Management Effects on High-Oleic Soybean
Fatty Acid Analyses

208944 FINAL REPORT
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Indiana Soybean Alliance
c/o Aly Wells
Project Period: 07/01/2015 to 06/30/2016

OBJECTIVES

We want to enable growers to make the best management decisions, to optimize their return/risk tradeoff, associated with high-oleic soybeans. Specifically, our **objectives** are to ***optimize oleic oil production and determine oleic stability across:***

1. ***Seed Rates x Planting Date,***
2. ***Foliar Protection and Foliar Feeding,***
3. ***Water Supply.***

RESULTS

OLEIC SEED RATE x PLANTING DATE

Six varieties (4 oleic + 2 standard) were planted in May 8, 2015 and June 4, 2015 at five seed rates (50, 100, 150, 200, and 250 thousand seeds per acre). These 60 treatments were replicated four times at West Lafayette (ACRE) in 2015. Weekly growth staging and canopy closure analyses (digital camera and crop reflectance) were conducted. Stand counts were taken at harvest and grain subsamples were taken for quality analyses (protein, oil, fatty acid profile) from the 240 plots.

Yield Results. The optimal seeding rates were very similar across varieties regardless if it was an oleic or standard soybean. The timely planting (May 8th) maximized yields around the 150,000 seeds per acre for the standard varieties with somewhat higher seeding rates for several of the oleic varieties. Final harvest stands near 100,000 to 120,000 plants per acre were appropriate for timely planting of these varieties. The top yields for individual varieties were ~60 (two oleic varieties), ~65 (one oleic variety), and ~70 (two standard and 1 oleic variety) bu per acre.

These soybeans were plant approximately one month later (June 4th) with the same seed rates. Soybean yield response to seeding rate was a linear increase with each incremental increase, which is typical of the seed rate response when soybeans are planted late (example in Fig. 1). Interestingly, three of the six varieties (two oleic and one standard) were able to reach the same yield level of the timely planting when seeded at the highest rate of 250,000 seeds per acre. The other three varieties also maximized their respective yield at the highest seed rate with five varieties reaching ~60 bu per acre and the sixth variety (oleic) reaching 55 bu per acre.

Oleic Quality Results. Three of the four oleic varieties were at or above the target oleic concentration (70%) across the five seed rates within the first planting date. Oleic concentrations tended to decrease as the seed rate increased. The fourth oleic variety was above the target level of oleic at the lower seed rates, but it did drop down to 69% oleic concentration at the top three seed rates (150, 200, and 250 thousand seeds per acre). The overall decrease in oleic concentration was only a few percent points of oleic acid. Two of the four oleic varieties showed a similar decrease in oleic concentrations as the seed rates increased at the June planting, which did place the oleic concentrations below 70% at the higher seed rates (example in Fig. 2). The other two oleic varieties

did not express changes in oleic concentration regardless of the seed rates at the second planting. These two varieties were always above the 70% target. The standard varieties averaged 25% oleic concentration with no changes as a result of seed rate or planting date.

