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Biomass Production of Single Species Cover Crop

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Biomass Production of Single Species Cover Crop

Abstract

Cover crops can benefit agricultural production by improving soil health and productivity, reducing weeds, and providing biomass for grazing. In this one-year study, biomass production was measured in 17 different single species summer cover crops and a fallow control. Overall, grass species produced more biomass than brassicas, with legumes, broadleaves, and fallow yielding intermediate amounts of biomass. Within the grass species, pearl millet, brown midrib (BMR) sorghum, and sorghum sudan produced more biomass than proso millet; German millet and browntop millet had intermediate biomass production. Within the brassicas, both brown and yellow mustards produced more biomass than collards. There was no difference in biomass production within the broadleaf species or the legume species tested. Plots that produced higher amounts of biomass also had fewer weeds, indicating the potential for cover crops to reduce weed growth and establishment. The cost of biomass production varied widely between the cover crops, with the broadleaf and grass species being the least expensive. Choice of a cover crop depends on the goals. Based on cost, weed suppression, and grazing potential, the most suitable cover crops identified in this study were pearl millet, BMR sorghum, sorghum sudan, German millet, okra, and cowpea.

Keywords

cover crop, summer annual, weeds, biomass production

Cover Page Footnote

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K-STATE Research and Extension

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G.F. Sassenrath and J.K. Farney

Summary

Cover crops can benefit agricultural production by improving soil health and productivity, reducing weeds, and providing biomass for grazing. In this one-year study, biomass production was measured in 17 different single species summer cover crops and a fallow control. Overall, grass species produced more biomass than brassicas, with legumes, broadleaves, and fallow yielding intermediate amounts of biomass. Within the grass species, pearl millet, brown midrib (BMR) sorghum, and sorghum sudan produced more biomass than proso millet; German millet and browntop millet had intermediate biomass production. Within the brassicas, both brown and yellow mustards produced more biomass than collards. There was no difference in biomass production within the broadleaf species or the legume species tested. Plots that produced higher amounts of biomass also had fewer weeds, indicating the potential for cover crops to reduce weed growth and establishment. The cost of biomass production varied widely between the cover crops, with the broadleaf and grass species being the least expensive. Choice of a cover crop depends on the goals. Based on cost, weed suppression, and grazing potential, the most suitable cover crops identified in this study were pearl millet, BMR sorghum, sorghum sudan, German millet, okra, and cowpea.

Introduction

Cover crops have a long history of use in agricultural production systems. The USDA 1938 Yearbook of Agriculture (USDA, 1938) refers to their use in maintaining soil organic matter. Sweet clover was commonly used as a green manure to provide nitrogen to the soil. A cover crop is typically grown during the dormant period following a grain crop and terminated before the planting of the next cash crop. Cover crops can also be used to provide grazing, reducing feed costs for cattle production. Cover crops are also valuable for reducing soil erosion and building the soil for improved productivity of the subsequent crop. Keeping the ground covered with a cover crop can also be a method of reducing weed pressure.

There are many new options of cover crops available to producers, many with highly-touted benefits. Multi-species cover crop mixtures are often promoted as being beneficial. However, these mixes can be quite expensive, though the exact benefits are not clear. Alternatively, single species cover crops have been demonstrated to provide

sufficient biomass and nutritional quality for grazing and are potentially much more economically feasible (Farney et al., 2018a, b).

Research is needed on how cover crops grow. The actual impacts of cover crops on the agricultural system are not clear. This study was undertaken to determine how different types of cover crops grew in southeast Kansas. Total biomass production was measured. Impact of cover crop on weed production was also noted.

Experimental Procedures

Cover crops were planted in 10 × 40 ft. replicated plots at the Southeast Research and Extension Center research fields near Columbus, KS. Cover crops were selected based on recommendations from the Midwest Cover Crops Council Cover Crop Decision Tool for Cherokee County, KS (http://mccc.msu.edu/covercroptool/covercroptool.php). Plant species were selected for the following characteristics: biomass production (residue); grazing capacity; soil health-building ability; weed suppression; or nitrogen fixation (Table 1). Seventeen cover crops were chosen, with a fallow treatment that had no cover crops planted in it.

Cover crop seed was purchased from Green Cover Seed, Bladen, NE, and DeLange Seed, Inc., Girard, KS. Prices are based on purchase costs of 50 pounds.

