE A NUMBER FROM A BETA DISTRIBUTION.
C
      G = GAMMAC(BETAR, 1, MO, JT, IX, U)
      SDIFFB=(G1*(AMXDFR(MO,JT)-AMNDFR(MO,JT))/(G1+G)) + AMNDFR(MO,JT)
     .       - 3.0
      SOLRAD = (AINT((AMXRAD-SDIFFB)*10))/10.
```

```
      IF (SOLRAD .LE. 0.0) GO TC 320
      GO TC 400
  350 SDIFFR=AINT((GAMMAD(ALPHAR,BETAR,MO,JT,IX,U)+AMNOFR(MO,JT))*10.)
     .          / 10. - 3.0
      SOLRAD = (AINT((AMXRAD-SDIFFR)*10))/10.
      IF (SOLRAD .LE. 0.0) GO TC 350
C
C*****************************************************************************
C* 4.  GENERATE TODAY'S MAX TEMP FROM A FORMULA RELATING IT TO YESTERDAY'S MAX.*
C* THERE ARE TWO SETS OF FORMULAS, DEPENDING ON WHETHER IT IS DRY CR WET TODAY.*
C*****************************************************************************
C
  400 DO 402 J=1,2
      A=0.
         DO 401 K=1,12
         CALL RANDUM(IX,U)
  401    A=A+U
  402 NRN(J)=A-6.
      IF (CCYT2(MO,JT) .GT. CCYT(MO,JT)) GO TC 403
      SDIFFX=RMAXT(MO,JT)+(CCYT(MO,JT)*SDMAXT(MC,JT)/SDMAXY(MO,JT))*
     *     (SDIFFX-RMAXY(MO,JT))+SDMAXT(MO,JT)*(SQRT(1.-CCYT(MO,JT)**2.
     .     )) * NRN(1)
C
C*****************************************************************************
C*         5.  GENERATE MIN TEMP TODAY, BASED CN TODAY'S GENERATED MAX.       *
C*****************************************************************************
C
      SDIFFN=RMINT(MO,JT)+(CCT(MO,JT)*SDMINT(MC,JT)/SDMAXT(MO,JT))*
     *     (SDIFFX-RMAXT(MO,JT))+SDMINT(MO,JT)*(SQRT(1.-CCT(MO,JT)**2.))*
     *     NRN(2)
      GO TC 404
  403 SDIFFN = RMINT(MC,JT)+CCYT2(MO,JT)*SDMINT(MO,JT)*(SDIFFX-
     .RMAXY(MO,JT))/SDMAXY(MO,JT)+SDMINT(MC,JT)*SQRT(1-CCYT2(MO,JT)**2)
     .        * NRN(1)
      SDIFFX=RMAXT(MO,JT)+CCT(MC,JT)*SDMAXT(MO,JT)*(SDIFFN-RMINT(MC,JT)
     .       )/SDMINT(MO,JT)+SDMAXT(MO,JT)*SQRT(1-CCT(MO,JT)**2)*NRN(2)
  404 AMXMXT = SIN((JDATE-AX)*.017214)*BX+CX
      AMXMNT = SIN((JDATE-AN)*.017214)*BN+CN
      MAXTMP = (AINT((AMXMXT-SDIFFX)*10.))/10.
      MINTMP = (AINT((AMXMNT-SDIFFN)*10.))/10.
C
C  THERE'S A SLIGHT CHANCE THAT GENERATED MIN TEMP WILL BE GREATER THAN MAX
C  TEMP.  IF SO, SET MIN EQUAL TO MAX.
C
      IF (MINTMP.GT.MAXTMP) MINTMP=MAXTMP
      RETURN
      END
      SUBROUTINE CYIELD(NCARAY,SCLX,HOCHK,SPDATE,OBHOWT,YDARAY,CAL,
     $         SYR,SMO,SDAY,NGSMPL,TSUM2,HSTA,TSUM1,HSTX25,CUMDM,
     .KWT,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5,NCSUM)
      INTEGER RPDATE
      INTEGER        HOCHK     ,SCLX(6)   ,SYR(6)    ,SMO(6)    ,
     *    SDAY(6)   ,HODATE    ,SCDATE    ,JHCDT     ,SPDATE(9),
     *    SPYR      ,SPMO      ,SPDY      ,DYSPMO    ,DYSPSD    ,
     *    CAL(12)   ,NGSMPL    ,DYJTHO    ,CYHORP
      REAL           NCARAY(7),NCEEM     ,NCEJT     ,NCEFAC    ,NCETOT    ,
     *    NCEBT     ,NCEHO     ,NCJTBT    ,NCJHPO    ,NCEMHO    ,FKNO      ,
     *    NCESD     ,NCERP     ,NCHORP    ,KNO       ,KW        ,FKW       ,
     *    NCJHO     ,OBHOWT(9),HEADWT    ,NCEHPO    ,YCARAY(50),PKNO,KWT
      REAL           PSI       ,R         ,HORATE    ,KNO3      ,HSTX25
```

```
      REAL          SCH      ,SCL      ,TSUM2    ,HSTN     ,KNCEHD,
     1    TSUM1    ,SC       ,XX       ,PGRK     ,CGRK     ,
     *MCDEL(34)/'  M1','M5-9','M6-3','P1.0','P1.1','M8',
     *'M9','M9-A','M9-B','M9-C','M9-D','M9-E','M9-F','M9-G','M9-H',
     .'M9-I','M9-J','M9-K',
     .'M9-L','M9-M','M9-N','M9-C','M9-P','M9-Q','M9-R',
     .'M9-S','M9-T','M9-U','M9-V','M9-W','M9-X','M9-Y','M9-Z','M9ZZ'/
      REAL KWPO1,KWPO2,KWPO3,CUMKW1,CUMKW2,CUMKW3,CUMKW4,CUMKW5
      REAL NCSUM(9)
      HDDATE=10000*SYR(4) + 100*SMO(4) + SDAY(4)
      SDDATE=10000*SYR(5) + 100*SMO(5) + SDAY(5)
      RPDATE=10000*SYR(6)+100*SMO(6)+SDAY(6)
      IF (SDDATE.EQ.00) SDDATE=(10000*SYR(4))+(100*SMO(4))+SDAY(4)+21
      IF(RPDATE.EQ.0) RPDATE=10000*SYR(4)+100*SMO(4)+SDAY(4)+30
C
C-------> (             YIELD M1                         ) <---------
C
C
C-------> (             CONVERT TO G/M**2                ) <---------
C
      NCEEM = NCARAY(2) * .067
      NCEJT = NCARAY(3) * .067
      NCEBT = NCARAY(4) * .067
      NCEHD = NCARAY(5) * .067
      NCESD = NCARAY(6) * .067
      NCERP = NCARAY(7) * .067
      NCJTBT = NCEJT + NCEBT
      NCJHPD = NCJTBT / (SCLK(3) + SCLK(4))
      NCEMHD = NCEEM + NCEJT + NCEBT
      NCEFAC = (NCEMHD / NCEBT) * .048
      IF (NCEFAC .LT. .19) NCEFAC = .19
      IF (NCEFAC .GT. .29) NCEFAC = .29
      NCEHPD = NCEHD / SCLK(5)
      IF (NCEHPD .GT. 10.0) NCEHPD = 10.0
      NCEHD = NCEHPD * SCLK(5)
      NCJHD = NCJHPD * NCEFAC
      WRITE (6,908)
  908 FORMAT ('-',50X,'(JT-HD)',11X,'(HD-SD)',7X,'NCE        DRY',
     1 '     SAMPLE',/,' ',
     2 3(5X,'YIELD'),4X,'HEADWT',12X,'NCE',15X,'NCE',8X,
     3 'FACTOR  HEAD WT.    DATE',6X,'PSI',/,3X,
     4 ' (BU/ACRE)   (KG/HA)    ',31('-'),'(G/M**2)',18('-'),9X,
     5 'G/M**2',/,43X,'*  TOTAL    DAILY    *   TOTAL    DAILY  *',/,'+',
     6 3X,112('_'),/)
C
C-------> (          CALCULATIONS OF YIELDS M1 - M1.4          ) <---------
C
      DO 500 I=1,NOSMPL
      IF (I .EQ. 1) GO TO 470
      IF (HDCHK .EQ. 0 .OR. SPDATE(I) .EQ. 0) GO TO 501
      IF (SPDATE(I) .GT. HDDATE) GO TO 460
C
C-------> (          HEADWT WAS OBSERVED BEFORE HEADING STAGE      ) <---------
C
      CALL JULIAN(CAL,SYR(4),SMO(4),SDAY(4),JHDOT)
C
      SPYR = SPDATE(I) / 10000
      SPMO = (SPDATE(I) - (SPYR*10000)) / 100
      SPDY = SPDATE(I) - ((SPYR*10000) + (SPMO*100))
C
```

```
      CALL JULIAN(CAL,SPYR,SPMC,SPDY,JSPDT)
C
      DYSPHD = JHDDT - JSPDT
      HEADWT = OBHDWT(I) + (DYSPHD*NCJHD) + NCEHD
      GC TC 480
  460 IF (SPDATE(I) .GT. SDDATE) GO TO 470
C
C--------> (    HEADWT OBSERVED BETWEEN HEADING AND SOFT DOUGH         ) <---------
C
      CALL JULIAN(CAL,SYR(5),SMO(5),SDAY(5),JSDDT)
C
      SPYR = SPDATE(I) / 10000
      SPMC = (SPDATE(I) - SPYR*10000) / 100
      SPDY = SPDATE(I) - (SPYR*10000 + SPMC*100)
C
      CALL JULIAN(CAL,SPYR,SPMC,SPDY,JSPDT)
C
      DYSPSD = JSDDT - JSPDT
      HEADWT = OBHDWT(I) + DYSPSD * NCEHPD
      GC TO 480
  470 HEADWT = NCEFAC * NCJTBT + NCEHD
  480 YIELD = .75 * HEADWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(I+4) = YIELD3
      II=I-1
  500 WRITE (6,917) YIELD3,YIELD2,YIELD,HEADWT,NCJTBT,NCJHD,NCEHD,
     * NCEHPD,NCEFAC,OBHDWT(I),SPDATE(I),MODEL(I),II
  501 CONTINUE
C
C--------> (                    YIELD M5-9                              ) <---------
C
C
C--------> (                  CONVERT TO G/M**2                         ) <---------
C
      NCEEM = NCARAY(2) * .067
      NCEJT = NCARAY(3) * .067
      NCEBT = NCARAY(4) * .067
      NCEHD = NCARAY(5) * .067
      NCESD = NCARAY(6) * .067
      NCERP = NCARAY(7) * .067
      NCJTBT = NCEJT + NCEBT
      NCJHPD = NCJTBT / (SCLK(3) + SCLK(4))
      NCEMHD = NCEEM + NCEJT + NCEBT
      NCEFAC = .20
      NCJHD = (NCJTBT / (SCLK(3) + SCLK(4))) * .20
      NCEHPD = NCEHD / SCLK(5)
      IF (NCEHPD .GE. 9.) NCEHPD = 9.
      DO 100 I=1,NOSMPL
        IF (I .EQ. 1) GO TC 170
        IF (HDCHK .EQ. 0 .OR. SPDATE(I) .EC. 0) GO TO 101
        IF (SPDATE(I) .GT. HDDATE) GO TC 160
C
C--------> (           HEADWT OBSERVED BEFORE HEADING STAGE            ) <---------
C
C
        CALL JULIAN(CAL,SYR(4),SMO(4),SDAY(4),JHDDT)
C
        SPYR = SPDATE(I) / 10000
        SPMO = (SPDATE(I) - SPYR*10000) / 100
```

```
      SPDY = SPDATE(I) - (SPYR*10000 + SPMO*100)
C
      CALL JULIAN(CAL,SPYR,SPMO,SPDY,JSPDT)
C
      DYSPHO = JHDDT - JSPDT
      HEADWT = OBHDWT(I) + DYSPHO*NCJHD + NCEHPD*SCLK(5)
      GO TO 180
  160 IF (SPDATE(I) .GT. SDDATE) GO TO 100
C
C-------->  (      HEADWT OBSERVED BETWEEN HEADING AND SOFT DOUGH        ) <---------
C
      CALL JULIAN(CAL,SYR(5),SMO(5),SDAY(5),JSDDT)
C
      SPYR = SPDATE(I) / 10000
      SPMO = (SPDATE(I) - SPYR*10000) / 100
      SPDY = SPDATE(I) - (SPYR*10000 + SPMO*100)
C
      CALL JULIAN(CAL,SPYR,SPMO,SPDY,JSPDT)
      DYSPSD = JSDDT - JSPDT
      HEADWT = OBHDWT(I) + DYSPSD*NCEHPD
      GO TO 180
  170 HEADWT = .20*NCJTBT + NCEHPD*SCLK(5)
  180 YIELD  = .75 * HEADWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(I+9) = YIELD3
      II = I - 1
      WRITE (6,917) YIELD3,YIELD2,YIELD,HEADWT,NCJTBT,NCJHD,NCEHD,
     *      NCEHPD,NCEFAC,OBHDWT(I),SPDATE(I),MODEL(2),II
  100 CONTINUE
C
C-------->  (                    YIELD M6-3                              ) <---------
C
C
C-------->  (                    CONVERT TO G/M**2                       ) <---------
C
  101 NCEEM = NCARAY(2) * .067
      NCEJT = NCARAY(3) * .067
      NCEBT = NCARAY(4) * .067
      NCEHD = NCARAY(5) * .067
      NCESD = NCARAY(6) * .067
      NCERP = NCARAY(7) * .067
      NCJTBT = NCEJT + NCEBT
      NCJHPD = NCJTBT / (SCLK(3) + SCLK(4))
      NCEMHD = NCEEM + NCEJT + NCEBT
      NCEFAC = .15
      NCEHPD = NCEHD / SCLK(5)
      NCJHD = (NCJTBT / (SCLK(3) + SCLK(4))) * .15
      R = NCEHPD / NCJHD
      PSI = .8
      IF (R .LT. 3.) PSI = 1.
      HDRATE = PSI * NCEHPD
      IF (HDRATE .GT. 15.) HDRATE = 15.
      DO 300 I=1,NOSMPL
        IF (I .EQ. 1) GO TO 270
        IF (HDCHK .EQ. 0 .OR. SPDATE(I) .EQ. 0) GO TO 301
        IF (SPDATE(I) .GT. HDDATE) GO TO 260
C
C-------->  (          HEADWT OBSERVED BEFORE HEADING STAGE              ) <---------
C
```

