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Management Strategies for Double-Crop Soybean Planted After Wheat

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Management Strategies for Double-Crop Soybean Planted After Wheat

Abstract

Double-crop (DC) soybeans (*Glycine max* L.) are gaining popularity as an alternative system to intensify productivity without expanding the farming area and can potentially increase net return. However, the DC soybean system faces many challenges such as late planting, which decreases yield potential. A study was conducted in four site-years in Ashland Bottoms, KS, during the 2016 and 2017 growing seasons. In both years, the soybean variety planted was Asgrow 4232 (MG 4.2). The soybean was planted right after two different wheat harvest timings (Study 1, early-wheat harvest 18–20% moisture; and Study 2, conventional-harvest 13–14% moisture). Seven treatments were evaluated in each of the soybean planting dates: 1) common practice; 2) no seed treatment (without seed fungicide + insecticide treatment); 3) non-stay green (without foliar fungicide + insecticide application); 4) high seeding rate (180,000 seeds/a); 5) wide rows (30-inch row-spacing); 6) nitrogen (N) fixation (without late-fertilizer N application); and 7) kitchen sink (includes all management practices). There was adequate precipitation distribution in 2016, which helped to nurture the soybean plants even when planting later in the season. In 2017, precipitation was not well distributed, and the early planting date was affected by low precipitation during early season. Overall, the high plant population and the kitchen sink treatments presented maximum yields, while the common practice scenario showed the lowest yields.

Keywords

soybean, improve yield, intensive management

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Summary

Double-crop (DC) soybeans (*Glycine max* L.) are gaining popularity as an alternative system to intensify productivity without expanding the farming area and can potentially increase net return. However, the DC soybean system faces many challenges such as late planting, which decreases yield potential. A study was conducted in four site-years in Ashland Bottoms, KS, during the 2016 and 2017 growing seasons. In both years, the soybean variety planted was Asgrow 4232 (MG 4.2). The soybean was planted right after two different wheat harvest timings (Study 1, early-wheat harvest 18–20% moisture; and Study 2, conventional-harvest 13–14% moisture). Seven treatments were evaluated in each of the soybean planting dates: 1) common practice; 2) no seed treatment (without seed fungicide + insecticide treatment); 3) non-stay green (without foliar fungicide + insecticide application); 4) high seeding rate (180,000 seeds/a); 5) wide rows (30-inch row-spacing); 6) nitrogen (N) fixation (without late-fertilizer N application); and 7) kitchen sink (includes all management practices). There was adequate precipitation distribution in 2016, which helped to nurture the soybean plants even when planting later in the season. In 2017, precipitation was not well distributed, and the early planting date was affected by low precipitation during early season. Overall, the high plant population and the kitchen sink treatments presented maximum yields, while the common practice scenario showed the lowest yields.

Introduction

Sustainable intensification of agricultural systems should be better studied and practiced, with the objective of increasing food production to meet the global population's needs. Although challenging, the goal of increasing soybean yields is possible with new and innovative technologies and cropping systems, improved production methods, and effective educational/technology transfer programs. Double-cropping (DC) soybean after small grains addresses world food demand by growing two crops in one year, and simultaneously addresses environmental concerns by growing a harvestable "cover crop" and minimizing the cost of summer weed control where there is no direct return on investment. Also, with declining commodity prices of wheat, producers are seeking other avenues to increase the productivity of their land and increase net return from their farms. Soybean can be managed in no-till (NT) systems, reducing costs due to less machinery, fuel, and labor expenses after the wheat harvest. Furthermore, NT maintains wheat residue on the soil surface, which prevents excessive runoff of nutrients and other chemicals and enhances good soil properties. Double-crop soybean area increased by 28% from 1988 to 2012 in the United States (Seifert and Lobell, 2015). The total

DC area was projected to be 4.5 million acres representing 5% of the soybean planted area in the US (USDA – NASS, 2018). However, the yield gap between full-season and double-crop soybeans is large, with the risk of crop failure due to heat and drought during the late summer. To improve yields for DC soybean some management practices should be further investigated:

- Fertilizer application, promoting stronger plant growth and earlier canopy closure to overcome stresses due to a late planting season;
- Ideal row spacing and seeding rate, allowing more plants in the same unit area, potentially suppressing weed establishment and increasing yield;
- Integrated pest management, the risk of late summer soil and foliar disease and insects could decrease yield; and
- Earlier planting time to lengthen growing season and allow more time for soybean plants to set pods and seed before the first killing frost.