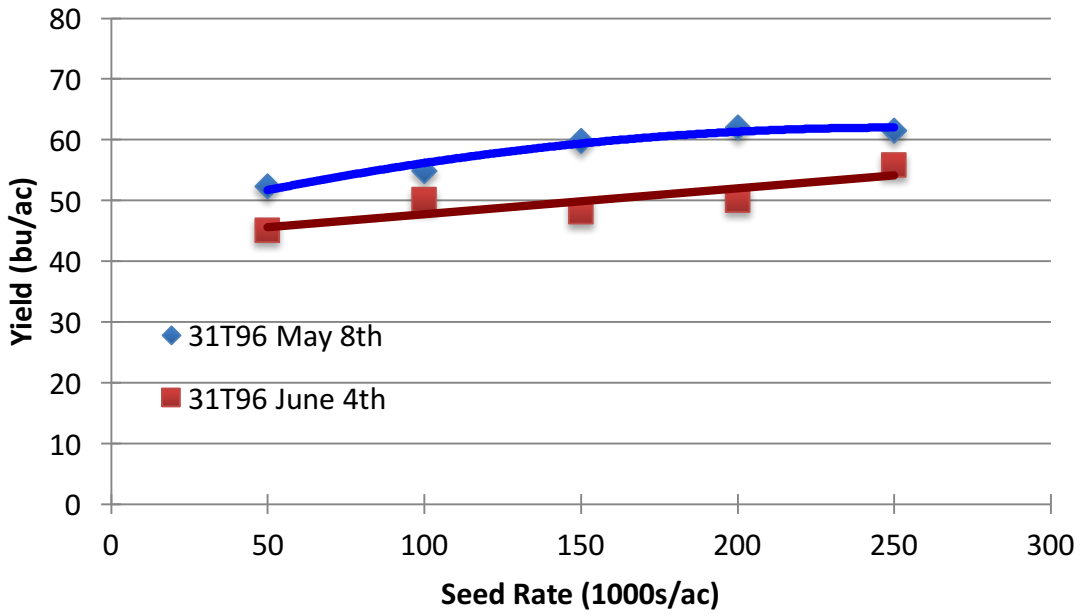

Figure 1. Example of the yield response of an oleic soybean variety planted timely (May 8th) and late (June 4th) across five seed rates (50, 100, 150, 200, and 250 thousand seeds/ac) near West Lafayette, IN 2015.

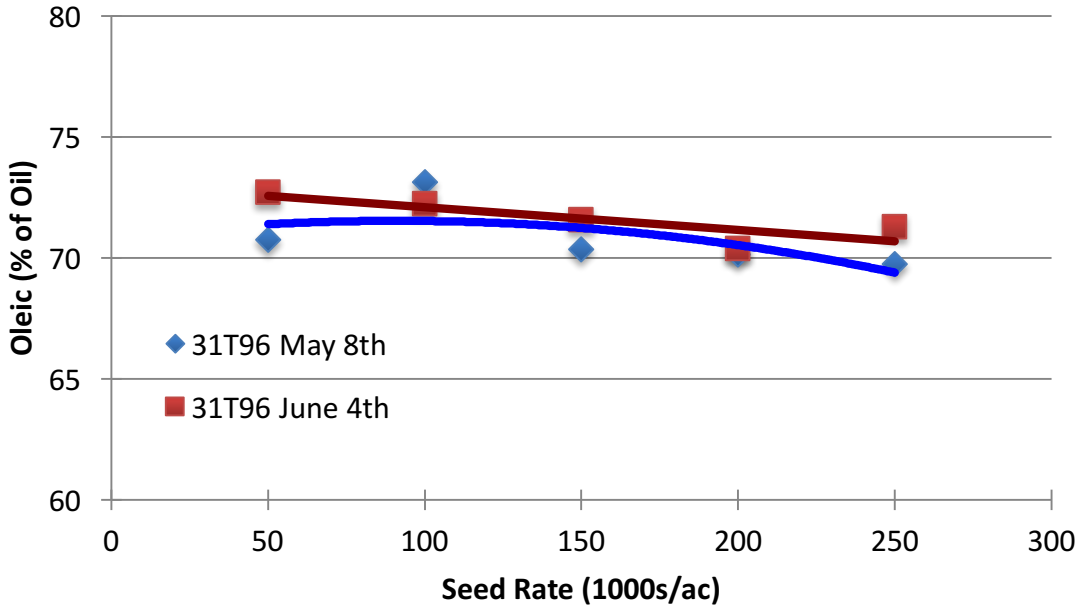

Figure 2. Example of the changes in oleic content (% of oil) of an oleic soybean variety planted timely (May 8th) and late (June 4th) across five seed rates (50, 100, 150, 200, and 250 thousand seeds/ac) near West Lafayette, IN 2015.

OLEIC VARIETY x MANAGEMENT

Four varieties (2 oleic + 2 standard) were planted on May 19, 2015 near Wanatah (Pinney PAC). Five management regimes were imposed across the four varieties to total 20 treatments that were replicated six times. The management regimes were untreated control, intense foliar protection from insects at R3 + R5, intense foliar protection from diseases at R1 + R3 + R5, intense foliar feeding at R1 + R3 + R5, and the combination of the latter three regimes. Weekly growth staging and general observations of insect and disease pressures were noted. Stand counts were taken at harvest and grain subsamples were taken for quality analyses (protein, oil, fatty acid profile) from the 120 plots.