```
      CALL JULIAN(CAL,SYR(4),SMO(4),SDAY(4),JHDOT)
C
      SPYR = SPDATE(I) / 10000
      SPMO = (SPDATE(I) - SPYR*10000) / 100
      SPDY = SPDATE(I) - (SPYR*10000 + SPMO*100)
C
      CALL JULIAN(CAL,SPYR,SPMO,SPDY,JSPDT)
C
      DYSPHD = JHDOT - JSPDT
      HEADWT = OBHDWT(I) + DYSPHD*NCJHD + HDRATE*SCLK(5)
      GO TO 280
  260 IF (SPDATE(I) .GT. SDDATE) GO TO 300
C
C--------> (     HEADWT OBSERVED BETWEEN HEADING AND SOFT DOUGH      ) <---------
C
      CALL JULIAN(CAL,SYR(5),SMO(5),SDAY(5),JSDDT)
C
      SPYR = SPDATE(I) / 10000
      SPMO = (SPDATE(I) - SPYR*10000) / 100
      SPDY = SPDATE(I) - (SPYR*10000 + SPMO*100)
C
      CALL JULIAN(CAL,SPYR,SPMO,SPDY,JSPDT)
C
      DYSPSD = JSDDT - JSPDT
      HEADWT = OBHDWT(I) + DYSPSD*HDRATE
      GO TO 280
  270 HEADWT = .15*NCJTBT + HDRATE*SCLK(5)
  280 YIELD = .75 * HEADWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(I+14) = YIELD3
      II=I-1
      WRITE (6,922) YIELD3,YIELD2,YIELD,HEADWT,NCJTBT,NCJHD,NCEHD,
     *       NCEHPD,NCEFAC,OBHDWT(I),SPDATE(I),PSI,MODEL(3),II
  300 CONTINUE
  301 CONTINUE
  917 FORMAT (' ',4F10.2,2X,2F8.2,4X,2F8.2,F9.4,F9.2,I10,11X,A4,'.',I1)
  922 FORMAT (' ',4F10.2,2X,2F8.2,4X,2F8.2,F9.4,F9.2,I10,4X,F3.1,4X,A4,
     *    '.',I1)
C
C--------> (          PARTITIONING MODELS FOR HEAD WEIGHT.          ) <---------
C
      CMOM = CUMOM * 10.
C--------> (                    YIELD P1.0                          ) <---------
C--------> (          PM 1.0  HEAD WEIGHT = B * TOP WEIGHT           ) <---------
C
      ROOTWT = CMOM * .2
      TOPWT = CMOM - ROOTWT
      HEADWT = 0.4179879 * TOPWT
      YIELD  = .75 * HEADWT
      YIELD = YIELD * .85
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * 0.1653
      YDARAY(20) = YIELD3
      WRITE (6,930) YIELD3, YIELD2, YIELD, HEADWT, MODEL(4)
C
C--------> (                    YIELD P1.1                          ) <---------
C--------> (          PM 1.1 HEAD WEIGHT = A + B * TOP WEIGHT        ) <---------
C
      ROOTWT = CMOM * .2
```

```
      TOPWT = CHOM - ROOTWT
      HEADWT = 96.757975 + 0.3201573 * TOPWT
      YIELD  = .75 * HEADWT
      YIELD = YIELD * .85
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(21) = YIELD3
      WRITE (6,930) YIELD3, YIELD2, YIELD, HEADWT, MODEL(5)
  930 FORMAT (' ',4F10.2,T119,A4)
      IF(NOSMPL.LE.1) GO TO 932
C
C ---> ( HEADWT FEEDBACK MODELS ) <----
C
      NSMPL=NOSMPL+1
      DO 600 I=2,NSMPL
      IF(SPDATE(I).GE.RPDATE) GO TO 932
        HDWT=OBHDWT(I)+NCSUM(I)*.067
        YIELD=HDWT*.75
        YIELD2=YIELD*10.00014
        YIELD3=YIELD*.1653
      YDARAY(40+I)=YIELD3
        J=I-1
        WRITE(6,931) YIELD3,YIELD2,YIELD,HDWT,OBHDWT(I),SPDATE(I),J
 600  CONTINUE
 931  FORMAT(' ',4F10.2,T89,F9.2,I10,T119,'HDWT FDBK.',I1)
C
C--------> (                  CALCULATION OF YIELD M8                   ) <---------
C
 932  NCEEM = NCARAY(2) * .067
      NCEJT = NCARAY(3) * .067
      NCEBT = NCARAY(4) * .067
      NCEHD = NCARAY(5) * .067
      NCESD = NCARAY(6) * .067
      NCERP = NCARAY(7) * .067
      NCEMHD = NCEEM + NCEJT + NCEBT
      NCHDRP = NCEHD + NCESD + NCERP
      WRITE (6,929)
  929 FORMAT(/,'-',72X,'(EM-HD)     (HD-RP)',/,' ',18X,3(6X,'YIELD'),
     1      5X,'KNO',6X,'KW',7X,'NCE',8X,'NCE',6X,'SCH',6X,'SCL',/,
     2      ' ',22X,'(BU/ACRE)     (KG/HA)     G/(M**2)',12X,'(G)',5X,
     3      '-----G/(M**2)-----',/,'+',21X,92('_'),/)
C
C--------> (                  KERNEL NUMBER CALCULATIONS                 ) <---------
C
      KNO = 16.6 * (NCEMHD + NCEHD)
      SCH = 1 - (.5 * TSUM1) / TSUM2
          IF (SCH .LT. .5) SCH = .5
          IF (SCH .GT. 1.) SCH = 1.
      SCL = 1 + (.2 * HSTN)
          IF (SCL .LT. .2) SCL = .2
          IF (SCL .GT. 1.) SCL = 1.
      SC = SCH * SCL
      FKNO = SC * KNO
      KW = NCHDRP / FKNO
      FKW = KW * (1 - (HSTX25 / SCLK(5)) * .1)
          IF (FKW .LT. .013) FKW = .013
          IF (FKW .GT. .060) FKW = .060
      YIELD = FKNO * FKW
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
```

```
      YDARAY(22) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,FKNO,FKW,NCEMHD,NCHORP,SCH,SCL,
     *                MODEL(6)
C
C--------> (                 CALCULATION OF YIELD M9                 )<----------
C
      YIELD = NCHORP * .8
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(23) = YIELD3
      KNO = 0.
      KW = 0.
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,KW,NCEMHD,NCHORP,SCH,SCL,
     *                MODEL(7)
C
C--------> ( CONVERSION OF KERNEL WEIGHT FROM MILLIGRAMS TO GRAMS, ) <----------
C--------> ( AND CHECK FOR MINIMUM AND MAXIMUM KERNEL WEIGHT.      ) <----------
C
      KWT = KWT * .001
      IF (KWT .LT. .020) KWT = .020
      IF (KWT .GT. .060) KWT = .060
C
      CUMKW1 = CUMKW1 * .001
C
      CUMKW2 = CUMKW2 * .001
      IF (CUMKW2 .LT. .020) CUMKW2 = .020
      IF (CUMKW2 .GT. .060) CUMKW2 = .060
C
      CUMKW3 = CUMKW3 * .001
      IF (CUMKW3 .LT. .020) CUMKW3 = .020
      IF (CUMKW3 .GT. .060) CUMKW3 = .060
C
      CUMKW4 = CUMKW4 * .001
      IF (CUMKW4 .LT. .020) CUMKW4 = .020
      IF (CUMKW4 .GT. .060) CUMKW4 = .060
C
      CUMKW5 = CUMKW5 * .001
      IF (CUMKW5 .LT. .020) CUMKW5 = .020
      IF (CUMKW5 .GT. .060) CUMKW5 = .060
C
C
C--------> (                        MODEL M9-A                       )<----------
C
      NCETOT = NCEMHD + NCHORP
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * KWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(24) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,KWT,NCEMHD,NCHORP,SCH,SCL,
     *                MODEL(8)
C
C--------> (                        MODEL M9-B                       )<----------
C
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * CUMKW1
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
```

```
      YCARAY(25) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,CUMKW1,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(9)
C
C-------> (                    MODEL M9-C                    ) <---------
C
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * CUMKW2
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(26) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,CUMKW2,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(10)
C
C-------> (                    MODEL M9-D                    ) <---------
C
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * CUMKW3
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(27) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,CUMKW3,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(11)
C
C--------> (            CALCULATION OF YIELD M9-E           ) <---------
C
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * CUMKW4
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(28) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,CUMKW4,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(12)
C
C--------> (            CALCULATION OF YIELD M9-F           ) <---------
C
      PKNO = (NCETOT * 12.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * CUMKW5
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(29) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,CUMKW5,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(13)
C
C--------> (            CALCULATION OF YIELD M9-G           ) <---------
C
      PKNO = (NCETOT * 9.5) + 3000
      KNO = PKNO * SC
      YIELD = KNO * KWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(30) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,KNO,KWT,NCEMHD,NCHORP,SCH,SCL,
     .               MODEL(14)
C
C--------> (            CALCULATION OF YIELD M9-H           ) <---------
```

```
C
      PKNC = (NCETOT * 9.5) + 3000
      KNO = PKNO * SC
      YIELC = KNO * CUMKW1
      YIELC2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YOARAY(31) = YIELC3
      WRITE (6,925) YIELC3,YIELC2,YIELD,KNC,CUMKW1,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(15)
C
C--------> (                     MODEL 9-I                       ) <---------
C
      PKNC = (NCETOT * 9.5) + 3000
      PKNC = PKNC * SC
      YIELC = PKNO * CUMKW2
      YIELC2 = YIELC * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(32) = YIELD3
      WRITE (6,925) YIELC3,YIELC2,YIELD,PKNC,CUMKW2,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(16)
C
C--------> (                     MODEL 9-J                       ) <---------
C
      PKNC = (NCETOT * 9.5) + 3000
      PKNC = PKNC * SC
      YIELC = PKNO * CUMKW3
      YIELC2 = YIELC * 10.00014
      YIELC3 = YIELD * .1653
      YOARAY(33) = YIELC3
      WRITE (6,925) YIELD3,YIELC2,YIELD,PKNC,CUMKW3,NCEMHD,NCHORP,SCH,
     .               SCL,MODEL(17)
C
C--------> (                     MODEL 9-K                       ) <---------
C
      PKNC = (NCETOT * 9.5) + 3000
      PKNO = PKNO * SC
      YIELO = PKNO * CUMKW4
      YIELO2 = YIELD * 10.00014
      YIELC3 = YIELC * .1653
      YOARAY(34) = YIELD3
      WRITE (6,925) YIELD3,YIELC2,YIELD,PKNO,CUMKW4,NCEMHD,NCHORP,SCH,
     .               SCL,MODEL(18)
C
C--------> (               CALCULATION OF YIELD M9-L                 ) <---------
C
      PKNO = (NCETOT * 9.5) + 3000
      PKNC = PKNO * SC
      YIELD = PKNO * CUMKW5
      YIELC2 = YIELD * 10.00014
      YIELC3 = YIELC * .1653
      YCARAY(35) = YIELD3
      WRITE (6,925) YIELD3,YIELC2,YIELD,PKNO,CUMKW5,NCEMHD,NCHORP,SCH,
     .               SCL,MODEL(19)
C
C--------> (               CALCULATION OF YIELD M9-M                 ) <---------
C
      PKNC = (NCETOT * 7.5) + 3000
      PKNC = PKNO * SC
      YIELC = PKNO * KWT
      YIELC2 = YIELC * 10.00014
```

```
      YIELD3 = YIELD * .1653
      YDARAY(36) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,KWT,NCEMHD,NCHORP,SCH,
     C              SCL,MODEL(20)
C
C--------> (                CALCULATION OF YIELD M9-N              ) <---------
C
      PKNO = (NCETOT * 7.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW1
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(37) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW1,NCEMHD,NCHORP,SCH,
     .              SCL,MODEL(21)
C
C--------> (                CALCULATION OF YIELD M9-O              ) <---------
C
      PKNO = (NCETOT * 7.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW2
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(38) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW2,NCEMHD,NCHORP,SCH,
     .              SCL,MODEL(22)
C
C--------> (                CALCULATION OF YIELD M9-P              ) <---------
C
      PKNO = (NCETOT * 7.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW3
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(39) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW3,NCEMHD,NCHORP,SCH,
     .              SCL,MODEL(23)
C
C--------> (                CALCULATION OF YIELD M9-C              ) <---------
C
      PKNO = (NCETOT * 7.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW4
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(40) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW4,NCEMHD,NCHORP,SCH,
     .              SCL,MODEL(24)
C
C--------> (                CALCULATION OF YIELD M9-R              ) <---------
C
      PKNO = (NCETOT * 7.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW5
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(41) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW5,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(25)
C
```