The objective of this study was to improve yields and profitability of soybeans grown in double crop systems without sacrificing wheat yield or profitability, and identify the main yield-limiting factors affecting crop productivity.

Procedures

The soil type at the Ottawa, KS, location was a Woodson silt loam (Mollisols) and at Ashland Bottoms, KS, location it was a Belvue silt loam. Soil samples were taken prior to planting at a depth of 0 to 6 in. Soil chemical parameters analyzed were pH, Mehlich P, cation exchange capacity (CEC), organic matter (OM), calcium, magnesium, and potassium (K) availability (Table 1).

The studies were arranged in a randomized complete block design with four replications. Plot size was 10-ft wide × 60-ft long. The soybean variety utilized was Asgrow 4232, maturity group 4.2. Soybean was planted immediately after wheat harvest of the cultivar WB Cedar. In each year, there were two experiments with two different planting dates (based on early and late wheat harvest). Early planting dates were June 10, 2016, and June 13, 2017; and late planting dates were June 23, 2016, and June 22, 2017. Seven treatments were evaluated: 1) common practice; 2) no seed treatment; 3) non-stay green; 4) high plant population (180,000 seeds/a); 5) wide rows (30 in.); 6) N fixation (without late-season fertilizer N); and 7) kitchen sink. The specific management practice included for each treatment is listed in Table 2.

The seed treatment was Acceleron Standard (Monsanto Company) which contains a fungicide + insecticide. For the foliar fungicide + insecticide application, the chemicals used were Aproach Prima + Prevathon (6 + 17 fl oz/a) and applied to soybean at the R3-R4 growth stage. Herbicides and hand weeding were used to maintain no weed interference for the entire season. Fertilizer application was performed on treatments 2 to 7 using the formulation 7-7-7-7S-7Cl (chloride). The application rate was 10.93 lb/a of N, phosphorus (P), potassium (K), sulfur (S), and chlorine (Cl). In treatment 2 to 6, late N was applied at a rate of 51 lb/a, in the formulation of 32-0-0 (N-P-K). Biomass was collected in a 12.5 ft^2 area, sampled outside the area collected for yield.

Results

Yield and Biomass

The year of 2016 presented adequate precipitation distribution and quantity. Therefore, there were no significant effects when comparing yield responses to management treatments (Figure 1). In 2017, precipitation distribution was not ideal for early planting. There was no rain between early and late planting, and for that reason, the experiment that was planted later presented an advantage in relation to uniform emergence.

For all the experiments, except for the early planting in 2017, the high plant population and kitchen sink treatments showed a trend of greater yields relative to the other treatments evaluated in this study.

Biomass accumulation was greater in 2016 for both planting dates when compared to 2017 (Figure 2). However, there were no significant effects for difference among planting dates or treatments for biomass accumulation.

Conclusions

Despite early planting being beneficial when planting DC soybeans, in a year with not very well distributed rain events, it is critical to observe previous soil moisture and precipitation forecast to guarantee good plant emergence and establishment of seedlings.

When planting DC soybean, it is strongly recommended to increase seed quantity. In adverse conditions, greater seed number will help to maintain plant population at a recommended level.

References

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Seifert, C. A., & Lobell, D. B. (2015). Response of double cropping suitability to climate change in the United States. *Environmental Research Letters*, *10*(2), 024002.

Table 1. Pre-plant soil characterization at 0- to -6-in. depth at Ashland, KS, for 2016 and 2017

Soil parameters	2016	2017
pH	5.9	6.1
Mehlich P (ppm)	57.7	62.5
CEC (meq/100 g)	7	9.4
Organic matter (%)	1.1	1.5
Potassium (ppm)	223.0	206.3
Calcium (ppm)	1028.8	1061.1
Magnesium (ppm)	105.8	118.3

CEC = cation exchange capacity.

