Mississippi Corn Promotion Board
2021 Progress Report

Project Title: Potential for Rapeseed (Canola) as a Winter Cover Crop in a Corn/Soybean Rotation System that Includes Hairy Vetch

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Project Summary (Issue/Response)

Corn-soybean rotations appear all across the Mississippi Delta and Mid-South as grain crop production has become more economical and cotton production has declined. Also during recent years, soil health has become an integral part of a sustainable farming practice that many are looking at inquisitively. The use of cover crops in row crop production is not a new concept by any means and has been used in conservation systems for centuries. A lot of emphases has been placed on "selling" the practice to producers with little data to determine the economic as well as ecologic advantage to the cover crops. Soil health is best defined as the continued capacity of the soil to function as a vital living ecosystem. Associated with soil health issues are cover crops taking on many varied forms that include crops such as wheat, rye, clovers, vetches, and tillage radishes. While the primary benefit afforded these crops come in the term, 'soil health', many other situations can arise that may not complement the current growing systems. Much of the Mid-south row-crop production occurs on beds that are necessary for getting water off and on the field and are less conducive to planting winter crops. Also in the last several years, the persistence of herbicide-resistant weeds has made fall and winter weed control essential for controlling troublesome weeds in the following crop. Crop rotations are beneficial in most production systems allowing for the rotation of herbicide modes of actions and chemistries. On the downside are the cost of potential cover crops and the problems with controlling pests that may overwinter or appear as a result of a non-traditional crop. Currently, the most predominant winter crop grown for profit is wheat. Most of the research or demonstrations currently being cited have no economic component and the most common question from producers is "How do I pay for it and what is my profit potential?" Canola offers a potential alternative that could be grown during the same time frame as wheat and could work into a double-crop/cover-crop scenario and provide a harvestable crop and potentially profitable crop. The objectives of this research were to evaluate yield potential, oil seed quality, and nutrient uptake of canola grown as a double crop after corn in a corn-soybean rotation, to determine nitrogen (N) requirement and nitrogen use of canola grown in MS, and to determine the economic implications of the cultural practices of canola and hairy vetch cover crop management with both harvestable and non-harvestable covers. This research was setup at four locations in Mississippi. Averaged over four locations, canola seed yield was 31 bu ac^{-1} for 120 and 150 lbs N ac^{-1} fertilizer treatments. This yield was 16 to 57% greater compared to all other N rate treatments. Seed yields were similar for 120 and 150 lbs N ac^{-1} treatments when average over four locations therefore no supplement N benefit was observed from 150 lbs N ac^{-1} application. Maximum yield potential for the canola variety Star 930W was achieved by a N rate of 120 lbs N ac^{-1}. At an average selling price of $22 bu^{-1} the estimated gross return was $682 ac^{-1}. Soybean was planted after harvesting canola in May 2021 and average yield of Soybean from all four locations was 53 bu ac^{-1} having a gross return of $716 ac^{-1} when average selling price was estimated to be $13.5 per bushel.

Project Results/Outcomes

Data were analyzed using the GLIMMIX procedure in SAS 9.4 (SAS Institute Cary, NC). Nitrogen rate treatments were treated as fixed effects whereas the replications and four research locations were treated as random effect. The post hoc means were separated based on T-grouping at $\alpha = 0.05$. The p-values for the statistical analyses are provided in Tables 1 and 2. A regression analysis was also performed for canola yield and nitrogen rate data for every location as well as averaged over all the locations (Figure 1). A polynomial regression model was fitted for the canola yields collected from for locations.

Averaged over four locations, canola seed yield was 16 to 57% greater for 120 and 150 lbs N ac^{-1} treatments compared to all other N rate treatments (Table 1). Seed yields were similar for 120 and 150 lbs N ac^{-1} treatments when average over four locations therefore no supplement N benefit was observed from 150 lbs N ac^{-1} application. Maximum yield potential for the canola variety Star 930W was achieved by a N rate of 120 lbs N ac^{-1} (Figure 1). There were no significant differences for oil content and plant population with respect to N rate treatments (Table 1). Test weight ranged between 48.5 to 49.9 lbs bu^{-1} and was highest for 120 lbs N ac^{-1} treatment. The seed index was calculated based on the gram weight of 400 seeds. Non-treated control and 30 lbs N ac^{-1} had the highest 1.75 and 1.73 g 400^{-1} seed weight, respectively, among all treatments. Seed moisture ranged between 13.0 to 16.5 % and decreases with an increase in N rate.

Aboveground biomass dry weight was 1587 and 1608 lbs ac^{-1} for 120 and 150 lbs ac^{-1} treatments, respectively, which was 31 to 50 % greater compared to 0, 30, and 60 lbs ac^{-1} treatments (Table 2). Nitrogen uptake in the aboveground biomass was similar among 90, 120, and 150 lbs ac^{-1} treatments and ranged between 22.4 to 26.2 lbs ac^{-1}. Sulfur uptake in the aboveground biomass was similar among 120 and 150 lbs N ac^{-1} treatment (Table 2). Sulfur uptake in the aboveground biomass was 8.8 lbs ac^{-1} for 150 lbs N ac^{-1} treatment which was at least 2 lbs ac^{-1} higher than 0, 30, 60, and 90 lbs ac^{-1} treatments. Canola yield from four sites in MS was at least 4.5 bu ac^{-1} lower compared to the national average yield of 37.8 and 35.5 bu ac^{-1} for 2018 and 2019, respectively (USDA-NASS, 2020).