```
C--------> (               CALCULATION OF YIELD M9-S              ) <---------
C
      KNCEHD = NCEMHD + NCEHD
      PKNO = (KNCEHD * 16.5) + 3000
      PKNC = PKNO * SC
      YIELD = PKNO * KWT
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNC,KWT,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(26)
C
C--------> (               CALCULATION OF YIELD M9-T              ) <---------
C
      PKNC = (KNCEHD * 16.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNC * CUMKW1
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW1,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(27)
C
C--------> (               CALCULATION OF YIELD M9-U              ) <---------
C
      PKNO = (KNCEHD * 16.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW2
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(44) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNC,CUMKW2,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(28)
C
C--------> (               CALCULATION OF YIELD M9-V              ) <---------
C
      PKNO = (KNCEHD * 16.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW3
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(45) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW3,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(29)
C
C--------> (               CALCULATION OF YIELD M9-W              ) <---------
C
      PKNO = (KNCEHD * 16.5) + 3000
      PKNC = PKNO * SC
      YIELD = PKNO * CUMKW4
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YDARAY(46) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,PKNO,CUMKW4,NCEMHD,NCHORP,SCH,
     .SCL,MODEL(30)
C
C--------> (               CALCULATION OF YIELD M9-X              ) <---------
C
      PKNC = (KNCEHD * 16.5) + 3000
      PKNO = PKNO * SC
      YIELD = PKNO * CUMKW5
      YIELD2 = YIELD * 10.00014
```

```
      YIELD3 = YIELD * .1653
      YDARAY(47) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,FKNO,CUMKW5,NCEMHO,NCHORP,SCH,
     .SCL,MODEL(31)
C
C--------> (                CALCULATION OF YIELD M9-Y              ) <---------
C
      YIELD = FKNO * CUMKW1
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(48) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,FKNO,CUMKW1,NCEMHO,NCHORP,SCH,
     .SCL,MODEL(32)
C
C--------> (                CALCULATION OF YIELD M9-Z              ) <---------
C
      YIELD = FKNO * CUMKW2
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(49) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,FKNO,CUMKW2,NCEMHO,NCHORP,SCH,
     .SCL,MODEL(33)
C
C--------> (                CALCULATION OF YIELD M9-ZZ             ) <---------
C
      YIELD = FKNO * CUMKW4
      YIELD2 = YIELD * 10.00014
      YIELD3 = YIELD * .1653
      YCARAY(50) = YIELD3
      WRITE (6,925) YIELD3,YIELD2,YIELD,FKNO,CUMKW4,NCEMHO,NCHORP,SCH,
     .SCL,MODEL(34)
  925 FORMAT (' ',23X,F6.2,F12.2,F10.2,F10.1,F9.4,F12.4,F8.1,2F9.4,4X,
     *       A4)
C
C--------> ( CONVERSION OF KERNEL WEIGHT FROM GRAMS TO MILLIGRAMS.  ) <---------
C
      KWT = KWT * 1000.
      CUMKW1 = CUMKW1 * 1000.
      CUMKW2 = CUMKW2 * 1000.
      CUMKW3 = CUMKW3 * 1000.
      CUMKW4 = CUMKW4 * 1000.
      CUMKW5 = CUMKW5 * 1000.
C
      RETURN
      END
GZ
```

APPENDIX E

SAMPLE OUTPUT FOR A WINTER WHEAT TEST FIELD FROM VERNON, TEXAS (1979-80)

```
MODEL SYS.PHOTO-81.2      1979-80 TAM101  PLANTED 10/24/79  VERNON, TEXAS - VERN #1

MAXIMUM AVAILABLE WATER (MM)....................  240.0000
THETA SUB V (15 BAR)............................    0.1600
THETA INITIAL IN 5 FT. PROFILE (MM).............  414.0000
THETA SUB 5 CM. LAYER...........................    0.2000
U (MM)..........................................   10.0000
ALPHA (P-T).....................................    1.3500
FALLRT..........................................    0.3500
SOIL CONSTANT (MM DAY TO -1/2)..................    3.5000
X SUB 5 (INIT.WATER CONTENT IN 5 CM. LAYER,WT..     0.1700
FIELD CAPACITY..................................  435.0000
BMTS MULTIPLIER.................................    1.4000
THE INITIAL LAYER VALUES USED ARE ............., 0.26, 0.26, 0.29, 0.29, 0.27
THE MAXIMUM LAYER VALUES USED ARE.............., 0.29, 0.29, 0.31, 0.32, 0.32
THE MINIMUM LAYER VALUES USED ARE ............., 0.15, 0.15, 0.15, 0.14, 0.16
THE LATITUDE USED ............................ 34.  5.
THE INPUT FORMAT USED .........(F6.1,2F6.2,3F5.2)

