POTENTIAL OF INTERPLANTED SOYBEAN AND GRAIN SORGHUM AS A FORAGE FOR DAIRY CATTLE - I

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Summary

Interplanted soybean (100 to 120 lbs/acre) and grain sorghum (15 to 20 lbs/acre) were harvested at 64, 88, 102, 123, and 130 days postplanting to determine the ratio and chemical composition of vegetative and seed parts for each plant at advancing stages of maturity. Initial vegetative dry matter yield was 6,300 lbs/acre and increased to 15,000 lbs/acre with 63% vegetative at 123 days postplanting. Vegetative portions (stems, leaves, stalks) of the soybean and grain sorghum plants constituted 100% of the dry matter at day 64, then decreased to 52% at day 130, whereas the contribution of the soy pod (plus bean) and milo head to total dry matter increased from 0% at day 64 to 13% and 35%, respectively, at day 130. Generally, TDN and crude protein decreased over time in the vegetative plant parts and increased in the seed parts, whereas neutral detergent fiber (NDF) increased in the vegetative plant parts and decreased in the seed parts. Chemical composition at day 123 for the vegetative parts was 56% estimated TDN, 46% ADF, and 9% crude protein. NDF was 74% for grain sorghum and 57% for soy, with the difference contributed by hemicellulose. For the grain parts, TDN was 75%; NDF was 40% for grain sorghum and 28% for soy with the difference contributed by hemicellulose; ADF was 18%; and protein was 9% for grain sorghum and 29% for soy.

Introduction

Localized groups of farmers in Kentucky, Indiana, Tennessee, Virginia, West Virginia, Georgia, South Carolina, Alabama, and Arkansas have been utilizing interseeded soybean-grain sorghum combinations as silage for dairy and beef cattle for many years. More recently, this practice has received much attention because of economic factors.

Selected varieties of soybeans and grain sorghum, under favorable management, will produce as much dry matter per acre as corn silage and cost less to produce. Further, soybean and grain sorghum (soy-sorghum) haylage is higher in protein and mineral content, thus reducing the amount of supplement needed to balance the ration relative to corn silage. Soy-sorghum haylage is of lesser quality than alfalfa but fits into a rotation schedule and has the potential of being an excellent emergency forage crop.

Seeding dates range from early May (soil temperature approximately 60 degrees F) to mid-July (dependent on soil moisture availability). Fertilization rate

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is dependent on soil test but generally includes 30 to 40 lbs of actual nitrogen, 60 to 90 lbs of P_2O_5, and 90 to 120 lbs of K_2O per acre applied preplant. An additional 30 lbs of K_2O is used if the soy-sorghum follows small grain silage.

Harvest dates range from 65 days postseeding (total vegetative stage) to 125 days postseeding (mature). The wide range in potential harvest dates adds flexibility to a soy-sorghum forage system.

The purpose of this study was to ascertain 1) the dry matter and nutritive contribution of vegetative and seed parts of the soybean and grain sorghum to the total composition of the mass, 2) the change in nutrient composition of vegetative and seed parts at various stages of maturity, and 3) the potential nutritive value of soy-sorghum as a forage for ruminants.

Procedures

Lee 74 soybeans and Dekalb C42A grain sorghum were mixed in the ratio of 120 lbs of soybeans to 20 lbs. of grain sorghum then seeded in 7-inch rows with a conventional John Deere grain drill calibrated to deliver 120 lbs of soybean and 20 lbs of grain sorghum seed per acre. Fertilization program included 36 lbs. of actual N, 90 lbs of P_2O_5 and 120 lbs. of K_2O per acre. Fertilizer was applied pre-plant and disked into the top 4 inches of soil.

Plots were replicated 5 times and samples taken from each plot at days 64, 88, 102, 123, and 130 postseeding. Sample sites were selected at random by tossing a large plastic ring of known area into the plots at either two or four locations, dependent on sampling date. All material within the ring was collected and sorted into soybean vegetative (leaves and stems), soybean pod (pod and seed), grain sorghum vegetative (leaves and stems), and grain sorghum seed head (seed head severed from stalk one inch below bottom seed). Plant parts were air dried to 90% dry matter by spreading in a large room maintained at 85 degrees Fahrenheit and equipped with a forced-air ventilation system. Each air-dried plant part was weighed and analyzed for nutrients, and the values from plots were averaged for statistical analyses. Chemical analyses were done by K-C Agriculture Laboratory Services, Nevada, Missouri, except for neutral detergent fiber (NDF) and sodium chloride insoluble nitrogen (Na-I-N), which were determined at Rutgers University, New Jersey.

