Kansas Agricultural Experiment Station Research Reports

Volume 4
Issue 7 *Kansas Field Research*

Article 6

2018

Effect of Management Practices on Double-Crop Soybean Yields

D. S. S. Hansel
Kansas State University, damaris@ksu.edu

J. Kimball
Kansas State University, jkimball@ksu.edu

D. E. Shoup
Kansas State University, dshoup@ksu.edu

I. A. Ciampitti
Kansas State University, ciampitti@ksu.edu

Recommended Citation

Hansel, D. S. S.; Kimball, J.; Shoup, D. E.; and Ciampitti, I. A. (2018) "Effect of Management Practices on Double-Crop Soybean Yields," *Kansas Agricultural Experiment Station Research Reports*: Vol. 4: Iss. 7. https://doi.org/10.4148/2378-5977.7607

Effect of Management Practices on Double-Crop Soybean Yields

Abstract

Double-crop soybean has great potential to increase profits and the use of agricultural land. However, there is a gap between double-crop versus full-season soybean yields. To address this yield difference, a study evaluating different management practices on double-crop soybean was conducted. A four-site-year experiment was conducted at Ottawa, KS, during the 2016 and 2017 growing season. 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%; and Study 2, conventional-harvest 13–14%). 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). In the 2017 season, a treatment was added with the purpose of isolating the fertilizer effect, 8) no fertilization (F). Aboveground biomass and yield were recorded. For the 2016 season, there was a different response for early and late planting in relation to yield responses. For the early planting, there were no differences in yield. However, for the late planting, high plant population, wide-rows and kitchen sink showed greater yields. For the early planting, the differences in biomass were not related to differences in yield. For the late planting, greater biomass corresponded to superior yields, except for the kitchen sink treatment that presented low biomass and greater yields, potentially via increasing biomass partitioning to the seed. For the 2017 season, biomass and yield followed the same pattern, yields increased in parallel to biomass. For the early planting, greater yields were observed for the high plant population, no nitrogen applied in reproductive R3, and kitchen sink. There were no significant differences in yield among treatments for the late planting date in 2016. However, in both years' yields were lower for late planting dates when compared with the early planting.

Keywords

soybean, improve yield, intensive management

Effect of Management Practices on Double-Crop Soybean Yields

D.S.S. Hansel, J. Kimball, D.E. Shoup, and I.A. Ciampitti

Summary

Double-crop soybean has great potential to increase profits and the use of agricultural land. However, there is a gap between double-crop versus full-season soybean yields. To address this yield difference, a study evaluating different management practices on double-crop soybean was conducted. A four-site-year experiment was conducted at Ottawa, 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%; and Study 2, conventional-harvest 13–14%). 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). In the 2017 season, a treatment was added with the purpose of isolating the fertilizer effect, 8) no fertilization (F). Aboveground biomass and yield were recorded. For the 2016 season, there was a different response for early and late planting in relation to yield responses. For the early planting, there were no differences in yield. However, for the late planting, high plant population, wide-rows and kitchen sink showed greater yields. For the early planting, the differences in biomass were not related to differences in yield. For the late planting, greater biomass corresponded to superior yields, except for the kitchen sink treatment that presented low biomass and greater yields, potentially via increasing biomass partitioning to the seed. For the 2017 season, biomass and yield followed the same pattern, yields increased in parallel to biomass. For the early planting, greater yields were observed for the high plant population, no nitrogen applied in reproductive R3, and kitchen sink. There were no significant differences in yield among treatments for the late planting date in 2016. However, in both years yields were lower for late planting dates when compared with the early planting.