                                   LAI

                             35 . . . 0.23
                             64 . . . 0.26
                             78 . . . 0.43
                             93 . . . 0.67
                            105 . . . 1.27
                            120 . . . 1.43
                            135 . . . 0.63
```

SOIL MOISTURE

791030	. . .	0.26	0.26	0.29	0.29	0.27
791210	. . .	0.28	0.28	0.28	0.29	0.27
800304	. . .	0.28	0.28	0.26	0.27	0.24
800402	. . .	0.25	0.25	0.30	0.30	0.27
800429	. . .	0.14	0.14	0.20	0.20	0.23

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC	DAY RESP	NIGHT RESP (MG/(DM**2)/DAY))	TOT. TSTR	NCE	DM/TR	TVP (MM/MB)	CUM DM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
10	24	392.	23.	3.	0.0	0.0	0.0	2.50	1.45	605.	0.0	0.0	0.0	1.0	C.C	C.0	C.0	0.0	0.0	412.6	1.00	0.79
10	25	431.	26.	4.	0.0	0.0	0.0	3.22	1.11	665.	0.0	0.0	0.0	1.0	0.0	0.0	C.0	0.0	0.13	411.4	1.00	0.75
10	26	438.	32.	7.	0.0	0.0	0.0	3.67	0.94	677.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.25	410.5	1.00	0.72
10	27	423.	19.	8.	0.0	0.0	0.0	2.87	0.83	654.	0.0	0.0	0.0	1.0	0.0	0.0	C.0	0.0	0.38	409.7	1.00	0.70
10	28	416.	20.	2.	0.0	0.0	0.0	2.74	0.75	643.	0.0	0.0	0.0	1.0	0.0	0.0	C.0	0.0	0.50	408.9	1.00	0.68
10	29	408.	23.	6.	15.0	0.0	0.0	2.80	2.07	631.	0.0	0.0	0.0	1.0	C.C	C.0	C.C	C.0	0.63	421.9	1.00	0.66
10	30	69.	7.	0.	13.7	0.0	0.0	0.0	0.0	107.	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.75	427.7	1.00	0.79
1C	31	324.	13.	5.	0.0	0.0	0.0	1.27	0.94	500.	0.0	0.0	0.0	1.0	0.C	0.0	0.0	C.0	0.88	426.8	1.00	1.11
TCT.		2901.			29.		0.	19.	8.	4481.	0.	0.	0.		0.	0.	0.0					

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MC	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC	DAY RESP	NIGHT RESP (MG/(DM**2)/DAY))	TOT. TSTR	NCE	DM/IR	IVP (MM/MB)	CUM DM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
11	1	228.	12.	-0.	0.0	0.00	0.00	0.07	0.05	353.	0.0	-2.9	-3.1	0.8	-6.0	*****	0.000	-0.0	1.00	426.7	1.00	1.09
11	2	245.	13.	1.	0.0	0.00	0.00	0.28	0.21	383.	0.1	-2.9	-3.1	0.9	-6.0	-175.8	0.000	-0.1	1.01	426.5	1.00	0.98
11	3	393.	18.	1.	0.0	0.00	0.00	2.31	1.71	624.	0.5	-3.0	-3.2	1.0	-5.[illegible]	-9.0	0.000	-0.1	1.02	424.8	1.00	0.97
11	4	309.	21.	6.	0.0	0.00	0.00	1.27	0.94	502.	0.7	-3.0	-3.2	1.0	-5.5	-6.3	0.000	-0.2	1.03	423.8	1.00	0.93
11	5	369.	18.	7.	0.0	0.01	0.01	2.05	1.52	612.	1.2	-3.1	-3.3	1.0	-5.2	-3.3	0.001	-0.2	1.04	422.3	1.00	0.91
11	6	367.	12.	2.	0.0	0.01	0.01	1.76	1.31	617.	1.2	-3.0	-3.3	0.8	-5.2	-3.2	0.002	-0.2	1.05	421.0	1.00	0.87
11	7	122.	10.	3.	0.0	0.01	0.0	0.0	0.0	207.	0.4	-2.9	-3.2	0.7	-5.7	0.0	0.0	-0.3	1.06	421.0	1.00	0.84
11	8	270.	22.	6.	0.0	0.01	0.01	0.70	0.52	468.	1.5	-3.1	-3.3	1.0	-4.9	-5.2	0.000	-0.3	1.07	420.5	1.00	0.84
11	9	74.	12.	2.	0.0	0.01	0.0	0.0	0.0	131.	0.4	-2.9	-3.2	0.8	-5.6	0.0	0.0	-0.3	1.08	420.5	1.00	0.83
11	10	118.	5.	-0.	0.0	0.01	0.0	0.0	0.0	208.	0.2	-2.8	-3.1	0.3	-5.7	0.0	0.0	-0.4	1.09	420.5	1.00	0.83
11	11	310.	11.	-3.	0.0	0.01	0.01	1.01	0.76	546.	1.3	-3.0	-3.3	0.7	-5.0	-3.1	0.001	-0.4	1.10	419.7	1.00	0.83
11	12	311.	12.	2.	3.0	0.01	0.01	1.09	0.81	555.	2.0	-3.1	-3.4	0.9	-4.5	-2.4	0.002	-0.4	1.11	421.9	1.00	0.81
11	13	351.	15.	-2.	0.0	0.01	0.02	1.63	1.21	631.	2.5	-3.1	-3.5	0.9	-4.1	-1.4	0.002	-0.5	1.12	420.7	1.00	0.86
11	14	334.	18.	1.	0.0	0.02	0.02	1.50	0.68	608.	2.8	-3.2	-3.6	1.0	-3.9	-1.3	0.001	-0.5	1.14	420.0	1.00	0.83
11	15	352.	20.	0.	0.0	0.02	0.03	1.80	1.48	650.	3.4	-3.2	-3.7	1.0	-3.5	-0.9	0.002	-0.5	1.15	418.6	1.00	0.82
11	16	329.	22.	1.	0.0	0.02	0.03	1.54	1.14	618.	3.5	-3.2	-3.7	1.0	-3.4	-0.9	0.001	-0.5	1.16	417.4	1.00	0.78
11	17	307.	22.	6.	0.0	0.02	0.02	1.25	0.96	589.	3.7	-3.3	-3.7	1.0	-3.2	-0.9	0.001	-0.6	1.17	416.5	1.00	0.76
11	18	311.	26.	13.	0.3	0.03	0.03	1.43	0.86	612.	4.4	-3.3	-3.8	1.0	-2.7	-0.6	0.002	-0.6	1.18	415.9	1.00	0.73
11	19	320.	25.	10.	0.0	0.03	0.04	1.54	0.79	645.	5.2	-3.4	-4.0	1.0	-2.2	-0.4	0.002	-0.6	1.19	415.1	1.00	0.72
11	20	49.	23.	15.	45.2	0.03	0.0	0.0	0.0	100.	0.9	-2.8	-3.2	1.0	-5.1	0.0	0.0	-0.6	1.20	454.2	1.00	0.70
11	21	340.	13.	3.	0.5	0.04	0.04	1.45	1.09	706.	6.1	-3.6	-4.1	0.9	-1.6	-0.2	0.006	-0.6	1.21	453.7	1.00	1.63
11	22	324.	7.	0.	0.0	0.04	0.03	1.10	0.83	676.	3.1	-3.1	-3.6	0.5	-3.6	-0.7	0.008	-0.7	1.22	452.8	1.00	1.24
11	23	325.	12.	-2.	0.0	0.04	0.04	1.23	0.93	681.	5.0	-3.4	-4.0	0.8	-2.3	-0.4	0.004	-0.7	1.23	451.9	1.00	0.97
11	24	213.	14.	3.	0.0	0.04	0.0	0.0	0.0	451.	4.5	-3.3	-3.9	1.0	-2.7	0.0	0.0	-0.7	1.24	451.9	1.00	0.95
11	25	320.	15.	2.	0.0	0.04	0.04	1.26	0.95	683.	7.0	-3.7	-4.3	1.0	-1.0	-0.1	0.004	-0.7	1.25	451.0	1.00	0.95
11	26	268.	18.	-0.	0.0	0.04	0.02	0.62	0.47	576.	6.0	-3.5	-4.1	1.0	-1.6	-0.5	0.001	-0.7	1.26	450.5	1.00	0.92
11	27	301.	15.	2.	0.0	0.04	0.04	1.02	0.77	647.	6.8	-3.6	-4.3	1.0	-1.1	-0.2	0.004	-0.7	1.27	449.7	1.00	0.91
11	28	281.	5.	-2.	0.0	0.04	0.02	0.60	0.45	606.	1.8	-2.9	-3.4	0.3	-4.5	-1.4	0.006	-0.7	1.28	449.3	1.00	0.89
11	29	315.	5.	-4.	0.0	0.04	0.03	0.93	0.70	679.	1.5	-2.8	-3.4	0.2	-4.7	-0.9	0.009	-0.8	1.29	448.6	1.00	0.88
11	30	223.	7.	-7.	0.0	0.04	0.00	0.01	0.01	479.	1.4	-2.8	-3.3	0.3	-4.8	-95.9	0.000	-0.8	1.30	448.6	1.00	0.87
TOT.		8380.			49.		1.	29.	21.	15842.	79.	-94.	-106.		-121.	-3778.	0.061					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TUTILL	TULEAVES	KSWAT
			***** EMERGENCE	*****				
11/ 1/79	1.00	0.03	0.02	0.50	0.00	2.82	2.82	1.00
11/ 2/79	1.00	0.12	0.08	0.65	0.00	9.67	9.67	1.00
11/ 3/79	1.00	0.23	0.17	0.75	0.00	19.32	19.32	1.00
11/ 4/79	1.00	0.40	0.33	0.84	0.00	32.92	32.92	1.00
11/ 5/79	1.00	0.55	0.49	0.89	0.01	45.27	45.27	1.00
11/ 6/79	1.00	0.63	0.58	0.92	0.01	52.07	52.07	1.00
11/ 7/79	1.00	0.70	0.66	0.94	0.01	58.27	58.27	1.00
11/ 8/79	1.00	0.87	0.86	0.99	0.01	72.17	72.17	1.00
11/ 9/79	1.00	0.95	0.96	1.00	0.01	78.97	78.97	1.00
11/10/79	1.00	0.97	0.97	1.01	0.01	80.10	80.10	1.00
11/11/79	1.00	0.99	0.99	1.00	0.01	82.17	82.17	1.00
11/12/79	1.00	1.08	1.11	1.03	0.01	89.37	89.37	1.00
11/13/79	1.00	1.12	1.16	1.04	0.01	92.70	92.70	1.00
11/14/79	1.00	1.23	1.30	1.06	0.02	101.85	101.85	1.00
11/15/79	1.00	1.35	1.46	1.08	0.02	111.80	111.80	1.00
11/16/79	1.00	1.49	1.64	1.10	0.02	123.25	123.25	1.00
11/17/79	1.00	1.65	1.86	1.13	0.02	137.00	137.00	1.00
11/18/79	1.00	1.89	2.19	1.16	0.03	156.65	156.65	1.00
11/19/79	1.00	2.10	2.49	1.18	0.03	173.95	173.95	1.00
11/20/79	1.00	2.33	2.82	1.21	0.03	192.90	192.90	1.00
11/21/79	1.00	2.42	2.95	1.22	0.04	200.50	200.50	1.00
11/22/79	1.00	2.46	3.02	1.23	0.04	204.20	204.20	1.00
11/23/79	1.00	2.50	3.07	1.23	0.04	206.87	206.87	1.00
11/24/79	1.00	2.60	3.22	1.24	0.04	215.27	215.27	1.00
11/25/79	1.00	2.70	3.37	1.25	0.04	223.57	223.57	1.00
11/26/79	1.00	2.75	3.45	1.25	0.04	228.07	228.07	1.00
11/27/79	1.00	2.77	3.49	1.26	0.04	100.00	236.47	1.00
11/28/79	1.01	2.80	3.52	1.26	0.04	100.75	237.22	1.00
11/29/79	1.01	2.81	3.50	1.25	0.04	101.10	237.57	1.00
11/30/79	1.01	2.81	3.47	1.23	0.04	101.27	237.75	1.00

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC	DAY RESP (MG/((DM**2)/DAY))	NIGHT RESP	TOT. TSTR	NCE	DM/TR	TVP (MM/MB)	CUM DM (MG/CM2)	BMIS	THETA (MM)	KS	KS30
12	1	280.	9.	-4.	0.0	0.04	0.02	0.63	0.47	601.	2.8	-3.0	-3.6	0.4	-3.7	-1.1	0.003	-0.8	1.31	448.1	1.00	0.87
12	2	304.	9.	-6.	0.0	0.04	0.03	0.87	0.65	652.	2.6	-2.9	-3.5	0.4	-3.5	-0.8	0.004	-0.9	1.32	447.4	1.00	0.86
12	3	310.	19.	-3.	0.0	0.05	0.04	1.18	0.89	674.	7.3	-3.6	-4.4	1.0	-0.7	-0.1	0.003	-0.9	1.33	446.5	1.00	0.84
12	4	296.	19.	1.	0.0	0.05	0.04	1.01	0.76	657.	7.8	-3.7	-4.4	1.0	-0.4	-0.1	0.003	-0.9	1.34	445.8	1.00	0.82
12	5	262.	19.	5.	0.0	0.06	0.03	0.56	0.42	597.	7.7	-3.7	-4.4	1.0	-0.4	-0.1	0.002	-0.9	1.35	445.4	1.00	0.80
12	6	301.	14.	-1.	0.0	0.06	0.05	0.99	0.75	691.	8.4	-3.8	-4.6	0.9	0.1	0.0	0.004	-0.9	1.36	444.6	1.00	0.79
12	7	293.	15.	-1.	0.0	0.06	0.05	0.97	0.46	680.	9.3	-3.9	-4.7	1.0	0.6	0.1	0.003	-0.9	1.37	444.1	1.00	0.78
12	8	273.	15.	1.	0.0	0.07	0.04	0.66	0.84	650.	9.6	-3.9	-4.8	1.0	0.5	0.2	0.003	-0.9	1.39	443.3	1.00	0.77
12	9	132.	17.	5.	0.0	0.07	0.0	0.0	0.0	321.	5.1	-3.3	-4.0	1.0	-2.2	0.0	0.0	-0.9	1.40	443.3	1.00	0.75
12	10	276.	23.	5.	0.0	0.08	0.05	0.80	0.89	687.	11.7	-4.2	-5.2	1.0	2.3	0.3	0.003	-0.9	1.41	416.1	1.00	0.93
12	11	246.	17.	1.	0.0	0.09	0.02	0.31	0.38	622.	11.0	-4.1	-5.1	1.0	1.6	0.6	0.002	-0.8	1.42	415.7	1.00	0.91
12	12	49.	1.	-3.	0.0	0.09	0.0	0.0	0.0	123.	0.0	-2.5	-3.1	0.0	-5.6	0.0	0.0	-0.9	1.43	415.7	1.00	0.90
12	13	134.	2.	-4.	9.9	0.09	0.0	0.0	0.0	338.	0.0	-2.5	-3.1	0.0	-5.6	0.0	0.0	-0.9	1.44	425.6	1.00	0.90
12	14	120.	6.	1.	0.0	0.09	0.0	0.0	0.0	304.	2.3	-2.9	-3.5	0.4	-4.0	0.0	0.0	-1.0	1.45	425.6	1.00	1.13