Yield Results. The standard varieties out-yielded the oleic varieties by 4 bu when comparing the untreated controls of each pair of soybean varieties (61.9 vs. 57.9 bu). Foliar management regimes had limited impact on the overall yield of these varieties and soybean types. Foliar fertilizer, foliar insecticide, and foliar fungicide regimes did not increase yield above the untreated control (UTC) within each respective soybean type (standard vs. oleic, Fig. 3). The foliar fungicide and foliar ALL added about 2 bushels when compared to UTC within the standard, but only differed from foliar insecticide. The foliar ALL added 3.7 bu in the oleic varieties compared to UTC, which seemed to build on the foliar components that only added ~1 to 1.5 bu when applied individually.

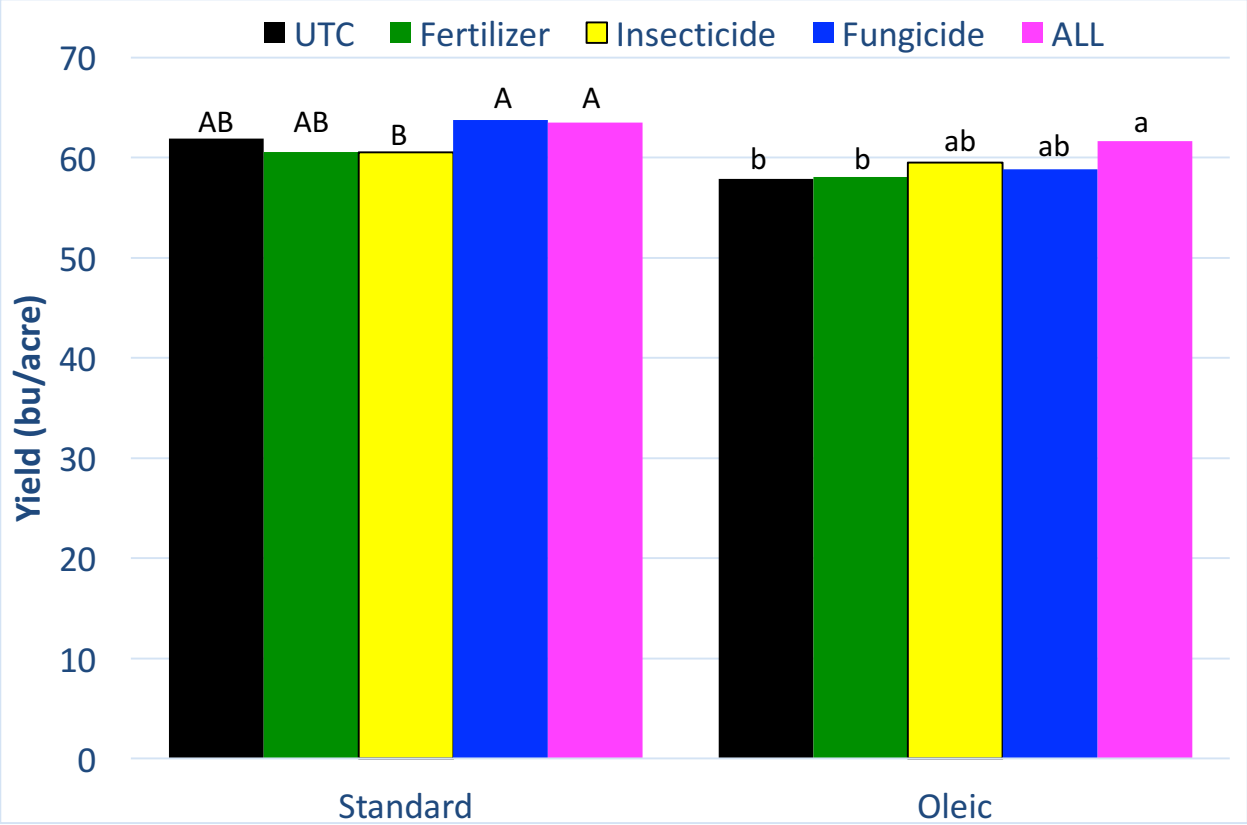

Figure 3. Intense foliar management regimes imposed to two standard and two oleic varieties in 2015 season at Wanatah IN. Means are averaged across the two respective varieties for each type of soybean. Differences due foliar treatments are denoted by different letters (Standard = UPPERCASE; Oleic = lowercase) at alpha = 0.05.

