Understanding the Components and Mechanisms Responsible for High Yielding Soybeans (Year-End Report for Year 2)

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Methods

Soybeans (Asgrow AG4135), MG 4.1, were planted on 5/25/2018 in 30 inch rows in soils predominately mapped as a Crider silt loam. The experimental site is located under the lateral irrigation system at The University of Kentucky Research and Education Center (UKREC) in Princeton, KY. Supplemental irrigation was applied at a rate of 0.6 inches of water per week if less than 1 inch of rainfall was received per week. The oxygen lines established in 2017 were used for the 2018 study. The oxygen treatment was started on 7/6/2018 and continued until 8/26/2018. Oxygen tanks were switched out every three days for the duration of the experiment. Liquid fertilizer was applied to soybean on 7/10/2018 at a rate of 35 gallon/acre for each product. The products were 32% UAN, 0-30-0, and 0-0-25 with a product density of 11.06, 9.7, and 11.2 lb/gallon, respectively. Application rate was held constant at 35 gallon/acre and density varied. The total amount of N, P_2O_5 and K_2O were calculated as 124, 102, and 98 lbs for the N, P, and K treatments. The double K received 196 lb K_2O/A and N-P-K treatment received 124, 102, and 98 lbs N-P_2O_5-K_2O/A. Soybean were harvested on 10/8/2018 with an Almaco plot combine.

Results and Discussion

Our hypothesis was that increasing the amount of gas exchange (oxygen and carbon dioxide) in the rooting zone would increase plant growth and yield. Two approaches were used, subsoiling and increasing the amount of oxygen in the plant row. A physical reduction of soil density over the row could reduce the amount of energy exerted by the soybean root to grow into unexplored soil. Both mechanisms were tested to see if one mechanism over the other was responsible for increased plant growth. No significant differences in soybean yield, moisture or test weight were observed in 2018 (Table 1). Although this result was somewhat disappointing to us, it suggests that subsoiling in the absence of compacted soil does not improve soybean yield. Further, it also suggests that gas exchange is adequate in the absence of compacted soil.

Most fertilizer applications are made prior to planting, either the year of planting or the year before, with satisfactory results. Some have questioned Land Grant University recommendations since they are typically lower than those made by private soil test labs. This study applied N, P, and K alone and in combination to determine if a mid-season application would benefit soybean yield. The theory behind this approach was to have more soluble nutrient when plants have a higher nutrient demand. The K application increased yield by 8 bu/A in 2017 (Table 2). A double K treatment was included in the 2018 study based on this result. Most other 2017 treatments tended to increase soybean yield to some degree. Like the oxygen study, overall yields and treatment differences were not as expected (Table 2). No significant differences were observed for fertilizer treatment in 2018. Late planting (July 11) in the 2017 trial was a possible cause for depressed soybean yield in these studies. However, there was no significant difference in yield with a more timely planting in 2018 (May 25). This study will conclude after its third year of data is collected in 2019.

Expenses

A second oxygen injection system needed to be installed for the second year of the study. We had to purchase diffusor hose, regulators, and other minor parts to make the final installation ($641). The land rental for the lateral irrigation was $980 per ½ acre. Approximately $320 was spent for oxygen. The remainder of the expenses were for labor.

Table 1. The influence of subsoiling and in-row oxygen application on soybean yield in 2018.

Treatment	Yield (bu/A)	Moisture (%)	Test Weight (lb/bu)
Untreated Check	59.1	14.9	51.8
In-Row Oxygen	60.3	14.9	51.6
Subsoiled	59.8	14.9	51.7

Table 2. The influence of late-season nutrient application on soybean yield in 2017 and 2018.

Treatment	Yield (bu/A) 2017	Yield (bu/A) 2018	Moisture (%) 2018	Test Weight (lb/bu) 2018
Untreated Check	46	59	14.8	52.0
Nitrogen (N)	50	60	14.8	51.4
Phosphorus (P)	47	59	14.7	51.6
Potassium (K)	54	57	14.8	52.0
Double K	ND*	60	14.7	51.9
NPK	50	60	14.8	51.8

*ND=no data collected for this variable in 2017.

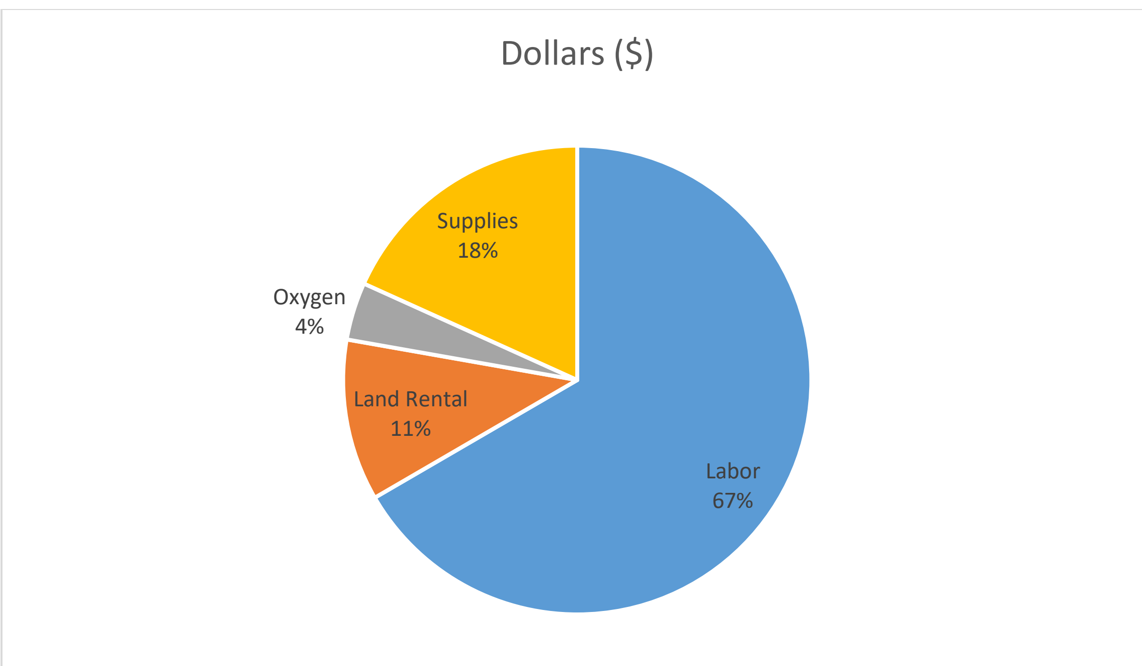

Figure 1. Percentage of expenditures in major categories.