12	15	266.	9.	2.	0.0	0.09	0.04	0.50	0.39	684.	8.4	-3.7	-4.6	0.7	0.1	0.0	0.009	-1.0	1.46	425.2	1.00	1.13
12	16	198.	3.	-8.	0.0	0.09	0.0	0.0	0.0	508.	0.0	-2.5	-3.1	0.0	-5.6	0.0	0.0	-1.0	1.47	425.2	1.00	0.99
12	17	290.	2.	-11.	0.0	0.09	0.04	0.58	0.44	740.	0.0	-2.5	-3.1	0.0	-5.6	-0.9	0.009	-1.0	1.48	424.8	1.00	0.99
12	18	241.	14.	-4.	0.0	0.09	0.02	0.23	0.18	618.	8.6	-3.7	-4.6	0.8	0.3	0.1	0.002	-1.0	1.49	424.6	1.00	0.98
12	19	186.	13.	-1.	0.0	0.09	0.0	0.0	0.0	478.	7.2	-3.5	-4.3	0.8	-0.7	0.0	0.0	-1.0	1.50	424.6	1.00	0.98
12	20	286.	15.	-2.	0.0	0.09	0.06	0.81	0.62	741.	13.4	-4.4	-5.4	1.0	3.5	0.4	0.005	-1.0	1.51	424.0	1.00	0.98
12	21	144.	18.	5.	0.0	0.10	0.0	0.0	0.0	378.	7.5	-3.6	-4.4	1.0	-0.5	0.0	0.0	-1.0	1.52	424.0	1.00	0.96
12	22	284.	21.	9.	0.0	0.11	0.08	0.91	0.70	764.	16.0	-4.8	-5.9	1.0	5.3	0.4	0.006	-1.0	1.53	423.3	1.00	0.96
12	23	118.	13.	6.	3.0	0.12	0.0	0.0	0.0	324.	7.2	-3.5	-4.3	1.0	-0.7	0.0	0.0	-1.0	1.54	426.3	1.00	0.95
12	24	286.	13.	3.	0.0	0.12	0.08	0.80	0.62	796.	16.8	-4.9	-6.1	0.9	5.8	0.5	0.011	-0.9	1.55	425.7	1.00	1.02
12	25	288.	19.	0.	0.0	0.13	0.09	0.89	0.69	811.	19.0	-5.3	-6.5	1.0	7.3	0.5	0.006	-0.9	1.56	425.0	1.00	1.00
12	26	244.	14.	3.	0.0	0.14	0.03	0.28	0.22	695.	16.8	-5.0	-6.1	1.0	5.7	1.3	0.003	-0.9	1.57	424.8	1.00	0.97
12	27	161.	13.	7.	1.3	0.14	0.0	0.0	0.0	465.	11.6	-4.2	-5.2	1.0	2.2	0.0	0.0	-0.8	1.58	426.1	1.00	0.97
12	28	20.	9.	4.	26.7	0.15	0.0	0.0	0.0	57.	1.0	-2.7	-3.3	0.7	-4.5	0.0	0.0	-0.9	1.59	452.4	1.00	1.00
12	29	104.	5.	1.	0.3	0.15	0.0	0.0	0.0	303.	2.7	-2.9	-3.6	0.4	-3.8	0.0	0.0	-0.9	1.60	452.7	1.00	1.63
12	30	224.	5.	-2.	0.0	0.15	0.00	0.02	0.02	655.	4.5	-3.3	-4.0	0.3	-2.3	-5.8	0.001	-0.9	1.61	452.7	1.00	1.26
12	31	287.	7.	-3.	0.0	0.15	0.08	0.68	0.53	838.	7.6	-3.6	-4.4	0.4	-0.5	-0.0	0.016	-0.9	1.62	452.2	1.00	1.01
TCT.		6902.			41.		1.	14.	11.	17452.	234.	-112.	-137.		-15.	-5.	0.099					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TOTILL	TOLEAVES	KSWAT
12/ 1/79	1.02	2.84	3.48	1.23	0.04	102.42	238.90	1.00
12/ 2/79	1.03	2.86	3.48	1.21	0.04	103.12	239.60	1.00
12/ 3/79	1.07	2.97	3.64	1.22	0.05	107.17	243.65	1.00
12/ 4/79	1.17	3.24	4.05	1.25	0.05	116.92	253.40	1.00
12/ 5/79	1.29	3.57	4.55	1.27	0.06	128.77	265.25	1.00
12/ 6/79	1.32	3.67	4.69	1.28	0.06	132.10	268.57	1.00
12/ 7/79	1.37	3.79	4.88	1.29	0.06	136.62	273.10	1.00
12/ 8/79	1.45	4.01	5.44	1.36	0.07	144.57	281.05	1.00
12/ 9/79	1.56	4.32	5.95	1.38	0.07	155.57	292.05	1.00
12/10/79	1.69	4.70	6.59	1.40	0.08	169.27	305.75	1.00
12/11/79	1.78	4.94	7.01	1.42	0.09	178.17	314.65	1.00
12/12/79	1.78	4.94	6.94	1.40	0.09	178.17	314.65	1.00
12/13/79	1.78	4.94	6.87	1.39	0.09	178.17	314.65	1.00
12/14/79	1.82	5.04	7.03	1.40	0.09	181.62	318.10	1.00
12/15/79	1.87	5.19	7.44	1.43	0.09	187.17	323.65	1.00
12/16/79	1.87	5.19	7.37	1.42	0.09	187.17	323.65	1.00
12/17/79	1.87	5.19	7.29	1.40	0.09	187.17	323.65	1.00
12/18/79	1.89	5.26	7.33	1.39	0.09	189.47	325.95	1.00
12/19/79	1.92	5.34	7.46	1.40	0.09	192.40	328.87	1.00
12/20/79	1.96	5.43	7.62	1.40	0.09	195.77	332.25	1.00
12/21/79	2.07	5.74	8.16	1.42	0.10	207.02	343.50	1.00
12/22/79	2.22	6.16	8.88	1.44	0.11	222.07	358.55	1.00
12/23/79	2.31	6.41	9.60	1.50	0.12	231.07	367.55	1.00
12/24/79	2.39	6.62	9.99	1.51	0.12	238.72	375.20	1.00
12/25/79	2.48	6.89	10.47	1.52	0.13	248.17	384.65	1.00
12/26/79	2.57	7.12	10.91	1.53	0.14	256.72	393.20	1.00
12/27/79	2.67	7.40	11.41	1.54	0.14	266.52	403.00	1.00
12/28/79	2.73	7.58	11.75	1.55	0.15	273.02	409.50	1.00
12/29/79	2.76	7.65	11.89	1.55	0.15	275.77	412.25	1.00
12/30/79	2.77	7.68	11.94	1.55	0.15	276.65	413.12	1.00
12/31/79	2.78	7.70	11.87	1.54	0.15	277.57	414.05	1.00

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC	DAY RESP	NIGHT RESP	TOT. TSTR	NCE	CM/TR	TVP (MM/MB)	CUM CM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
											(MG/(DM**2)/DAY))											
1	1	245.	14.	-2.	0.0	0.15	0.03	0.28	0.22	717.	15.6	-4.8	-5.5	0.9	5.1	1.0	C.C03	-0.9	1.64	452.0	1.00	0.99
1	2	150.	10.	3.	0.0	0.15	0.0	0.0	0.0	443.	8.7	-3.8	-4.6	0.7	0.2	0.0	0.0	-0.9	1.65	452.0	1.00	0.98
1	3	81.	3.	-2.	0.0	0.15	0.0	0.0	0.0	235.	0.9	-2.7	-3.2	0.1	-5.0	0.0	0.0	-0.9	1.66	452.0	1.00	0.98
1	4	39.	0.	-2.	0.0	0.15	0.0	0.0	0.0	115.	0.0	-2.5	-3.1	0.0	-5.6	0.0	C.0	-1.0	1.67	452.0	1.00	0.98
1	5	36.	2.	-2.	0.0	0.15	0.0	0.0	0.0	107.	0.2	-2.6	-3.1	0.1	-5.5	0.0	C.0	-1.0	1.68	452.0	1.00	0.98
1	6	197.	17.	-1.	0.0	0.16	0.0	0.0	0.0	586.	15.5	-4.8	-5.8	1.0	4.5	C.C	C.C	-1.0	1.69	452.0	1.00	0.98
1	7	175.	0.	-5.	0.0	0.15	0.0	0.0	0.0	516.	0.0	-2.5	-3.1	0.0	-5.6	0.0	0.0	-1.0	1.70	452.0	1.00	0.98
1	8	287.	6.	-5.	0.0	0.15	0.08	0.65	0.51	846.	5.0	-3.3	-3.9	0.2	-2.2	-0.2	0.015	-1.0	1.71	451.5	1.00	0.98
1	9	229.	9.	-3.	0.0	0.15	0.01	0.07	0.06	677.	8.4	-3.8	-4.5	0.5	0.1	0.1	0.C02	-1.0	1.72	451.4	1.0C	0.97
1	10	162.	20.	7.	0.0	0.17	0.0	0.0	0.0	489.	13.5	-4.5	-5.4	1.0	3.6	0.0	0.0	-1.0	1.73	451.4	1.00	0.97
1	11	233.	14.	3.	0.0	0.18	0.02	0.13	0.11	719.	20.9	-5.6	-6.7	1.0	8.6	3.0	C.C02	-C.9	1.74	451.3	1.00	0.97
1	12	264.	11.	1.	0.0	0.19	0.07	0.50	0.40	825.	19.1	-5.4	-6.4	0.8	7.3	0.7	C.012	-0.9	1.75	450.9	1.0C	0.97
1	13	302.	21.	5.	0.0	0.20	0.18	1.15	0.92	964.	30.2	-7.0	-8.3	1.0	14.8	0.5	C.011	-C.8	1.76	450.0	1.00	0.96
1	14	230.	25.	3.	0.0	0.22	0.02	0.12	0.10	753.	24.8	-6.3	-7.4	1.0	11.1	3.5	0.C01	-C.7	1.77	449.9	1.00	C.94
1	15	114.	16.	7.	0.0	0.23	0.0	0.0	0.0	381.	13.1	-4.6	-5.4	1.0	3.2	0.0	0.0	-0.7	1.78	449.9	1.00	0.94
1	16	282.	15.	3.	0.0	0.25	0.15	0.78	0.63	955.	34.0	-7.7	-9.0	1.0	17.3	0.8	C.015	-0.6	1.79	449.2	1.00	0.94
1	17	297.	14.	-1.	0.0	0.25	0.18	0.93	0.75	1012.	33.1	-7.6	-8.9	0.9	16.6	0.6	0.018	-C.5	1.80	448.5	1.00	0.92
1	18	222.	20.	3.	0.0	0.27	0.00	0.00	0.00	773.	29.0	-7.0	-8.2	1.0	13.8	198.6	C.00C	-C.4	1.81	448.5	1.00	0.91
1	19	31.	15.	2.	1.5	0.28	0.0	0.0	0.0	111.	4.3	-3.4	-3.9	1.0	-3.0	0.0	0.0	-0.4	1.82	450.0	1.00	0.91
1	20	17.	2.	1.	6.3	0.29	0.0	0.0	0.0	61.	0.4	-2.8	-3.2	0.2	-5.6	0.0	0.0	-0.4	1.83	456.3	1.00	0.94
1	21	94.	6.	1.	1.8	0.30	0.0	0.0	0.0	339.	5.7	-3.6	-4.1	0.4	-2.0	0.0	C.0	-0.4	1.84	458.1	1.00	1.09
1	22	101.	5.	-1.	0.0	0.30	0.0	0.0	0.0	365.	4.7	-3.4	-3.9	0.3	-2.6	0.0	0.0	-0.4	1.85	458.1	1.00	1.14
1	23	332.	14.	-3.	0.0	0.31	0.32	1.33	1.10	1210.	39.6	-8.7	-10.0	0.8	21.0	0.4	0.029	-0.3	1.86	457.0	1.00	1.04
1	24	319.	18.	-0.	0.0	0.33	0.32	1.28	1.07	1179.	49.9	-10.3	-11.7	1.0	27.8	0.6	C.023	-0.1	1.87	455.9	1.00	0.98
1	25	274.	13.	1.	0.0	0.36	0.17	0.64	0.53	1038.	40.7	-9.0	-10.2	0.9	21.6	0.9	C.C21	0.0	1.89	455.4	1.00	0.95
1	26	101.	2.	-6.	0.0	0.35	0.0	0.0	0.0	381.	0.0	-2.8	-3.2	0.0	-6.1	0.0	0.0	-0.0	1.90	455.4	1.00	0.94
1	27	152.	-3.	-7.	0.0	0.35	0.0	0.0	0.0	571.	0.0	-2.8	-3.2	0.0	-6.0	0.0	0.0	-0.1	1.91	455.4	1.00	0.94
1	28	37.	-4.	-6.	0.0	0.34	0.0	0.0	0.0	138.	0.0	-2.8	-3.2	0.0	-6.0	0.0	0.C	-0.1	1.92	455.4	1.00	0.94
1	29	41.	-4.	-7.	0.0	0.34	0.0	0.0	0.0	152.	0.0	-2.8	-3.2	0.0	-6.0	0.0	0.0	-0.1	1.93	455.4	1.00	0.94
1	30	57.	-0.	-6.	0.0	0.34	0.0	0.0	0.0	214.	0.0	-2.8	-3.1	0.0	-6.C	0.0	C.C	-C.2	1.94	455.4	1.00	0.94
1	31	297.	-3.	-10.	0.0	0.33	0.14	0.56	0.46	1105.	0.0	-2.8	-3.1	0.0	-6.0	-0.3	0.065	-C.2	1.95	454.9	1.00	C.94
TOT.		5398.			10.		2.	8.	7.	17978.	417.	-145.	-169.		1C4.	210.	C.217					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TOTTILL	TOLEAVES	KSWAI
1/ 1/80	2.81	7.78	12.02	1.54	0.15	280.52	417.00	1.00
1/ 2/80	2.87	7.96	12.35	1.55	0.15	286.97	423.45	1.00
1/ 3/80	2.87	7.97	12.37	1.55	0.15	287.27	423.75	1.00
1/ 4/80	2.87	7.97	12.37	1.55	0.15	287.27	423.75	1.00
1/ 5/80	2.87	7.97	12.37	1.55	0.15	287.32	423.80	1.00
1/ 6/80	2.91	8.09	12.59	1.56	0.16	291.42	427.90	1.00
1/ 7/80	2.91	8.09	12.46	1.54	0.15	291.42	427.90	1.00
1/ 8/80	2.92	8.09	12.34	1.53	0.15	291.60	428.07	1.00
1/ 9/80	2.93	8.13	12.42	1.53	0.15	293.00	429.47	1.00
1/10/80	3.12	8.65	13.38	1.55	0.17	306.30	442.77	1.00
1/11/80	3.25	9.03	14.52	1.61	0.18	315.10	451.57	1.00
1/12/80	3.35	9.30	15.05	1.62	0.19	321.25	457.72	1.00
1/13/80	3.56	9.89	16.22	1.64	0.20	334.15	470.62	1.00
1/14/80	3.81	10.58	17.59	1.66	0.22	348.10	484.57	1.00
1/15/80	4.03	11.18	18.81	1.68	0.23	359.70	496.17	1.00
1/16/80	4.21	11.69	19.85	1.70	0.25	368.90	505.37	1.00
1/17/80	4.28	11.88	20.23	1.70	0.25	372.22	508.70	1.00
1/18/80	4.52	12.54	21.61	1.72	0.27	383.57	520.05	1.00
1/19/80	4.71	13.06	22.71	1.74	0.28	392.07	528.55	1.00
			***** DOUBLE RIDGE *****					
1/20/80	4.75	13.17	23.18	1.76	0.29	353.77	132.97	1.00
1/21/80	4.83	13.40	24.16	1.80	0.30	357.27	136.47	1.00
1/22/80	4.85	13.47	24.48	1.82	0.30	358.40	137.59	1.00
1/23/80	4.91	13.64	25.23	1.85	0.31	400.97	140.17	1.00