OLEIC VARIETY x WATER SUPPLY

Eight varieties (6 oleic + 2 standard) were planted on May 19, 2015 near Wanatah (Pinney PAC) in a Tracy Sand. Half of the field was dryland and the other half was irrigated once the varieties reached reproductive stages. The soybeans were irrigated to equal a minimum one inch of water supply per week when rainfall was included. Weekly growth staging and crop reflectance was taken, especially through R8. Stand counts were taken at harvest and grain subsamples were taken for quality analyses (protein, oil, fatty acid profile) from the 64 plots (8 varieties x 2 Water Regimes x 4 reps).

Yield Results. Under the dryland regime, yield performance of the standard and oleic varieties were comparable. Under irrigation, standard varieties tended to yield more than the oleic varieties. A standard variety was the top yielding variety under dryland (Std 3.3, 66.4 bu) and irrigation (Std 2.9, 75.7 bu) regimes (Fig. 4) for this single year and location.

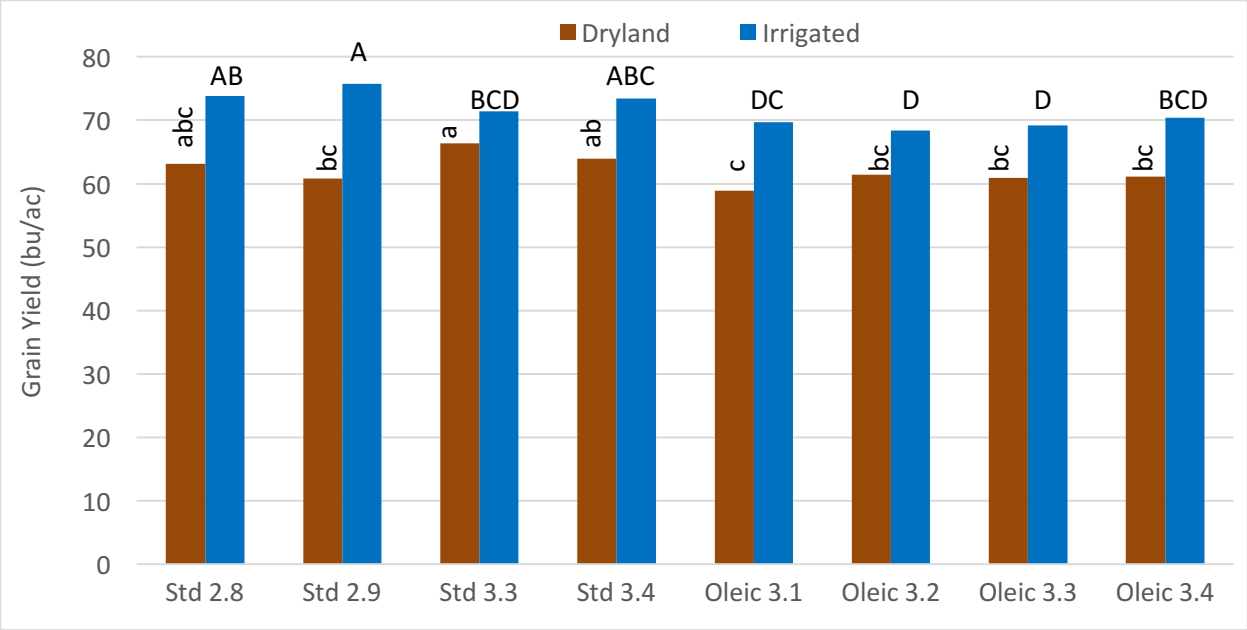

Figure 4. Grain yield of standard and oleic soybean varieties under dryland (brown) and irrigated (blue) regimes. Means of varieties are separated within each water regime (Dryland = lowercase, Irrigation = UPPERCASE) at alpha = 0.10.

Oleic Quality Results. Seeds of high-oleic varieties were larger than standard varieties regardless of water regime. Irrigation enlarged seeds for both standard (3.6%) and high-oleic varieties (7.8%). Oleic acid was much greater for high-oleic varieties in both water regimes (~70% vs. ~24%, Fig. 5). Irrigating soybean had little influence on oleic acid. However, percentage oleic tended to increase in response to irrigation for standard varieties while decrease for high-oleic varieties (Fig. 6). All fatty acid concentrations were different between standard and oleic varieties except for stearic.

