Increasing Double Crop Soybean Yields through Intensive Management: Final Year

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Introduction:

There has been recent interest from Kentucky soybean producers to increase double crop soybean yields while remaining profitable. Double crop soybeans are grown in a more stressful environment than full season soybeans, which includes a shorter growing period, higher temperatures, and lower water availability during seed set and seed fill. The goal of this research was to identify intensive management practices of the winter wheat double crop soybean rotational system to increase soybean yield and profitability for Kentucky double crop producers.

Objectives:

The objectives of this study were to 1) determine the effect of wheat harvest timing on double crop soybean yield, in the form of soybean planting timings; 2) investigate the effect of intensive management programs on double crop soybean yield; and 3) evaluate the profitability of the intensive management programs.

Materials and Methods:

This study was conducted in 2017, 2018, and 2019 on two different soil types at the University of Kentucky Grain and Forage Center of Excellence in Princeton KY. Double crop soybean plots were planted following wheat harvest at two different timings: early harvest at 20 to 22% grain moisture and at the normal harvest timing of 13 to 15% grain moisture. The soybean trails were arranged in a split plot randomized complete block design, where the main plot was planting timing, and the split plot were the management treatments. Management treatments consisted of a combination of seeding rate, the use of seed treatment, and foliar pesticide applications. Treatments were replicated five times in each of the planting dates.

Treatments included:

1) 150,000 seeds/A planting population, no seed treatment, and foliar pesticide application when economic thresholds were met – UK Rec
2) 150,000 seeds/A planting population, use of seed treatment, and foliar pesticide application when economic thresholds were met – UK+ST
3) 150,000 seeds/A planting population, use of seed treatment, and a prophylactic foliar pesticide application of Quadris Top and Warrior II with Zeon Technology at the R3 growth stage – UK+ST+PF
4) 225,000 seeds/A planting population, no seed treatment, and foliar pesticide application when economic thresholds were met – INT
5) 225,000 seeds/A planting population, use of seed treatment, and foliar pesticide application when economic thresholds were met – INT+ST
6) 225,000 seeds/A planting population, use of seed treatment, and a prophylactic foliar pesticide application of Quadris Top and Warrior II with Zeon Technology at the R3 growth stage – INT+ST+PF

Early season plant populations were measured at approximately the V2 growth stage. Canopy closure was measured once a week using the Canopeo software until the soybean canopy was fully closed. Disease ratings (particularly frogeye leaf spot) and leaf defoliation ratings (to estimate insect damage) were measured prior to the prophylactic pesticide application and at 14 and 21 days after application for all soybean plots. Economic thresholds treatment plots were scouted once a week and fungicide or/and insecticide was applied as needed. Harvest plant populations were measured at physiological maturity prior to harvest. All soybean plots were harvested at approximately 13% grain moisture and evaluated for yield. Yield component data of seed number m^{-2}, seed weight, pod number and seeds per pod were measured. Grain samples from each plot were tested for protein and oil content at the University of Minnesota NIR laboratory. Partial budget analysis was conducted to evaluate the profitability of each of the intensive management treatments compared to the current UK recommendation.

Results:

The three years of results indicate that there was an effect of the planting timing and management treatments on soybean yield. Planting double crop soybean immediately after wheat harvested at 20 to 22% grain moisture had increased yields from approximately 10 to 12 bu per acre each year. In 2017, the early double crop soybean was planted 10 days before the normal planting timing while in 2018 and 2019 there was an approximate 21 day difference between the planting timings. Each of the intensive management options: increased seeding rate, the use of seed treatments, and prophylactic foliar pesticide application were examined, before looking at each of the six management treatments. The increased seeding rate increased seed yield by approximately 5.5 bu per acre and increased plant populations compared to the UK recommended seeding rate. There was no difference in seed yield when the seed treatment was applied however, the plots with seed treatment had significantly greater plant populations compared to the non-seed treated plots. The prophylactic R3 foliar pesticide application increased soybean yields by approximately 4 bu per acre in 2018 and 2019.

The six intensive management treatments were then evaluated for yield (Figure 1). The most intensive management treatment (INT+ST+PF) had the greatest yield, however it was similar to the INT+ST treatment. The four treatments of UK+ST, UK+ST+PF, INT, and INT+ST had similar yields to each other. The UK Rec treatment had the lowest yield, however it was still similar to the UK+ST, UK+ST+PF, and INT treatments.

Economic evaluation of each of the intensive management treatments compared to the UK recommendation is important to determine the profitability of each management treatment. Partial budget analysis was conducted to determine the double crop soybean management profitability. The partial budget analysis (Table 1) indicates that two treatments had positive net benefits compared to the UK recommendation while three treatments had negative net benefits. The INT+ST+PF, the high intensive management treatment, had a positive net benefit of almost $5 per acre while the INT treatment of the higher seeding rate, had a positive net benefit of almost $12 per acre. These two positive net benefits show that there is a possibility of some intensive management practices being profitable.

Results from this project are currently apart of K. Rod's PhD dissertation, and will be published in a peer review journal, which was submitted in summer of 2020. It is still under review, but we are hopeful it will be published late-winter 2021. Based upon these findings, and additional research, University of Kentucky's recommendations for double crop soybean production were revised.