Results and Discussion

Biomass Results

Biomass production varied by cover crop (Figure 1). The grasses had the highest biomass production, and of those, pearl millet, sorghum sudan, and BMR sorghum produced the greatest amount of biomass. Okra, cowpea, German millet, and sunn hemp produced intermediate amounts of biomass, roughly equivalent to that produced by the weeds in the fallow treatment. The weed species were mostly crabgrass and foxtail. Pigweed was found in some of the treatments.

Some interesting observations were made with weed pressure. For most of the cover crops with lower biomass (less than ~3000 lb dry matter/a), the weed pressure was high. One notable exception was the collards. The collards had the lowest biomass production (1435 lb/a), but no weed pressure. This may result from the compact growth habit of collards, with the growing point close to the soil surface, and large leaves that shaded out weeds (Figure 2). Collards also had the second-highest water content of any of the cover crops (data not shown); therefore, the dry matter measurement may not adequately capture the amount of plant material in the plots. Note that common vetch, mung bean, and spring forage pea all had biomass slightly greater than 4000 lb/a, but only mung bean had no weeds. This resulted in part because of the greater canopy coverage by the mung bean, effectively shading out weeds (Figure 2).

The biomass clippings reported here were taken nearly 60 days after those reported in Farney and Sassenrath (2019). As observed at the earlier harvest date, the highest biomass was produced by the grasses, particularly pearl millet, sorghum sudan, and BMR sorghum. The extra growth time appeared to allow the spring forage peas a greater

biomass production than found in the earlier sampling period in July but was still insufficient to reduce weed pressure.

Costs to plant the species varied widely from a low of $5/a for okra to a high of $49.20/a for cowpeas (Table 1). Seeding rates were based on the average suggested planting rate. Costs for biomass production were cheapest for brassicas and grasses (Figure 3). Costs per ton of biomass were also low for cowpea and spring forage pea, but spring forage pea did not produce sufficient canopy to reduce weed pressure. Although collards were good at suppressing weeds and are reported to be excellent forage (GreenCoverSeed.com), the cost per ton of biomass produced was the highest of all the 17 cover crops tested.

In summary–based on cost, weed control, and grazing potential–pearl millet, BMR sorghum, sorghum sudan, German millet, okra, and cowpea were all suitable cover crops. Brassicas such as mustard may improve the soil health. Yellow mustard in particular has higher glucosinolate concentrations than other brassicas and has been shown to reduce certain soil-borne diseases (Sassenrath et al., 2017, 2019). However, the mustards cost more than average per ton biomass produced and were not good at suppressing weeds. Moreover, they have limited grazing potential. Mung bean and sunn hemp were able to reduce weed pressure and are a potential source of additional nitrogen. However, the cost per ton of biomass for mung beans is high. Moreover, it is not clear whether sunn hemp is safe or palatable for cattle to graze. The safflowers, browntop millet, and proso millet were inexpensive to produce, but did not reduce weed pressure. Cattle will not graze safflower, though the millets should be good forage quality.

Crop producers are accustomed to receiving accurate, detailed information about seed for crop production. Unfortunately, cover crop seeds are not nearly as well regulated, and information of specific genus and species for cover crops are often not available. Additional information, such as planting rates, fertility requirements, and germination are also often lacking. More critically, detailed information about potential toxicity of cover crop seed or foliage is not readily available. For a more detailed description of cattle preference to some of the plant species discussed in this section please refer to Farney (2019) in this experiment station report. Additionally, a detailed list of potential toxicity issues and management for toxicity issues can be found in the extension publication MF3244 (Farney et al., 2018). Many cover crops have potential toxicity concerns for cattle producers, and thus understanding the potential issues and management strategies will aid in selection of plants to use as both a cover crop and forage.

Acknowledgment

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Table 1. Benefits and agronomics of cover crops used in the study

	Benefits*					Agronomics	
Cover Crop	Residue	Good grazing	Soil builder	Weed fighter	Nitrogen source	Seeding rate, lb/a	Price $/a
Brassica							
Collards[1]	1	4	3	3	0	8	15.20
Brown mustard	1	0	2	3	0	8	15.60
Yellow mustard	1	0	2	3	0	8	29.25
Broadleaf							
Okra[1]	2	2	2	2	0	5	5.00
Baldy safflower	3	0	1	1	0	15	11.20
Safflower	3	0	1	1	0	15	11.20
Grass							
Brown midrib sorghum	4	3	4	4	0	20	33.30
Sorghum sudan	4	4	4	4	0	20	27.00
Brown top millet	3	3	3	3	0	20	13.00
German millet	3	3	3	3	0	20	10.00
Pearl millet	4	4	4	4	0	20	26.75
Proso millet	3	3	3	3	0	20	7.50
Legume							
Cowpea	1	3	3	2	4	50	49.20
Mung bean	1	2	1	1	3	15	5.10
Spring forage pea	1	3	1	1	3	50	31.20
Common vetch	1	0	2	2	3	25	5.70
Sunn hemp	4	1	3	3	4	15	18.60

