Utilizing soybean maturity class and planting date evaluation to improve soybean production in West and Central ND.

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**Situation Statement:**

Soybean production in North Dakota (ND) has steadily grown with a record 6 million acres planted in 2014. While most of this growth has taken place in the Eastern part of the state, there is growing interest from producers and stakeholders to expand soybean production and productivity beyond Central ND, towards non-traditional production areas, west of the Missouri River. Soybean production would give producers in western ND another crop to diversify their rotations and another option for a later planted crop when inadvertent situations prohibit timely planting of small grains or other early season crops. A serious limitation to soybean production, West of the Missouri, is very dry summers with low available moisture at critical growth stages, and short growing cycle. Soybeans flower in response to length of day and temperature. The earlier maturing cultivars begin flowering when days are long and nights are short (in summer), and the later maturing cultivars flower when days are relatively shorter and nights relatively longer. Maturity is the first important consideration for choosing a cultivar that is suitable to a given geographical location. Some of the cultivars farmers grow are sometimes not suitable to drought western regions; as a result, a few producers have experienced setbacks from low yields, thereby retarding expansion of soybean production in these areas.

There has not been recent and consistent research done to assess the performance of soybeans in western ND. There is a great need for information on the impact that relative maturity groups (MGs) would have on soybean yields, and how planting dates would impact MG performance. This research was carried out to assess the performance of soybeans in Hettinger in Western ND, and Carrington, Eastern ND, and then assess its profitability in light of improved no-till practices in Hettinger, to minimize adverse climatic effects of drought stress.

**Goal**:

To increase soybean production and productivity from current levels in Western and Central North Dakota

**Research Objectives**

1. Assess and determine optimum yielding maturity classes/groups of soybeans for dryland production in Western and Central ND
2. Determine the impact of early and late planting on yields of early and late maturing soybean

**Description of the research conducted**

Three sites were chosen for this study based on geographical location and extent of soybean production from relatively low to high production, at the Hettinger Research Extension Center (HREC), located in South Western ND, Mandan (Central ND), and Carrington Research Extension Center (CREC). Planting was effective at the third site, Mandan, but the crop was later destroyed by deer. The three MGs (cultivars) planted at HREC (shown on table 1), were also planted at CREC plus an additional cultivar. Planting date intervals differed by site (Table 1). Each planting date was about 7 or 8 days from the previous date at Hettinger, and 12 to 15 days at CREC. The two Proseed cultivars (MG 0.2 and 0.6) were Roundup Ready soybeans, while the other two (MG 0.4, 0.7) were conventional soybean cultivars.

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| **Table 1. Maturity groups and dates planted within each location** |
| Cultivars | Hettinger | Carrington |
| Planting dates |
| Too early | Early | Normal | Too early | Normal | Very late |
| 5-May | 13-May | 19-May | 27-May | 5-May | 20-May | 1-Jun | 16-Jun |
| Maturity Groups |
| Proseed 10-20 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Ashtabula | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Proseed 30-60 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Prosoy |   |   |   |   | 0.7 | 0.7 | 0.7 | 0.7 |

The experimental design was a Randomized Complete Block with a split-plot arrangement. The main plots consisted of three planting dates and subplots consisted of the maturity groups (MGs). Each subplot had four rows 25ft long, with inter-row spacing at 22 inches. Seeds were planted 1.25 inches. All four rows were harvested from each plot at maturity. No fertilizer was added based on soil the recommendation at CREC. All other inputs such as irrigation (at CREC), and pest control, were managed as needed. Soybean plots were harvested with a small plot combine on two dates, two weeks apart at both locations, starting with the first two planting dates, on October 2nd. Previous crop was oats at HREC, and wheat, at CREC. Results were analyzed by Analysis of Variance, and with the Mixed Model, means were separated by Tukey-Kramer’s test at the 95% level of significance.