Introduction

Double-crop (DC) soybean is cultivated in many regions of United States. In most double-crop systems, soybean is planted immediately after wheat harvest, which increases potential profit where there would be fallow or a non-cash cover crop. Also, soybean can be managed in no-till (NT) systems, reducing costs with less machinery expense after the wheat harvest. Furthermore, NT maintains wheat residue on soil surface, enhancing good soil properties. However, there are many challenges that discourage farmers from planting double-crop soybean. The yield gap between full-season and double-crop soybeans is large, with the high risk of crop failure due to heat and drought during the late summer. To improve yields for DC soybean there are some management practices that should be further investigated: 1) fertilizer application, promoting stronger plant growth and earlier canopy closure to overcome stresses due to a late planting season; 2) ideal row spacing and seeding rate, allowing more plants in the same unit area, potentially suppressing weed establishment and increasing yield; 3) integrated pest management, due to the late planting, the risk of late summer soil and foliar disease and insects could decrease yield; and 4) 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 in double-crop soybean planted after wheat harvest and identify the main yield-limiting factors affecting crop productivity from a perspective of environment and management practices.

Procedures

The soil type at the Ottawa location was a Woodson silt loam (Mollisols). Soil samples were taken prior to planting at a depth of 0 to 6 in. Soil chemical parameters analyzed were pH, Melich 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 4 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. Study 1 (early wheat harvest) was planted on June 10, 2016, and June 13, 2017, and Study 2 (conventional wheat harvest) on June 23, 2016, and June 22, 2017. Seven treatments were evaluated in 2016 season: 1) common practice, CP; 2) no seed treatment, NST; 3) non-stay green, NSG; 4) high plant population (180,000 seeds/a), HP; 5) wide rows, WR (30-in.); 6) N fixation, NF (without late-season fertilizer N); and 7) kitchen sink, KS. In the 2017 season, the same seven treatments from the previous year were evaluated, plus a treatment isolating the effect of fertilization (without fertilization—treatment 8). 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), K, S and 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

Despite DC soybean usually yielding significantly less than full-season soybean, the 2016 season was a very good year for summer crops, with weather conditions that favored a high-yielding environment. In 2017, the weather conditions were normal. Double-crop soybean yields were lower than in 2016. Yields in 2016 were between 50 and 70 bu/a, and in 2017 ranged between 40 and 60 bu/a.

The accumulated seasonal precipitation was 17.6 in. in 2016, which was 4 inches greater than the 2017 summer growing season, and was well distributed throughout the growing season.

Biomass and Grain Yield

In 2016, in studies 1 and 2, plant biomass was greater for the wide rows, while lower values were recorded for the non-stay green treatment. For seed yield, in Study 1, the N fixation treatment presented the greatest yield at 64 bu/a, while the common practice was the lowest yield level at 58 bu/a (Figure 1). The yield gap between maximum and minimum yield values in this study was approximately 6 bu/a (Figure 1). In Study 2, the common practice yielded the least again in addition to the no seed treatment at 57 bu/a. The yield gap from maximum (wide rows treatment) and minimum yielding (common treatment) treatments was 7.5 bu/a (Figure 1).

In 2017, yields were lower for the late planting compared with the early planting, even with a small difference of 9 days in planting. Late planting did not present any significant differences in yield. However, early planting presented greater yields for the treatments of high population, N fixation, and kitchen sink. The greatest difference in productivity was between high population and common practices, with a 13 bu/a difference in yields.

Conclusions

When planting DC soybean, a higher plant population is required to overcome the stresses of planting out of the ideal timing. Yields were also maximized when all inputs were added. Late planting yielded less than early planting in all four site years. Therefore, anticipating planting of DC soybeans is a strategy that was demonstrated to be efficient for increasing yields. Best management practices for DC soybean can improve overall productivity, increasing yield and biomass. Further evaluation and testing should be performed to better understand and predict the effect of management practices on DC soybean systems.

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

Soil parameters	2016	2017
pH	5.8	5.7
Mehlich P (ppm)	14.5	19.6
CEC (meq/100 g)	15.4	23.6
Organic matter (%)	2.8	3.0
Potassium (ppm)	79.3	122.9
Calcium (ppm)	2248.7	2447.4
Magnesium (ppm)	303.5	348.7

Table 2. Management practices for treatments imposed on double-crop soybean planted after wheat for the early- and late-planting studies at Ottawa, 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
8	No fertilization	Yes	Yes	No	140K	15	Yes