*: 0 = poor; 1 = fair; 2 = good; 3 = very good; 4 = excellent; from the Midwest Cover Crops Council.
[1]Information from GreenCoverSeed.com.

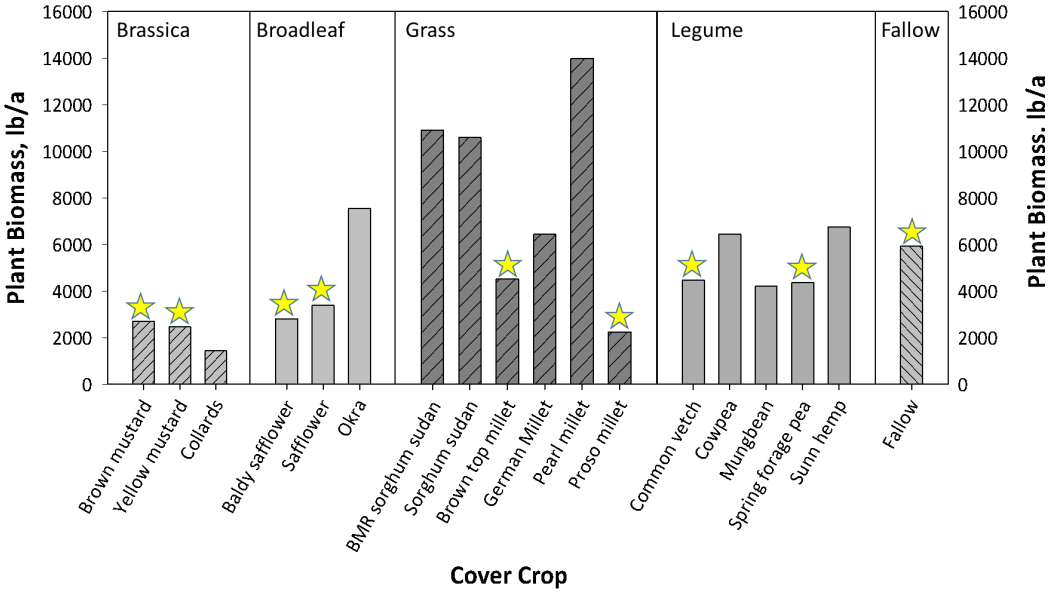

Figure 1. Biomass production from 17 single species cover crops and fallow. Averages of three replications are given. Plots with high weed pressure are indicated by a star. Fallow was entirely comprised of weeds.