1/24/80	5.02	13.92	26.50	1.90	0.33	405.25	144.44	1.00
1/25/80	5.18	14.39	28.63	1.99	0.36	412.15	151.34	1.00
1/26/80	5.18	14.39	28.35	1.97	0.35	412.15	151.34	1.00
1/27/80	5.18	14.39	28.06	1.95	0.35	412.15	151.34	1.00
1/28/80	5.18	14.39	27.78	1.93	0.34	412.15	151.34	1.00
1/29/80	5.18	14.39	27.51	1.91	0.34	412.15	151.34	1.00
1/30/80	5.18	14.39	27.23	1.89	0.34	412.15	151.34	1.00
1/31/80	5.18	14.39	26.96	1.87	0.33	412.15	151.34	1.00

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR	MXT	MNT	RAIN	LAI	TRAN EVAP	POT. EVAP	TOT. EVAP	INT. LIGHT	GROSS PHOTO	DAY RESP	NIGHT RESP	TOT. TSTR	ACE	CM/TR	IVP	CUM CM	BMTS	THETA	KS	KS30
		(LYS)	(C)	(C)	(MM)		(MM)	(MM)	(MM)	MZ/CMCM	=======	(MG/((DM**2)/DAY))	=======				(MM/MB)	(MG/CM2)		(MM)		
2	1	355.	3.	-11.	0.0	0.33	0.29	1.17	0.97	1316.	0.0	-2.8	-3.1	0.0	-5.9	-C.1	C.C62	-C.3	1.96	454.0	1.00	0.93
2	2	352.	11.	-2.	0.0	0.34	0.39	1.51	1.26	1313.	38.5	-8.8	-9.6	0.7	20.1	0.3	0.C48	-0.1	1.97	452.7	1.00	0.91
2	3	364.	14.	-2.	0.0	0.35	0.46	1.76	1.47	1374.	53.4	-11.1	-12.1	0.9	3C.1	0.4	C.041	C.1	1.98	451.2	1.00	0.89
2	4	333.	19.	1.	0.0	0.39	0.44	1.52	1.28	1297.	60.7	-12.3	-13.4	1.0	35.0	0.5	0.029	0.3	1.99	449.9	1.00	0.86
2	5	371.	14.	-1.	0.0	0.39	0.54	1.86	1.57	1450.	63.3	-12.8	-13.8	0.9	36.6	0.5	0.053	0.6	2.00	448.4	1.00	0.83
2	6	361.	15.	-3.	0.0	0.39	0.50	1.72	1.45	1410.	57.6	-12.1	-12.9	0.9	32.7	0.4	C.C42	0.8	2.01	446.9	1.00	0.80
2	7	29.	8.	2.	0.0	0.40	0.0	0.0	0.0	114.	3.1	-3.6	-3.8	0.6	-4.3	0.0	0.0	0.7	2.02	446.9	1.00	0.78
2	8	61.	1.	-5.	6.6	0.40	0.0	0.0	0.0	238.	0.0	-3.1	-3.3	0.0	-6.4	0.0	C.C	C.7	2.02	453.5	1.00	0.78
2	9	271.	-4.	-12.	0.0	0.39	0.10	0.34	0.10	1062.	0.0	-3.1	-3.3	0.0	-6.4	-0.4	0.047	0.7	2.03	453.4	1.00	0.94
2	10	402.	2.	-16.	0.0	0.39	0.42	1.46	1.23	1566.	0.0	-3.1	-3.2	0.0	-6.3	-0.1	C.C78	C.6	2.04	452.2	1.00	0.94
2	11	370.	2.	-10.	0.0	0.39	0.37	1.28	1.08	1438.	0.0	-3.1	-3.2	0.0	-6.3	-0.1	C.C84	0.6	2.05	451.1	1.00	C.91
2	12	302.	5.	-5.	0.0	0.38	0.22	0.78	0.66	1172.	7.0	-4.2	-4.4	0.1	-1.5	-0.0	0.052	0.6	2.06	450.5	1.00	0.89
2	13	372.	16.	-1.	0.0	0.41	0.58	1.94	1.65	1471.	70.5	-14.3	-14.8	1.0	41.4	0.5	0.C45	0.8	2.07	448.8	1.00	0.88
2	14	241.	19.	6.	0.0	0.43	0.08	0.26	0.22	967.	47.6	-10.8	-11.1	1.0	25.7	2.1	0.007	1.0	2.08	448.6	1.00	0.85
2	15	125.	12.	-3.	0.0	0.43	0.0	0.0	0.0	502.	18.3	-6.2	-6.3	0.7	5.8	0.0	C.0	1.1	2.09	448.6	1.00	0.85
2	16	277.	-3.	-8.	0.0	0.43	0.13	0.41	0.35	1111.	0.0	-3.3	-3.3	0.0	-6.6	-0.3	0.076	1.0	2.09	448.2	1.0C	0.85
2	17	353.	-2.	-12.	0.0	0.42	0.30	0.96	0.81	1411.	0.0	-3.3	-3.3	0.0	-6.5	-0.1	0.110	1.0	2.10	447.4	1.00	0.84
2	18	337.	11.	-3.	0.0	0.42	0.41	1.31	1.12	1347.	40.6	-9.8	-9.8	0.6	20.9	0.3	C.C50	1.1	2.11	446.3	1.00	0.83
2	19	387.	24.	7.	0.0	0.45	0.82	2.52	2.16	1575.	79.3	-16.2	-16.1	1.0	47.0	0.4	0.040	1.4	2.12	444.1	1.00	0.81
2	20	334.	25.	4.	0.0	0.49	0.59	1.69	1.47	1398.	74.1	-15.6	-15.4	1.0	43.2	0.5	C.C26	1.7	2.13	442.7	1.00	0.77
2	21	423.	23.	9.	0.0	0.52	1.11	3.03	2.65	1790.	57.7	-19.6	-19.2	1.0	58.9	0.4	C.C70	2.1	2.14	440.0	1.00	0.74
2	22	405.	24.	5.	0.0	0.54	1.04	2.76	2.42	1745.	56.7	-19.6	-19.1	1.0	57.9	0.4	C.050	2.5	2.15	437.6	1.00	0.70
2	23	228.	10.	2.	0.0	0.54	0.02	0.06	0.06	985.	39.4	-10.4	-10.1	0.7	19.0	5.2	C.C05	2.6	2.16	437.5	1.00	0.66
2	24	251.	24.	1.	0.0	0.59	0.17	0.43	0.30	1114.	64.8	-14.8	-14.2	1.0	35.8	1.4	0.008	2.9	2.16	437.3	1.00	0.66
2	25	444.	11.	-2.	0.0	0.59	1.05	2.57	2.50	1975.	75.6	-16.7	-15.9	0.7	43.0	0.3	C.144	3.1	2.17	434.8	1.00	0.65
2	26	440.	20.	-5.	0.0	0.59	1.20	2.93	2.31	1956.	114.0	-23.2	-22.0	1.0	68.8	0.4	0.064	3.6	2.18	432.4	1.00	0.61
2	27	461.	24.	-0.	0.0	0.60	1.45	3.52	2.39	2054.	120.5	-24.6	-23.2	1.0	72.7	0.3	C.061	4.1	2.19	430.1	1.00	0.58
2	28	427.	27.	5.	0.0	0.62	1.37	3.22	2.19	1927.	114.9	-24.0	-22.5	1.0	68.4	0.3	0.052	4.6	2.20	427.9	1.00	0.54
2	29	119.	14.	-6.	0.0	0.62	0.0	0.0	0.0	536.	22.7	-8.8	-8.1	0.7	5.9	0.0	0.0	4.6	2.21	427.9	1.00	0.52
TOT.		9192.			7.		14.	41.	34.	37624.	1360.	-321.	-320.		719.	13.	1.345					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TUFILL	TULEAVES	KSWAT
2/ 1/80	5.18	14.39	26.69	1.85	0.33	412.15	151.34	1.00
2/ 2/80	5.24	14.55	27.37	1.88	0.34	414.45	153.64	1.00
2/ 3/80	5.32	14.76	28.30	1.92	0.35	417.47	156.66	1.00
			***** JOINTING	*****				
2/ 4/80	5.59	15.50	31.54	2.03	0.39	427.62	166.81	1.00
2/ 5/80	5.51	15.28	31.70	2.07	0.39	431.05	170.24	1.00
2/ 6/80	5.49	15.23	31.79	2.09	0.39	433.92	173.11	1.00
2/ 7/80	5.46	15.15	32.46	2.14	0.40	438.72	177.91	1.00
2/ 8/80	5.46	15.15	32.14	2.12	0.40	438.72	177.91	1.00
2/ 9/80	5.46	15.15	31.81	2.10	0.39	438.72	177.91	1.00
2/10/80	5.46	15.15	31.50	2.08	0.39	438.72	177.91	1.00
2/11/80	5.46	15.15	31.18	2.06	0.39	438.72	177.91	1.00
2/12/80	5.46	15.15	30.87	2.04	0.38	438.72	177.91	1.00
2/13/80	5.44	15.09	32.94	2.18	0.41	442.55	181.74	1.00
2/14/80	5.37	14.90	34.59	2.32	0.43	454.70	193.89	1.00
2/15/80	5.36	14.86	34.91	2.35	0.43	457.12	196.31	1.00
2/16/80	5.36	14.86	34.56	2.33	0.43	457.12	196.31	1.00
2/17/80	5.36	14.86	34.21	2.30	0.42	457.12	196.31	1.00
2/18/80	5.35	14.83	34.12	2.30	0.42	459.05	198.24	1.00
2/19/80	5.26	14.59	36.04	2.47	0.45	474.45	213.64	1.00
2/20/80	5.18	14.37	39.66	2.76	0.49	488.85	228.04	1.00
2/21/80	5.09	14.14	41.58	2.94	0.52	504.70	243.89	1.00
2/22/80	5.02	13.92	43.23	3.10	0.54	518.95	258.14	1.00
2/23/80	4.99	13.84	43.90	3.17	0.54	524.90	264.09	1.00
2/24/80	4.92	13.66	47.51	3.48	0.59	537.15	276.34	1.00
2/25/80	4.91	13.63	47.77	3.51	0.59	539.42	278.61	1.00
2/26/80	4.89	13.58	47.70	3.51	0.59	543.07	282.26	1.00
2/27/80	4.86	13.49	48.34	3.58	0.60	549.00	288.19	1.00
2/28/80	4.78	13.27	50.02	3.77	0.62	564.79	303.99	1.00
2/29/80	4.77	13.24	49.72	3.76	0.62	566.72	305.91	1.00

MODEL SYS.PHOTO-81.2   1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTO	DAY RESP	NIGHT RESP	TOT. TSTR	ACE	DM/TR	TVP (MM/MB)	CUM CM (MG/CM2)	DMTS	THETA (MM)	KS	KS30
											=======(MG/((DM**2)/DAY))=======											
3	1	461.	-3.	-11.	0.0	0.61	0.72	1.71	0.72	2068.	0.0	-4.8	-4.4	0.0	-9.2	-0.1	0.327	4.5	2.22	427.1	1.00	0.52
3	2	454.	3.	-15.	0.0	0.60	0.82	1.97	1.51	2031.	0.0	-4.8	-4.4	0.0	-9.2	-0.1	0.143	4.5	2.23	425.6	1.00	0.51
3	3	250.	15.	-3.	0.0	0.60	0.15	0.35	0.44	1118.	57.6	-14.6	-13.3	0.9	29.7	1.4	0.012	4.7	2.23	425.2	1.00	0.49
3	4	469.	24.	2.	0.0	0.65	1.61	3.68	2.21	2146.	130.7	-27.4	-24.8	1.0	78.5	0.3	0.072	5.2	2.24	384.8	1.00	0.93
3	5	471.	7.	-4.	0.0	0.64	1.12	2.58	1.69	2145.	41.6	-12.4	-11.1	0.3	18.1	0.1	0.205	5.3	2.25	383.1	1.00	0.90
3	6	458.	25.	-4.	0.0	0.64	1.52	3.48	2.06	2087.	126.5	-27.1	-24.2	1.0	75.3	0.3	0.055	5.8	2.26	381.0	1.00	0.88
3	7	394.	20.	6.	0.0	0.66	1.09	2.47	1.61	1808.	110.9	-24.8	-22.0	1.0	64.1	0.4	0.075	6.3	2.27	379.4	1.00	0.86
3	8	479.	15.	0.	0.0	0.67	1.47	3.28	1.96	2207.	136.2	-29.4	-25.9	1.0	80.9	0.4	0.132	6.8	2.28	377.5	1.00	0.84
3	9	480.	24.	1.	0.0	0.68	1.75	3.84	2.23	2230.	138.9	-30.4	-26.5	1.0	82.1	0.3	0.073	7.3	2.29	375.2	1.00	0.82
3	10	404.	22.	2.	0.0	0.72	1.24	2.62	1.70	1906.	121.8	-27.9	-24.2	1.0	65.6	0.4	0.065	7.8	2.30	373.5	1.00	0.79
3	11	233.	15.	8.	0.0	0.73	0.07	0.15	0.17	1105.	71.2	-19.5	-16.8	1.0	34.8	3.3	0.006	8.0	2.30	373.4	1.00	0.77
3	12	496.	21.	8.	0.0	0.75	1.96	4.00	2.39	2372.	154.2	-34.3	-29.4	1.0	90.5	0.3	0.149	8.7	2.31	371.0	1.00	0.77
3	13	528.	16.	1.	0.0	0.75	1.97	4.00	2.39	2533.	165.4	-36.7	-31.1	1.0	97.7	0.3	0.169	9.3	2.32	368.6	1.00	0.74
3	14	528.	23.	1.	0.0	0.77	2.21	4.43	2.62	2545.	167.3	-37.6	-31.6	1.0	98.1	0.3	0.106	10.0	2.33	366.0	1.00	0.72
3	15	347.	21.	6.	0.0	0.78	0.91	1.82	1.31	1680.	111.2	-28.3	-23.6	1.0	59.3	0.4	0.057	10.4	2.34	364.7	1.00	0.69
3	16	262.	25.	9.	0.0	0.79	0.32	0.63	0.69	1279.	85.3	-24.3	-20.1	1.0	40.9	0.9	0.016	10.6	2.35	364.0	1.00	0.68
3	17	540.	14.	2.	0.0	0.80	2.06	4.00	2.44	2640.	173.8	-40.0	-32.9	1.0	101.0	0.3	0.246	11.3	2.36	361.5	1.00	0.67
3	18	448.	17.	-2.	0.0	0.80	1.50	2.91	1.87	2190.	146.9	-35.7	-29.1	1.0	82.1	0.4	0.110	11.9	2.37	359.7	1.00	0.64
3	19	424.	21.	4.	0.0	0.81	1.49	2.88	1.86	2080.	140.2	-35.1	-28.5	1.0	76.6	0.3	0.092	12.4	2.37	357.8	1.00	0.62
3	20	477.	17.	4.	0.0	0.82	1.81	3.46	2.17	2350.	159.1	-38.9	-31.4	1.0	88.8	0.3	0.153	13.0	2.38	355.6	1.00	0.61
3	21	553.	20.	1.	0.0	0.83	2.44	4.63	2.79	2732.	185.7	-44.3	-35.3	1.0	106.0	0.3	0.140	13.7	2.39	352.9	1.00	0.58
3	22	306.	21.	3.	0.0	0.83	0.63	1.19	0.97	1515.	103.4	-30.2	-23.9	1.0	49.4	0.5	0.038	14.0	2.40	351.9	1.00	0.56
3	23	331.	21.	4.	2.3	0.84	0.85	1.58	1.18	1648.	112.9	-32.3	-25.4	1.0	55.2	0.4	0.049	14.4	2.41	353.0	1.00	0.55
3	24	508.	11.	2.	0.0	0.85	1.84	3.43	2.17	2531.	141.4	-37.5	-29.4	0.8	74.5	0.3	0.295	14.9	2.42	350.8	1.00	0.59