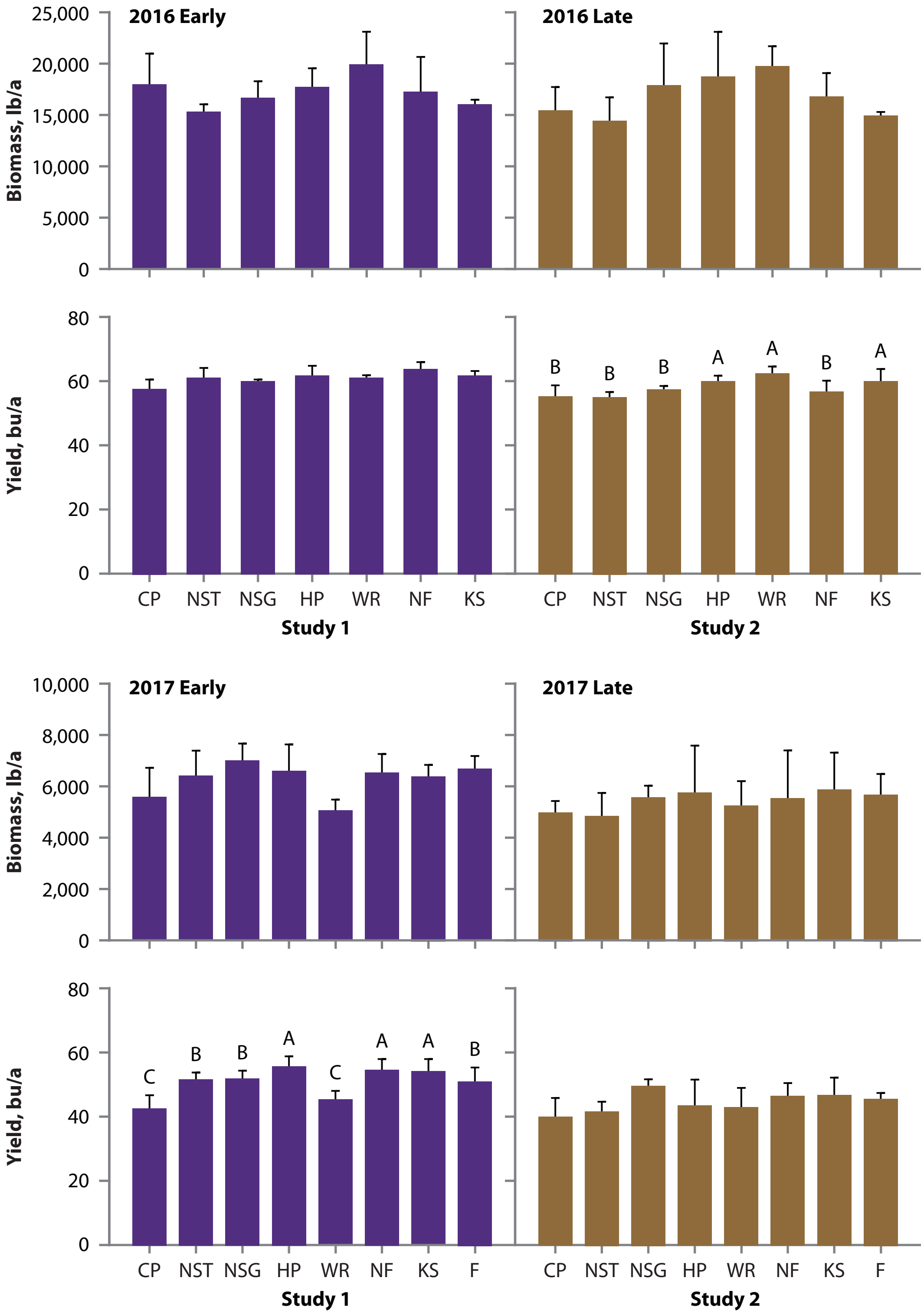

Figure 1. Biomass and yield in studies 1 and 2 for 2016 (upper panels) and 2017 (lower panels) growing seasons, Ottawa, KS. Common practice, CP; no seed treatment, NST; non-stay green, NSG; high population, HP; wide rows, WR; nitrogen fixation, NF; kitchen sink, KS; no fertilizer - F (Table 1). Letters show significance (*P* < 0.05).