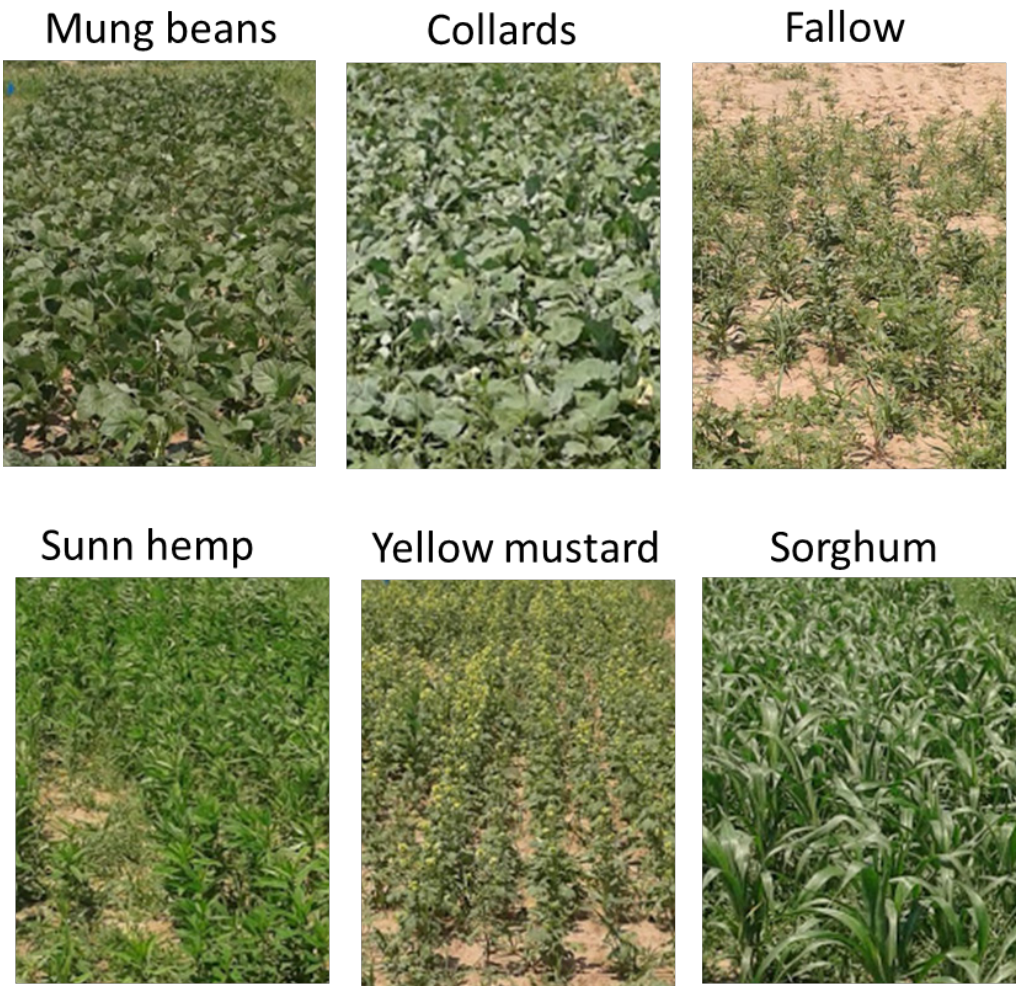

Figure 2. Cover crops in early summer 2018.

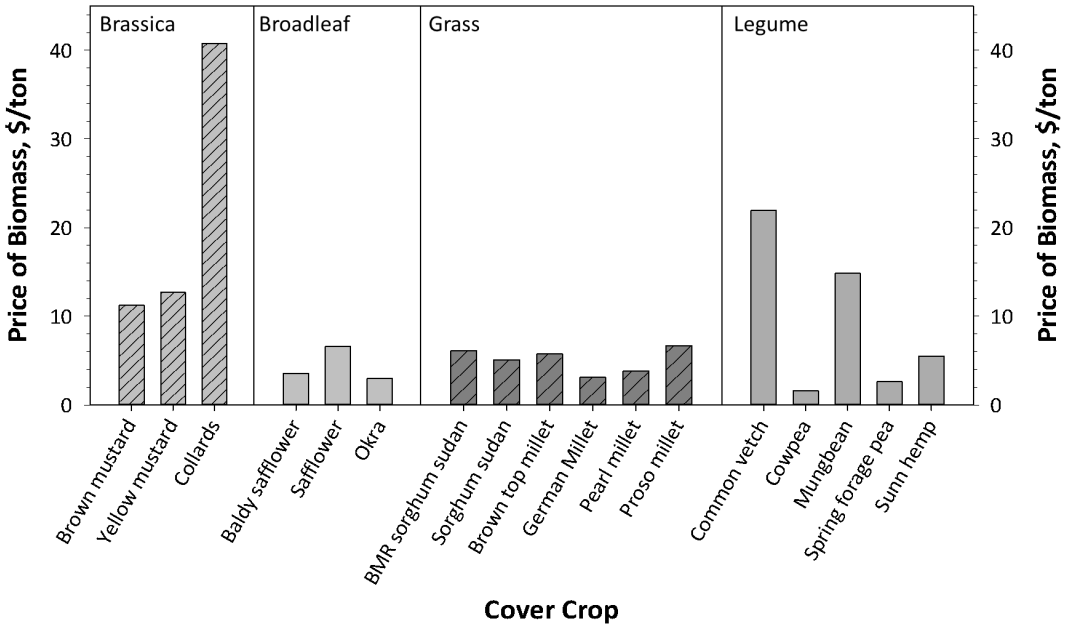

Figure 3. Cost of production per pound of biomass produced for the 17 cover crop species, $/ton.