Table 2. Management practices for treatments imposed on double-crop soybean planted after wheat for the early- and late-planting studies at Ashland Bottoms, KS, in 2016 and 2017

Treatment	Description	Seed treatment	Fungicide/ insecticide	Fertility	Population	Rows	Late nitrogen
1	Common practice	No	No	No	140K	30	No
2	No seed treatment	No	Yes	Yes	140K	15	Yes
3	Non-stay green	Yes	No	Yes	140K	15	Yes
4	High population (180K)	Yes	Yes	Yes	180K	15	Yes
5	Wide rows	Yes	Yes	Yes	140K	30	Yes
6	Nitrogen fixation	Yes	Yes	Yes	140K	15	No
7	Kitchen sink	Yes	Yes	Yes	140K	15	Yes

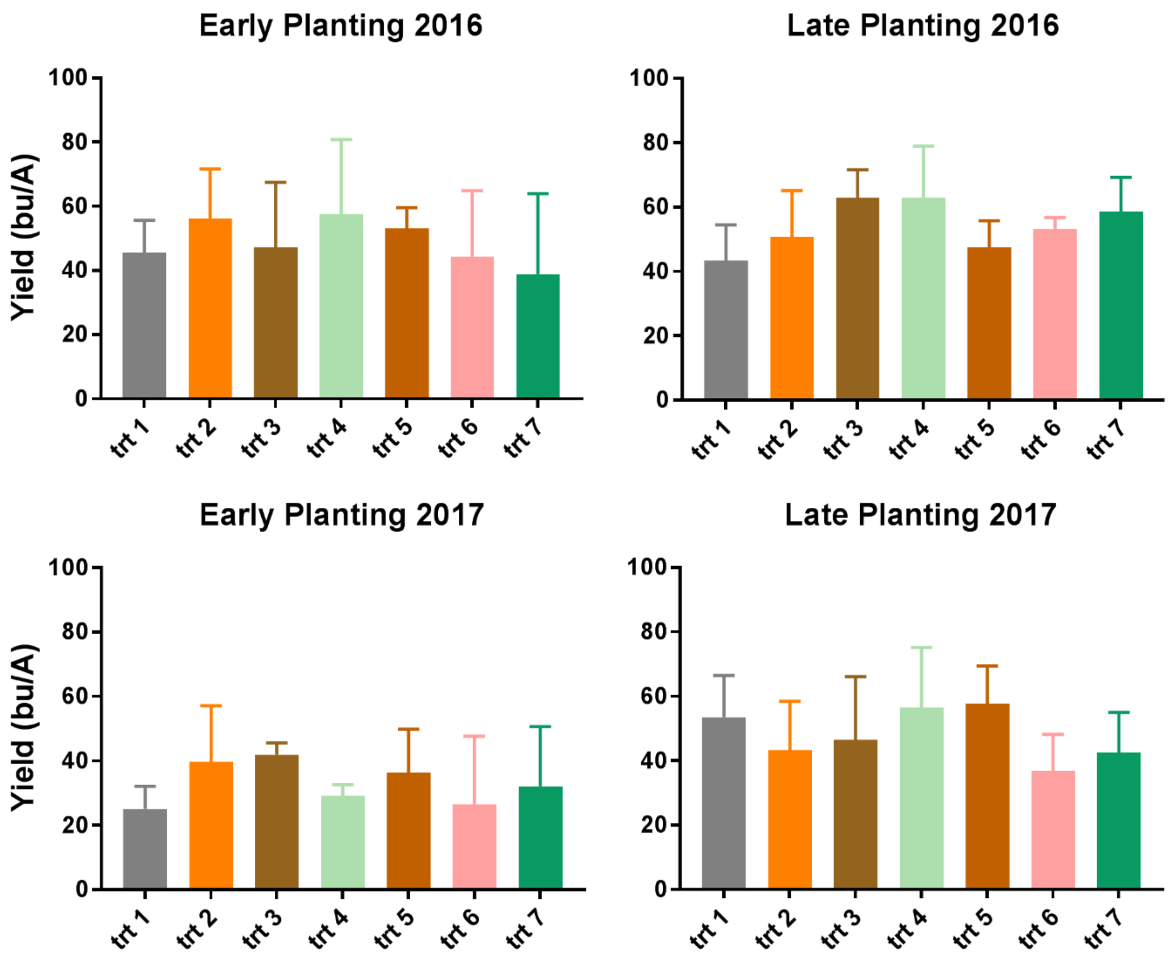

Figure 1. Grain yield for double-crop soybean, when planted early and late at Ashland Bottoms, KS, for 2016 and 2017. See Table 1 for list of treatments.