Total dry matter yield per acre and percent contribution from individual plant parts were determined by relating the amount harvested within the ring to the area represented in the ring and expanding to a per acre basis. Values obtained with this method were determined to be reasonable estimates by direct comparison to weights obtained from whole plot harvest.

Results and Discussion

Total dry matter yield per acre and the contribution of vegetative and seed parts to the total dry matter over time is shown in Table 1. Maximum dry matter

Table 1. Contribution of soybean and grain sorghum plant parts to dry matter yield

	Age of Forage, Days				
Item	64	88	102	123	130
DM, lbs/acre	6,291	10,082	13,162	15,008	12,388
Soy Pod, %	0	2	6	9	13
Grain Sorghum Head, %	0	14	26	28	35
Vegetative, %	100	84	68	63	52

(DM) yield occurred at day 123 postseeding and just prior to a heavy frost (day 125). Soy pod and grain sorghum head contributions to total DM increased rapidly between day 88 and day 102. This followed a rapid increase in grain sorghum heads from 0% at day 64 to 14% at day 88.

Total digestible nutrients (TDN) remained relatively constant over time (Table 2) in the vegetative plant parts and the soy pod but increased from 62% at day 88 to 77% at day 123 in the grain sorghum head. TDN from all sources maximized at day 123.

Table 2. TDN, % of dry matter.

	Age of Forage, Days				
Item	64	88	102	123	130
Grain Part					
Soy	--	71	69	74	74
Grain Sorghum	--	62	73	77	78
Vegetative Part					
Soy	59	59	58	56	51
Grain Sorghum	59	56	56	56	54

Differences from forage and forage part were significant [$P<.02$].

R^2 from $A + T + T^2$ regression from top to bottom were .34, .92, .53 and .39.

Total protein remained constant in the soy pod and grain sorghum head from day 88 through day 130 but decreased in the vegetative parts with advancing maturity (Table 3). Neutral detergent fiber (NDF) content in the vegetative part

Table 3. Total protein, % of dry matter

	Age of Forage, Days				
Item	64	88	102	123	130
Grain Part					
Soy	—	22	28	29	28
Grain Sorghum	--	9	10	9	8
Vegetative Part					
Soy	17	14	15	11	9
Grain Sorghum	12	8	7	7	6

Differences from forage and forage part were significant [P<.01].

R^2 from A + T + T^2 regression from top to bottom were .30, .32, .41 and .54.

was not affected by stage of maturity. However, NDF decreased dramatically in the grain sorghum head between 88 and 123 days postseeding. Only a slight decrease in NDF was observed in the soy pod by day 123. (Table 4).

Table 4. NDF, % of dry matter

	Age of Forage, Days				
Item	64	88	102	123	130
Grain Part					
Soy	—	36	36	28	29
Grain Sorghum	--	72	51	40	35
Vegetative Part					
Soy	50	53	55	57	62
Grain Sorghum	71	72	73	74	77

Differences from forage and forage part were significant [P<.01].

R^2 from A + T + T^2 regression from top to bottom were .40, .74, .54 and .35.

Acid detergent fiber insoluble protein (ADF-I-P) remained relatively constant in seed parts but increased in the vegetative parts of both soybean and grain sorghum through day 123 (Table 5).

Table 5. ADF IP, % of total protein

	Age of Forage, Days				
Item	64	88	102	123	130
Grain Part					
Soy	--	4	3	5	6
Milo	--	23	19	24	19
Vegetative Part					
Soy	15	13	17	23	25
Milo	22	21	31	30	22

Differences from forage and forage part were significant.

R^2 from A + T + T^2 regression from top to bottom were .41, .00, .34 and .12.

These results suggest that soy-sorghum may be harvested as silage either in the vegetative stage or during various stages of soy pod and grain sorghum head formation with little change in total nutrient composition. However, maximum dry matter yield per acre is obtained when the grain sorghum is near the soft dough stage. Decreased TDN and protein percentage in vegetative parts with advancing maturity were offset by an increase in TDN and protein percentage of the seed parts. Subsequent animal acceptance of soy-sorghum silage was apparently not affected by stage of maturity.

Further studies involving animal performance and digestibility at the various soy-sorghum maturity stages is needed to ascertain the best time to harvest the crop.