3	25	482.	15.	3.	0.0	0.85	1.83	3.39	2.15	2407.	165.8	-42.5	-33.1	1.0	90.2	0.3	0.183	15.5	2.43	348.7	1.00	0.57
3	26	408.	20.	7.	0.0	0.86	1.44	2.65	1.75	2040.	141.1	-38.8	-30.0	1.0	72.3	0.3	0.111	16.0	2.44	346.9	1.00	0.54
3	27	96.	15.	11.	5.3	0.87	0.0	0.0	0.0	481.	33.4	-19.5	-15.1	1.0	-1.2	0.0	0.0	16.0	2.44	352.2	1.00	0.53
3	28	572.	18.	7.	0.0	0.87	2.69	4.90	3.00	2879.	200.4	-50.5	-38.3	1.0	111.6	0.3	0.252	16.7	2.45	349.2	1.00	0.65
3	29	409.	11.	4.	0.0	0.88	1.25	2.26	1.55	2059.	125.4	-37.0	-27.9	0.9	60.4	0.3	0.236	17.1	2.46	347.7	1.00	0.63
3	30	573.	18.	4.	0.0	0.88	2.66	4.80	2.96	2893.	202.2	-51.8	-38.8	1.0	111.6	0.3	0.226	17.9	2.47	344.7	1.00	0.61
3	31	573.	22.	0.	0.0	0.89	2.79	5.02	3.09	2900.	203.2	-52.9	-39.1	1.0	111.2	0.3	0.139	18.6	2.48	341.6	1.00	0.58
TOT.		13412.			8.		44.	88.	56.	64607.	3854.	-972.	-791.		2091.	14.	3.532					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TLTILL	TULEAVES	KSWAT
3/ 1/80	4.77	13.24	49.22	3.72	0.61	566.72	305.91	1.00
3/ 2/80	4.77	13.24	48.73	3.68	0.60	566.72	305.91	1.00
3/ 3/80	4.76	13.20	48.53	3.68	0.60	569.59	308.79	1.00
3/ 4/80	4.69	13.02	52.25	4.01	0.65	582.44	321.64	1.00
3/ 5/80	4.69	13.01	51.80	3.98	0.64	583.12	322.31	1.00
3/ 6/80	4.66	12.94	51.80	4.00	0.64	588.54	327.74	1.00
3/ 7/80	4.60	12.76	53.03	4.16	0.66	601.59	340.79	1.00
3/ 8/80	4.56	12.66	53.72	4.24	0.67	609.19	348.39	1.00
3/ 9/80	4.50	12.49	54.82	4.39	0.68	621.69	360.89	1.00
3/10/80	4.45	12.34	57.87	4.69	0.72	633.44	372.64	1.00
3/11/80	4.39	12.17	58.97	4.84	0.73	646.44	385.64	1.00
3/12/80	4.32	11.99	60.15	5.02	0.75	660.84	400.04	1.00
3/13/80	4.28	11.88	60.82	5.12	0.75	669.44	408.64	1.00
3/14/80	4.23	11.74	61.70	5.26	0.77	681.04	420.24	1.00
3/15/80	4.17	11.57	62.68	5.42	0.78	694.39	433.59	1.00
3/16/80	4.10	11.37	63.86	5.62	0.79	711.39	450.59	1.00
3/17/80	4.06	11.27	64.38	5.71	0.80	719.34	458.54	1.00
3/18/80	4.05	11.23	64.62	5.75	0.80	722.89	462.09	1.00
3/19/80	4.00	11.09	65.38	5.90	0.81	734.94	474.14	1.00
3/20/80	3.95	10.96	66.03	6.02	0.82	745.54	484.74	1.00
3/21/80	3.91	10.84	66.64	6.15	0.83	755.99	495.19	1.00
3/22/80	3.86	10.71	67.32	6.29	0.83	767.99	507.19	1.00
3/23/80	3.81	10.57	68.00	6.44	0.84	780.64	519.84	1.00
3/24/80	3.78	10.49	68.35	6.51	0.85	787.24	526.44	1.00
3/25/80	3.75	10.39	68.80	6.62	0.85	796.24	535.44	1.00
3/26/80	3.69	10.25	69.43	6.77	0.86	809.29	548.49	1.00
3/27/80	3.65	10.12	70.01	6.92	0.87	821.89	561.09	1.00
3/28/80	3.60	9.98	70.56	7.07	0.87	834.49	573.69	1.00
3/29/80	3.57	9.90	70.88	7.16	0.88	841.99	581.19	1.00
3/30/80	3.53	9.79	71.32	7.29	0.88	852.99	592.19	1.00
3/31/80	3.49	9.68	71.74	7.41	0.89	863.89	603.09	1.00

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTO	DAY RESP	NIGHT RESP (MG/(DM**2)/DAY))	TOT. TSTR	NCE	CM/TR	TVP (MM/MB)	CUM DM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
4	1	584.	23.	4.	0.0	0.90	3.01	5.39	3.30	2962.	208.2	-54.5	-40.3	1.0	113.4	0.3	0.149	19.4	2.49	338.3	1.00	0.56
4	2	306.	18.	7.	0.0	0.90	0.65	1.16	0.94	1553.	109.4	-36.7	-27.0	1.0	45.6	0.5	0.064	19.7	2.50	416.1	1.00	0.71
4	3	606.	17.	3.	0.0	0.90	2.91	5.18	3.20	3083.	217.6	-57.3	-41.7	1.0	118.6	0.3	0.232	20.5	2.51	412.9	1.00	0.70
4	4	584.	17.	1.	0.0	0.91	2.72	4.82	3.00	2976.	210.4	-56.6	-40.9	1.0	112.9	0.3	0.211	21.2	2.51	409.9	1.00	0.68
4	5	494.	23.	4.	0.0	0.91	2.29	4.04	2.57	2520.	178.5	-51.7	-37.0	1.0	85.7	0.3	0.114	21.8	2.52	407.3	1.00	0.65
4	6	599.	29.	12.	0.0	0.92	3.93	6.28	4.21	3063.	217.6	-60.2	-43.0	1.0	114.4	0.2	0.146	22.6	2.53	403.1	1.00	0.63
4	7	600.	31.	7.	0.0	0.93	3.95	6.28	4.22	3075.	219.0	-61.6	-43.2	1.0	114.1	0.2	0.116	23.4	2.54	398.9	1.00	0.59
4	8	618.	19.	6.	0.0	0.93	3.21	5.60	3.47	3171.	226.1	-62.8	-44.2	1.0	119.0	0.2	0.257	24.2	2.55	395.4	1.00	0.56
4	9	618.	22.	1.	0.0	0.93	3.28	5.72	3.55	3173.	226.5	-63.9	-44.3	1.0	118.3	0.2	0.160	24.9	2.56	391.8	1.00	0.53
4	10	598.	29.	7.	0.0	0.94	3.85	6.08	4.11	3073.	219.7	-63.7	-44.1	1.0	111.9	0.2	0.132	25.7	2.57	387.7	1.00	0.50
4	11	547.	22.	8.	0.0	0.94	2.79	4.83	3.05	2816.	201.7	-60.8	-41.9	1.0	99.0	0.2	0.188	26.4	2.58	384.7	1.00	0.46
4	12	205.	11.	6.	0.0	0.94	0.0	0.0	0.0	1056.	72.4	-36.0	-24.7	1.0	11.7	0.0	0.0	26.4	2.58	384.7	1.00	0.44
4	13	343.	13.	5.	0.0	0.94	0.89	1.55	1.15	1768.	126.8	-46.8	-31.8	1.0	48.3	0.4	0.138	26.8	2.59	383.5	1.00	0.44
4	14	552.	19.	1.	0.0	0.94	2.64.	4.55	2.89	2848.	204.3	-62.5	-41.8	1.0	100.0	0.3	0.168	27.4	2.60	380.6	1.00	0.43
4	15	642.	28.	1.	0.0	0.95	4.19	6.55	4.44	3313.	238.1	-70.3	-46.6	1.0	121.2	0.2	0.138	28.2	2.61	376.2	1.00	0.40
4	16	467.	30.	8.	0.0	0.97	2.65	4.08	2.89	2429.	176.1	-59.8	-39.6	1.0	76.8	0.2	0.081	28.8	2.62	373.3	1.00	0.36
4	17	600.	24.	7.	0.0	0.99	3.39	5.68	3.64	3140.	229.2	-70.8	-46.6	1.0	111.8	0.2	0.175	29.5	2.63	369.7	1.00	0.34
4	18	585.	20.	6.	0.0	1.00	3.10	5.13	3.34	3075.	225.7	-70.8	-46.4	1.0	108.5	0.2	0.216	30.2	2.64	366.3	1.00	0.31
4	19	629.	28.	5.	0.0	1.02	4.27	6.36	4.51	3326.	245.8	-76.6	-49.6	1.0	119.6	0.2	0.149	31.0	2.65	361.8	1.00	0.28
4	20	643.	30.	8.	0.0	1.04	4.66	6.85	4.90	3420.	254.6	-80.0	-51.5	1.0	123.1	0.2	0.142	31.9	2.65	356.9	1.00	0.25
4	21	642.	31.	10.	0.0	1.06	4.78	6.93	5.02	3442.	258.3	-82.4	-52.8	1.0	123.0	0.2	0.154	32.7	2.66	351.9	1.00	0.21
4	22	544.	29.	11.	0.0	1.09	3.72	5.31	3.95	2935.	221.9	-76.7	-48.8	1.0	96.4	0.2	0.139	33.3	2.67	347.9	1.00	0.17
4	23	604.	31.	15.	0.0	1.11	4.60	6.48	4.84	3283.	250.2	-84.0	-53.4	1.0	112.8	0.2	0.166	34.1	2.68	343.1	1.00	0.13
4	24	488.	26.	16.	0.0	1.13	2.87	4.38	3.10	2666.	204.5	-76.2	-48.2	1.0	80.2	0.2	0.189	34.6	2.69	340.0	1.00	0.10
4	25	294.	22.	8.	0.0	1.07	0.89	1.41	1.12	1576.	118.4	-57.6	-35.5	1.0	25.4	0.2	0.056	34.8	2.75	338.9	1.00	0.07
4	26	180.	16.	6.	0.0	1.02	0.0	0.0	0.0	954.	70.6	-45.9	-28.5	1.0	-3.7	0.0	0.0	34.8	2.81	338.9	1.00	0.06
4	27	647.	20.	5.	0.0	0.97	3.47	5.86	3.69	3370.	244.6	-79.6	-49.2	1.0	115.9	0.2	0.244	35.5	2.87	335.2	1.00	0.06
4	28	645.	25.	5.	0.0	0.91	3.59	6.35	3.81	3286.	232.6	-76.7	-47.0	1.0	108.9	0.2	0.156	36.3	2.93	331.4	1.00	0.03
4	29	568.	29.	9.	0.0	0.84	3.33	5.69	3.55	2817.	238.7	-86.0	-52.4	1.0	100.3	0.2	0.114	36.9	2.99	296.4	1.00	-0.07
4	30	405.	21.	14.	2.0	0.77	1.16	2.98	1.38	1954.	109.7	-58.1	-35.7	1.0	15.9	0.1	0.126	37.0	3.03	297.1	0.67	-0.08
TOT.		15839.			2.		87.	142.	94.	82125.	5957.	-1927.	-1278.		2753.	6.	4.320					

LAI-TILLER MODEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TUTILL	TULEAVES	KSWAT
4/ 1/80	3.44	9.54	72.23	7.57	0.90	877.44	616.64	1.00
4/ 2/80	3.39	9.42	72.65	7.72	0.90	889.79	628.99	1.00
4/ 3/80	3.36	9.32	72.98	7.83	0.90	899.74	638.94	1.00
4/ 4/80	3.33	9.23	73.26	7.94	0.91	908.84	648.04	1.00
4/ 5/80	3.28	9.10	73.65	8.10	0.91	922.39	661.59	1.00
4/ 6/80	3.21	8.90	74.20	8.33	0.92	942.74	681.94	1.00
4/ 7/80	3.15	8.73	74.63	8.54	0.93	961.04	700.23	1.00
4/ 8/80	3.11	8.62	74.91	8.69	0.93	973.64	712.83	1.00
4/ 9/80	3.07	8.52	75.14	8.82	0.93	985.05	724.28	1.00
4/10/80	3.01	8.36	75.46	9.03	0.94	1002.64	741.83	1.00
4/11/80	2.97	8.23	75.70	9.20	0.94	1017.59	756.78	1.00
4/12/80	2.94	8.15	75.83	9.30	0.94	1026.34	765.53	1.00
4/13/80	2.91	8.07	75.96	9.41	0.94	1035.69	774.88	1.00
4/14/80	2.88	7.99	76.09	9.53	0.94	1045.79	784.98	1.00
4/15/80	2.84	7.89	76.46	9.69	0.95	1060.09	799.28	1.00
4/16/80	2.84	7.89	78.17	9.91	0.97	1078.89	818.08	1.00
4/17/80	2.84	7.89	79.57	10.09	0.99	1094.34	833.53	1.00
4/18/80	2.84	7.89	80.73	10.23	1.00	1107.09	846.28	1.00
4/19/80	2.84	7.89	82.22	10.42	1.02	1123.54	862.73	1.00
4/20/80	2.84	7.89	83.93	10.64	1.04	1142.44	881.63	1.00
4/21/80	2.84	7.89	85.76	10.87	1.06	1162.64	901.83	1.00
4/22/80	2.84	7.89	87.53	11.09	1.09	1181.59	921.43	0.97
4/23/80	2.84	7.89	89.54	11.35	1.11	1202.43	943.73	0.93
			***** BOOTING	*****				
4/24/80	2.84	7.89	91.40	11.58	1.13	1220.84	964.28	0.90
4/25/80	2.84	7.66	88.76	11.25	1.07	1233.67	979.03	0.87
4/26/80	2.84	7.50	86.83	11.01	1.02	1242.94	989.83	0.86
4/27/80	2.84	7.31	84.67	10.73	0.97	1253.28	1001.88	0.86
4/28/80	2.84	7.08	81.96	10.39	0.91	1265.83	1017.03	0.83
			***** HEADING	*****				
4/29/80	2.84	6.78	78.49	9.95	0.84	1279.97	1036.43	0.73
4/30/80	2.84	6.50	75.30	9.54	0.77	1292.88	1054.28	0.72

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1

MO	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC (MG/((DM**2)/DAY))	DAY RESP (MG/((DM**2)/DAY))	NIGHT RESP (MG/((DM**2)/DAY))	TOT. TSTR	NCE	DM/TR	TVP (MM/MB)	CUM CM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
5	1	277.	22.	13.	0.0	0.71	0.46	1.22	0.68	1301.	72.8	-49.5	-29.7	1.0	-6.4	-0.1	0.038	37.0	3.06	296.4	0.68	-0.04