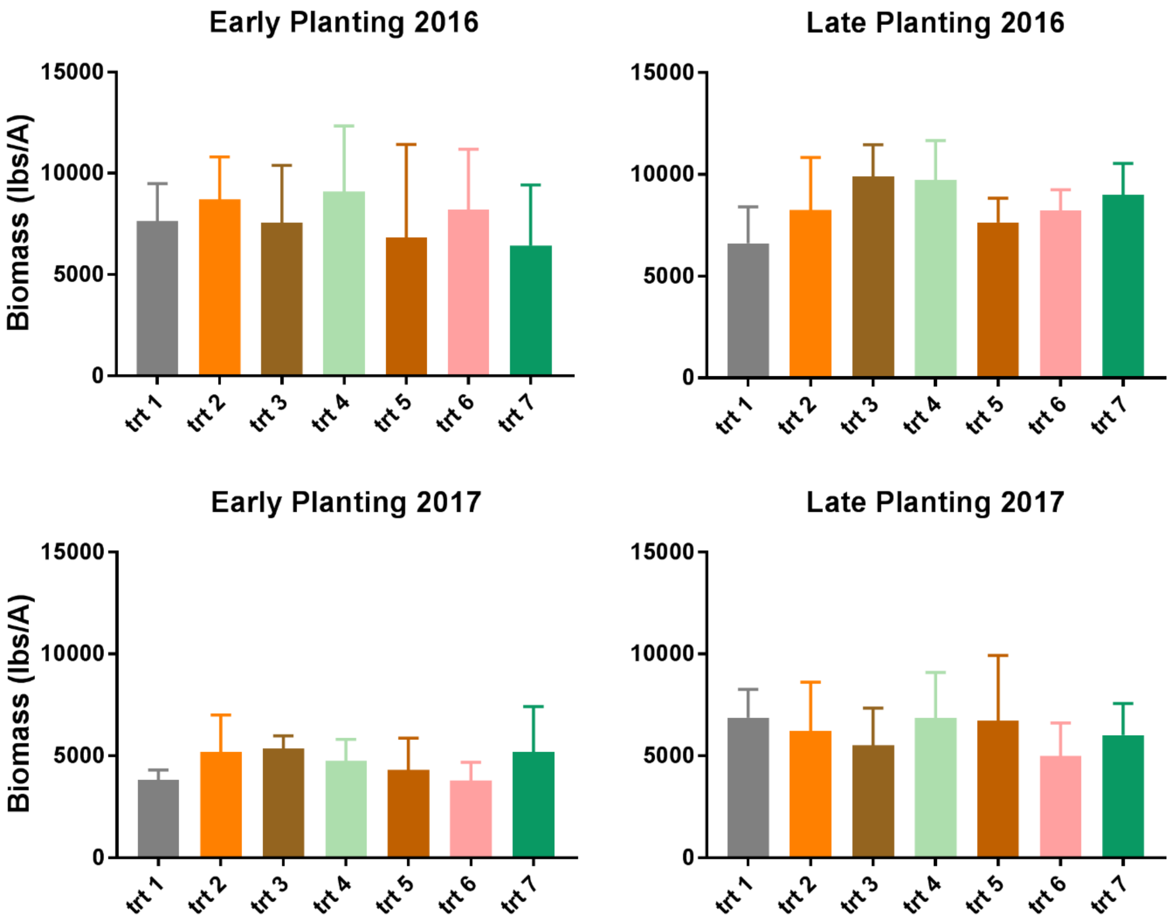

Figure 2. Dry biomass at growth stage R7 (maturity) for double-crop soybean, when planted early and late at Ashland Bottoms, KS, for 2016 and 2017. See Table 1 for list of treatments.