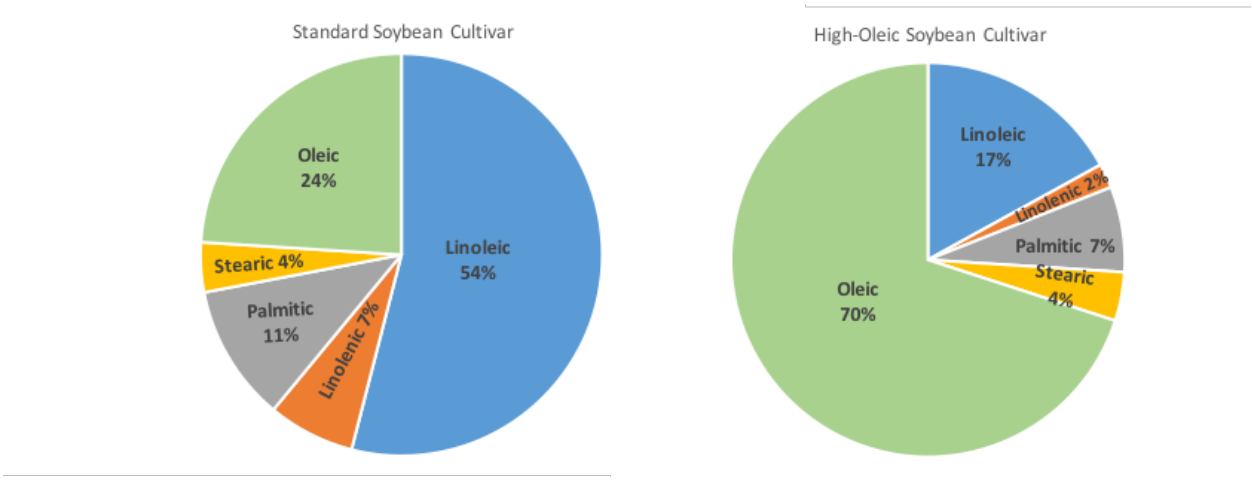

Figure 5. Fatty acid profile of standard vs. oleic soybean varieties under dryland regime. All fatty acid concentrations were different between types except for stearic (alpha = 0.05).

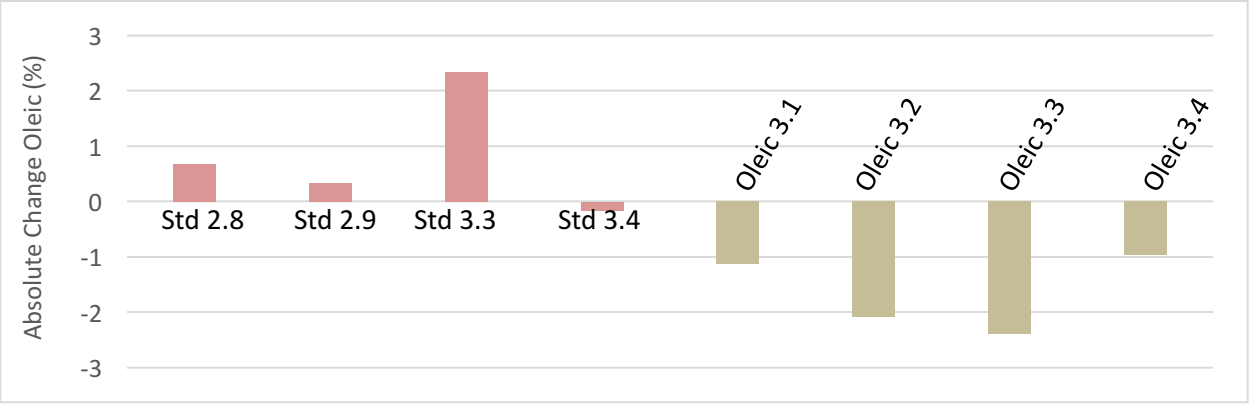

Figure 6. The absolute changes in oleic composition for standard and oleic varieties due to irrigation.

CLOSING COMMENTS

Preliminary results were shared throughout the summer and fall of 2016 with soybean growers and crop professionals. The number of varieties evaluated in the seed rate study was reduced to a more manageable size in 2016, and it will be repeated in 2017. The variety x management study was not modified in 2016, but was repeated in two locations (Wanatah and West Lafayette). The water supply study was factored with and without a fungicide treatment in 2016 and will be repeated in 2017.

The Purdue Diagnostic Training Center financially supported Ben Hall (Ph.D. student) to conduct and manage these studies. He presented the water supply study at the 2016 Crop Science Society of America meetings in Phoenix, AZ, and placed 3rd in the Ph.D. poster competition.