5	2	548.	23.	12.	0.0	0.65	1.83	5.04	2.05	2505.	136.4	-60.6	-36.2	1.0	39.6	0.1	0.122	37.3	3.10	294.3	0.67	-0.04
5	3	439.	25.	10.	0.0	0.59	1.19	3.55	1.41	1950.	100.8	-52.1	-30.7	1.0	18.0	0.1	0.063	37.4	3.13	292.9	0.65	-0.05
5	4	355.	26.	12.	0.0	0.53	0.76	2.43	0.98	1525.	75.5	-45.3	-26.7	1.0	3.4	0.0	0.039	37.4	3.17	291.9	0.63	-0.06
5	5	519.	31.	11.	0.0	0.47	1.50	5.09	1.71	2142.	102.1	-49.5	-28.8	1.0	23.8	0.1	0.047	37.6	3.20	290.2	0.62	-0.06
5	6	450.	30.	15.	0.0	0.41	1.09	4.04	1.30	1780.	80.4	-43.1	-25.2	1.0	12.1	0.1	0.043	37.7	3.24	288.9	0.60	-0.07
5	7	559.	29.	12.	0.0	0.36	1.40	5.57	1.61	2119.	91.6	-43.8	-25.3	1.0	22.4	0.1	0.055	37.8	3.28	287.3	0.58	-0.07
5	8	551.	21.	10.	4.3	0.32	1.13	4.84	1.34	2019.	83.3	-40.4	-23.4	1.0	15.5	0.1	0.094	37.9	3.31	290.3	0.56	-0.08
5	9	511.	23.	5.	0.0	0.29	1.05	4.38	1.26	1812.	78.6	-38.7	-22.0	1.0	17.9	0.1	0.052	38.1	3.35	289.0	0.60	0.02
5	10	662.	37.	16.	0.0	0.24	1.76	7.98	1.97	2220.	92.5	-40.8	-23.5	0.8	28.1	0.1	0.040	38.2	3.38	287.1	0.58	0.01
5	11	536.	35.	17.	0.0	0.19	1.15	5.73	1.35	1686.	66.7	-34.4	-19.5	0.9	12.8	0.1	0.031	38.3	3.42	285.7	0.56	0.01
5	12	636.	32.	17.	0.0	0.15	1.31	7.15	1.52	1872.	71.6	-34.0	-19.2	1.0	18.4	0.1	0.046	38.5	3.45	284.2	0.54	0.00
5	13	633.	26.	12.	0.0	0.12	1.09	6.40	1.29	1757.	65.1	-31.4	-17.6	1.0	16.1	0.1	0.057	38.6	3.49	282.9	0.53	-0.01
5	14	501.	28.	10.	17.8	0.10	0.73	4.58	3.62	1305.	47.3	-26.9	-15.0	1.0	5.4	0.0	0.029	38.6	3.53	297.1	0.51	-0.01
5	15	95.	17.	12.	58.7	0.08	0.0	0.0	0.0	236.	11.5	-18.4	-10.4	1.0	-17.3	0.0	0.0	38.5	3.56	344.7	0.68	0.34
5	16	677.	24.	11.	0.0	0.06	2.00	6.86	6.33	1567.	114.9	-39.6	-22.2	1.0	53.2	0.2	0.116	38.8	3.60	338.4	1.00	1.48
5	17	672.	28.	10.	0.0	0.04	2.21	7.14	6.72	1439.	109.1	-38.1	-21.2	1.0	49.8	0.2	0.088	39.2	3.63	331.6	1.00	1.13
5	18	509.	22.	14.	0.0	0.03	1.23	4.47	2.92	1009.	79.6	-31.4	-17.6	1.0	30.7	0.2	0.111	39.4	3.67	328.7	1.00	0.77
5	19	663.	26.	11.	0.0	0.02	1.84	6.85	3.29	1213.	100.4	-35.7	-19.7	1.0	45.1	0.2	0.091	39.7	3.70	325.4	1.00	0.72
5	20	487.	29.	12.	0.0	0.01	1.31	4.51	2.42	820.	71.9	-29.6	-16.3	1.0	26.0	0.1	0.051	39.9	3.74	323.0	1.00	0.67
5	21	631.	24.	12.	0.0	0.00	1.79	6.95	2.73	1004.	90.6	-33.2	-18.3	1.0	39.1	0.1	0.114	40.1	3.78	320.3	0.99	0.64
5	22	607.	25.	13.	0.0	0.00	1.66	6.71	2.49	939.	83.7	-31.9	-17.5	1.0	34.4	0.1	0.097	40.3	3.81	317.8	0.96	0.60
5	23	619.	30.	10.	0.0	0.0	1.74	7.26	2.49	956.	82.7	-32.0	-17.3	1.0	33.4	0.1	0.059	40.6	3.85	315.3	0.93	0.57
5	24	701.	37.	19.	0.0	0.0	2.24	9.64	2.93	1083.	61.7	-27.9	-15.2	0.6	18.6	0.1	0.057	40.7	3.88	312.4	0.90	0.54
5	25	706.	36.	19.	1.8	0.0	2.16	9.65	2.80	1091.	71.3	-30.2	-16.2	0.7	24.9	0.1	0.056	40.9	3.92	311.4	0.86	0.51
5	26	601.	34.	17.	0.0	0.0	1.66	7.52	2.26	929.	73.7	-30.7	-16.4	1.0	26.6	0.1	0.047	41.0	3.95	309.1	0.85	0.52
5	27	67.	25.	19.	57.9	0.0	0.0	0.0	0.0	103.	7.9	-16.5	-8.9	1.0	-11.5	0.0	0.0	40.9	3.99	356.3	0.82	0.50
5	28	674.	31.	18.	0.0	0.0	0.0	8.46	5.34	1042.	97.3	-35.6	-19.1	1.0	42.7	0.0	0.0	41.2	4.05	350.9	1.00	1.62
5	29	380.	30.	20.	6.3	0.0	0.0	3.52	2.22	588.	54.9	-26.7	-14.3	1.0	13.5	0.0	0.0	41.3	4.11	355.0	1.00	1.12
5	30	611.	33.	20.	3.3	0.0	0.0	7.71	4.87	944.	81.6	-32.6	-17.4	0.9	31.7	0.0	0.0	41.5	4.18	353.4	1.00	0.97
5	31	393.	29.	22.	0.0	0.0	0.0	3.72	2.35	608.	56.8	-27.2	-14.5	1.0	15.0	0.0	0.0	41.6	4.24	351.1	1.00	0.93
TOT.		16271.			150.		36.	169.	74.	41561.	2414.	-1108.	-625.		681.	3.	1.644					

LAI-TILLER MCDEL
PLANTING DATE: 10/24/79

DATE	TILL/PLANT	LVS/PLANT	LA/PLANT(CM**2)	LA/LEAF(CM**2)	LAI	TUTILL	TULEAVES	KSHAI
5/ 1/80	2.84	6.23	72.19	9.15	0.71	1306.17	1071.68	0.76
5/ 2/80	2.84	5.96	65.04	8.75	0.65	1319.52	1C89.28	0.76
5/ 3/80	2.84	5.69	65.94	8.36	0.59	1332.55	1106.63	0.75
5/ 4/80	2.84	5.40	62.53	7.93	0.53	1346.73	1125.68	0.74
5/ 5/80	2.84	5.08	58.84	7.46	0.47	1362.00	1146.33	0.74
5/ 6/80	2.84	4.73	54.83	6.95	0.41	1378.45	1168.73	0.73
5/ 7/80	2.84	4.42	51.18	6.49	0.36	1393.33	1189.13	0.73
5/ 8/80	2.84	4.18	48.45	6.14	0.32	1404.37	1204.38	0.72
5/ 9/80	2.84	3.96	45.92	5.82	0.29	1415.98	1218.53	0.82
5/10/80	2.84	3.61	41.81	5.30	0.24	1434.71	1241.53	0.81
5/11/80	2.84	3.25	37.62	4.77	0.19	1453.60	1264.93	0.81
5/12/80	2.84	2.89	33.44	4.24	0.15	1472.34	1288.33	0.80
5/13/80	2.84	2.60	30.13	3.82	0.12	1487.04	1306.83	0.79
5/14/80	2.84	[illegible].31	26.78	3.39	0.10	1501.78	1325.53	0.79
5/15/80	2.84	2.09	24.19	3.07	0.08	1516.28	1340.03	1.00
5/16/80	2.84	1.82	21.10	2.67	0.06	1533.58	1357.33	1.00
5/17/80	2.84	1.53	17.68	2.24	0.04	1552.68	1376.43	1.00
5/18/80	2.84	1.25	14.44	1.83	0.03	1570.78	1394.53	1.00
5/19/80	2.84	0.96	11.13	1.41	0.02	1589.33	1413.08	1.00
5/20/80	2.84	0.64	7.42	0.94	0.01	1610.03	1433.78	1.00
5/21/80	2.84	0.36	4.19	0.53	0.00	1628.08	1451.83	1.00
5/22/80	2.84	0.07	C.81	0.10	0.00	1646.98	1470.73	1.00
5/23/80	2.84	0.00	0.00	0.00	0.00	1667.13	1490.88	1.00

MODEL SYS.PHOTO-81.2 1979-80 TAM101 PLANTED 10/24/79 VERNON, TEXAS - VERN #1 SYED

MC	DAY	SR (LYS)	MXT (C)	MNT (C)	RAIN (MM)	LAI	TRAN EVAP (MM)	POT. EVAP (MM)	TOT. EVAP (MM)	INT. LIGHT ME/CMCM	GROSS PHOTC (MG/((DM**2)/DAY))	DAY RESP	NIGHT RESP	TOT. TSTR	NCE	DM/TR (MM/MB)	TVP	CUM DM (MG/CM2)	BMTS	THETA (MM)	KS	KS30
6	1	233.	3C.	15.	3.0	0.0	0.0	1.04	0.66	360.	33.7	-22.5	-11.7	1.0	-0.5	C.0	C.0	41.6	4.30	353.4	1.00	0.88
6	2	541.	34.	22.	0.0	0.0	0.0	6.59	2.49	835.	58.9	-27.9	-14.8	0.8	16.2	0.0	C.0	41.7	4.36	350.9	1.00	0.93
6	3	591.	32.	22.	0.3	0.0	0.0	7.30	1.45	912.	81.8	-32.8	-17.4	1.0	31.6	0.0	0.0	41.9	4.43	349.8	1.00	0.87
6	4	609.	33.	21.	0.0	0.0	0.0	7.64	1.11	940.	82.1	-33.0	-17.4	0.9	31.7	C.0	C.0	42.1	4.49	348.7	1.00	0.85
6	5	676.	34.	23.	0.0	0.0	0.0	9.01	0.94	1044.	70.7	-30.7	-16.2	0.7	23.8	0.0	C.0	42.3	4.55	347.7	1.00	0.82
6	6	671.	36.	21.	0.0	0.0	0.0	9.08	0.83	1036.	58.0	-28.2	-14.7	0.6	15.1	0.0	C.0	42.4	4.61	346.9	1.00	0.80
6	7	644.	39.	23.	0.0	0.0	0.0	8.93	0.75	994.	21.4	-20.6	-10.7	0.2	-9.9	0.0	0.C	42.3	4.68	346.2	1.0C	0.78
6	8	363.	29.	19.	30.2	0.0	0.0	3.19	2.01	561.	52.4	-26.8	-13.9	1.0	11.7	0.0	C.0	42.4	4.74	373.1	1.00	0.76
6	9	408.	25.	18.	0.0	0.0	0.0	3.75	2.37	630.	58.9	-27.9	-14.6	1.0	16.4	0.0	0.0	42.5	4.80	370.7	1.00	1.40
6	10	643.	30.	19.	0.0	0.0	0.0	7.93	5.01	993.	92.7	-35.3	-18.5	1.0	38.9	0.0	0.0	42.8	4.86	365.7	1.00	1.15
6	11	630.	32.	20.	0.0	0.0	0.0	7.91	2.99	973.	90.9	-35.1	-18.3	1.0	37.4	C.0	C.C	43.0	4.93	362.7	1.00	0.82
6	12	694.	32.	17.	0.0	0.0	0.0	8.89	1.45	1072.	0.0	0.0	0.0	1.0	0.0	0.0	0.C	43.0	4.99	361.2	1.0C	C.75
6	13	754.	37.	18.	0.0	0.0	0.0	10.55	1.11	1164.	0.0	0.0	0.0	0.7	0.0	0.0	C.0	43.0	4.99	360.1	1.00	0.72
6	14	681.	38.	18.	0.0	0.0	0.0	9.41	0.94	1051.	0.0	0.0	0.0	0.5	0.C	0.0	0.0	43.0	4.99	359.2	1.0C	0.69
6	15	758.	34.	16.	0.0	0.0	0.0	10.26	0.83	1171.	0.0	0.0	0.0	1.0	0.0	0.0	0.0	43.0	4.99	358.4	1.00	0.67
TCT.		8893.			33.		0.	111.	25.	13736.	701.	-321.	-168.		212.	0.	C.0					

MODELING TILLER PRODUCTION AND COMPONENTS OF LEAF AREA IN WINTER WHEAT AS AFFECTED BY TEMPFRATURE, WATER, AND PLANT POPULATION

by

JEFF BAKER

B. S., Mississippi State University, 1978

AN ABSTRACT OF A MASTER'S THESIS

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requirements for the degree

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Department of Agronomy

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1982

MODELING TILLER PRODUCTION AND COMPONENTS OF LEAF AREA IN WINTER WHEAT AS AFFECTED BY TEMPERATURE, WATER, AND PLANT POPULATION

ABSTRACT

A leaf area index (LAI) term is used by some plant growth models to estimate various quantities such as photosynthesis and evapotranspiration. It is suggested that daily estimates of LAI for winter wheat (*Triticum aestivum* L. em. Thell.) may be obtained by modeling the following individual components of LAI: tillers/plant, leaves/tiller, leaf area/leaf and leaf area/plant using plant population as the single crop parameter. In order to study the effects of environment on each of these components, five cultivars of winter wheat were hand planted during the first week of September and the second week of October, 1979. Equations describing daily changes in each of these components were developed from easily obtainable meteorological data and data collected on plant growth in the field. Predicted values of tillers/plant agreed favorably with observed values from several independent data sets for winter, spring, and durum wheats. The model performed best when estimating LAI for the test fields in which soil moisture became limiting, but failed to adequately match the higher values of LAI for fields in which soil moisture did not become limiting.