Figure 1. Yield of the six intensive management treatments from two locations at Princeton KY in 2018 and 2019. Treatments included: UK-Rec: 150,000 seeds/A, no seed treatment, foliar pesticide applications at economic thresholds; UK+ST: 150,000 seeds/A, seed treatment, foliar pesticide applications at economic thresholds; UK+ST+PF: 150,000 seeds/A, seed treatment, prophylactic R3 pesticide application; INT: 225,000 seeds/A, no seed treatment, foliar pesticide applications at economic thresholds; INT+ST: 225,000 seeds/A, seed treatment, foliar pesticide applications at economic thresholds; and INT+ST+PF: 225,000 seeds/A, seed treatment, prophylactic R3 pesticide application. Yields are adjusted to 13% grain moisture. Means labeled with the same letter are not significantly different ($P \leq 0.05$).

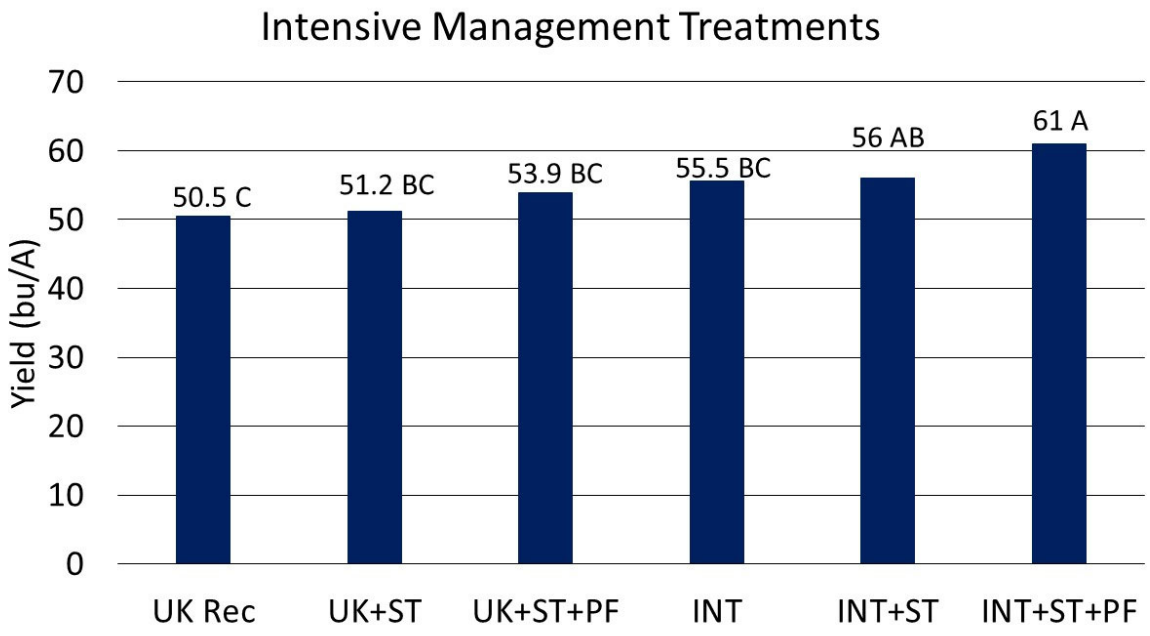

Table 1. Partial budget analysis of the intensive management treatments to determine profitability. Each treatment is compared to the UK Rec treatment which is the UK's current double crop soybean recommendation. Treatments include: UK-Rec: 150,000 seeds/A, no seed treatment, foliar pesticide applications at economic thresholds; UK+ST: 150,000 seeds/A, seed treatment, foliar pesticide applications at economic thresholds; UK+ST+PF: 150,000 seeds/A, seed treatment, prophylactic R3 pesticide application; INT: 225,000 seeds/A, no seed treatment, foliar pesticide applications at economic thresholds; INT+ST: 225,000 seeds/A, seed treatment, foliar pesticide applications at economic thresholds; and INT+ST+PF: 225,000 seeds/A, seed treatment, prophylactic R3 pesticide application. The average October 2019 Kentucky soybean price of $8.89 was used (USDA, NASS, 2020).

Intensive Management Treatments	Inputs	Yield	Additional Cost	Additional Benefit	Net Benefit
		bu/a	per acre		
UK Rec	150,000 seeds a^{-1}/ No Seed treatment/ Foliar Pesticide Application at economic thresholds	50.5	$0.00	$0.00	$0.00
UK+ST	150,000 seeds a^{-1}/ Pioneer Premium Seed Treatment/ Foliar Pesticide Application at economic thresholds	51.2	$18.21	$6.22	-$11.99
UK+ST+PF	150,000 seeds a^{-1}/Pioneer Premium Seed Treatment/Prophylactic R3 Pesticide Application	53.9	$46.58	$30.23	-$16.35
INT	225,000 seeds a^{-1}/No Seed Treatment/ Foliar Pesticide Application at economic thresholds	55.5	$32.68	$44.45	$11.77
INT+ST	225,00 seeds a^{-1}/Pioneer Premium Seed Treatment/As Needed Foliar Pesticide Application	56.0	$60.00	$48.90	-$11.10
IN+ST+PF	225,000 seeds a^{-1}/Pioneer Premium Seed Treatment/Prophylactic R3 Pesticide Application	61.0	$88.37	$93.35	$4.98