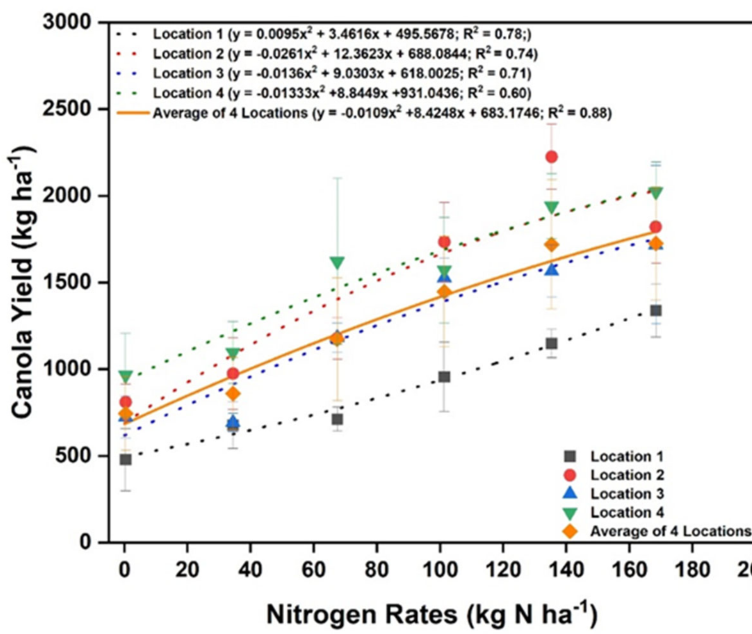

Figure 1. Canola yield response to N rate. Individual points represent the mean value and bars represent ± 95 confidence interval error bars.

Project Results

Nitrogen application	Seed Yield	Test Weight	Seed Moisture	Oil	Seed Index	Plant Population	Plant Height
lb N ac^{-1}	bu ac^{-1}	lb bu^{-1}	-------g kg^{-1}-------		g 400^{-1}	Plants ft^{-2}	inch
0	13d	48.5c	165a	467	1.75a	7	36d
30	15d	48.3c	164a	464	1.73a	7	38dc
60	21c	49.9a	134c	471	1.66b	8	40bc
90	26b	50.0a	130c	470	1.62b	7	42b
120	31a	50.2a	136bc	466	1.62b	7	44a
150	31a	49.3b	149b	462	1.65b	7	44a
p-values	<0.0001	<0.0001	<0.0001	0.1127	<0.0001	0.8238	<0.0001

Table 1. Mean and probability values (p-values) associated with the N rate treatments for the statistical analysis of seed yield, test weight, seed moisture, seed oil, seed index, plant population and plant height. Underlined numbers are statistically different at α = 0.05.

N Application Rates	Dry Weight	N	P	K	Na	Ca	Mg	S	Zn	B	Fe	Al	Mn	Cu
lb N ac^{-1}	---------------lb ac^{-1}---------------													
0	791c	12.9d	3.3c	21.5c	9.8b	15.7c	2.2c	4.0c	1.8c	2.4d	7.4b	4.9b	1.6e	0.18d
30	990c	17.4bcd	4.2bc	27.2bc	13b	19.2bc	2.7bc	5.4bc	2.2bc	3d	9.8b	5.3b	2de	0.23cd
60	1092bc	17.2cd	4.4bc	29bc	13.7b	20.8bc	2.9bc	4.9bc	2.4bc	3.4cd	8.1b	5b	2.3cd	0.27bc
90	1370ab	22.4abc	5.3ab	36.3ab	29ab	26.4b	3.4ab	5.8bc	2.9ab	4.3bc	10.9ab	8ab	2.8bc	0.27abc
120	1587a	26.2a	6.4a	45.8a	50.4ab	34.8a	4a	6.9ab	3.4a	5.4a	13.9a	10.2a	3.4a	0.34a
150	1608a	22.7ab	6.1a	45.8a	78.2a	35.3a	4.2a	8.8a	3.2a	5.2ab	14.2a	10.5a	3ab	0.31ab
p-values	<0.0001	<0.0001	<0.0001	<0.0001	0.0495	<0.0001	0.0007	0.0269	0.0003	<0.0001	0.0032	0.0017	<0.0001	0.0023

Table 2. Mean and probability values (p-values) associated with the N rate treatments for the statistical analysis of aboveground biomass dry weight and nutrient uptake. Underlined numbers are statistically different at α = 0.05.

Project Impacts/Benefits

Results from a successful study will be vital to the potential adoption of the crops and offer a potential income source that can come directly from the crop being grown. Most studies look at the agronomic and ecological aspects of practice but fail to identify the economic factors that a producer must have to assess whether that practice can be adopted for his operation. With no yield advantage in many cases, the producer must have a way to cover the cost of the cover crop including, land preparation, seed cost, planting, burn-down, and potential insect and disease issues associated with having a green crop in the non-crop season. Canola in this study was harvested during the last week of May in 2021 and with careful planning and management by growers' canola can very well fit in the double-cropping system. In general, nutrient uptake was increased with higher N application rates and canola growers will have to watch for the soil nutrient depletion from the additional crops. It should be noted that only one cultivar was used for the N rate study. Therefore, future research should be expanded to additional canola varieties that might perform better in the MS agro-climatic region.

Project Deliverables

Singh, G., Kaur, G., and Dhillon, J.S. 2021. Optimizing nitrogen application rates for winter canola production in Mississippi. ASA-CSA-SSSA International Annual Meeting. Salt Lake City, UT, Nov. 7-10.

The second year of results for this study will be collected in spring 2022 and will be made available through the social media platform. This information in the form of deliverables is being made to producers and consultants as needed and will be better as more information (through repeated studies) becomes available.

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