**Results**

Planting date and MG had significant impact on soybean yields, protein, oil, and test weight. At HREC, mean yield across MGs and planting dates was 30.9bu/a. The MG 0.6 (Proseed 30-60) produced a mean yield of 36.2bu/a, while the MG 0.4 cultivar (Ashtabula) produced the lowest yield at 26.6bu/a. There was a significant interaction between MG and PD (Table 2). At HREC, MG 0.6 produced significantly higher yields than MG 0.2 and 0.4 when the soybean was planted early or late, except on May 19th, when all MGs produced above average yields for the site (Figure 1). On the other hand, evidence of planting date impact on MG performance or vice versa, did not provide any indication whether by planting MG 0.2 0.6 early or late conferred a yield advantage or disadvantage to the cultivar. Generally, later maturing cultivars 0.7 would be recommended for Hettinger, and the shorter MG cultivars (0.4 or lower), for sites that are cooler, and have shorter growing seasons like North East of the state. The MG 0.6 cultivar also produced significantly higher seed protein content than MG 0.4, but less seed oil. It is probable that the results in 2015 were less influenced by MG. The two cultivars of MGs 0.2 and 0.6 were produced by the same company and were both non-conventional cultivars. It is probable that the genetic differences impacted how the crops responded to the environment, or the occurrence of stress during an important growth stage such as flowering, could have had some impact. This first year result nevertheless supports the use of later maturity cultivars than 0.4, as seen from the stable yield produced by Proseed 30-60 across the four planting dates (Figure 1).

At the CREC site, where four cultivars were produced under irrigated conditions, yields were higher than at HREC, with an average yield of 42.5bu/a, significantly higher than the other three cultivars (MGs 0.2, 0.4, and 0.7), which produced between 40 and 41.2bu/a. Yields ranged from 38.1bu, when planted on May 19th, to 45.3bu when planted on June 1st. Past research at Carrington suggests the ideal planting date is close to the 20th of May, for dryland production. Beyond the 1st of June, risk of yield can increase quite fast. Our results suggest that under adequate moisture, high yields are possible when soybean is planted on June 1st. The highest yield was recorded with MG 0.6 (Proseed 30-60) at 48.7bu/a. The MGs 0.2., 0.4, and 0.7 (Prosoy) cultivars had similar yields. Protein content was low (<34%) for all varieties, and oil content was not different between MGs. Yield differences were significant between dates. The highest yields were recorded when soybean was planted on May 19th (35bu/a), followed by May 27th (31.4bu/a), which is when majority farmers near Hettinger County plant their soybeans. More often than planting date, the cultivar influence on yield was more commonly observed as shown on table 3.

At Carrington, yield response to MG and planting date was significant. Proseed 30-60 (0.6) again produced the highest yield (48.2bu), which was significantly higher than the rest. Ashtabula (0.4) had the lowest yield (40.0) but this was not significantly different from Proseed 10-20 (40.2bu/a) and Prosoy (40.1bu/a). Planting on June 1st gave the highest yield, and the lowest on May 13th (Figure 2). Differences in yields that were associated with maturity class at CREC did not depend on planting date. Overall, planting between the 19th of May and the 1st of June provided the highest yields at both locations. While some research results are suggesting that early planting would produce as high as todays normal window for planting, more studies are needed under varying climatic locations to determine if normal window for planting should be wider or be restricted.

In summary, soybean planted between May 19th and June 1st produced higher yields than seeding before (e.g., May 5th and 13th) or later than June 1st. Outside this window, plants may be more vulnerable to early planning to late spring frost, and early frost in the fall

 Identical letters within respective planting dates are not significantly different from each other

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| **Tabe 2. Effect of soybean planting date and maturity group on seed yield, protein, oil content, and test weight (Hettinger, ND)** |
|   |  Planting Date (PD) | Maturity Group (MG) | Cultivar | Yield | Protein | Oil | TWT |
|  |  |  |  | bu/ac | % | % | lb/bu |
| Very early | 5-May | 0.2 | Proseed 10-20 | 29.8 | 33.1 | 16.3 | 54.0 |
| 5-May | 0.4 | Ashtabula | 22.6 | 32.7 | 17.5 | 55.0 |
| 5-May | 0.6 | Proseed 30-60 | 36.7 | 33.7 | 16.6 | 55.2 |
| Early | 13-May | 0.2 | Proseed 10-20 | 25.9 | 33.1 | 15.8 | 55.6 |
| 13-May | 0.4 | Ashtabula | 21.4 | 32.9 | 17.4 | 55.4 |
| 13-May | 0.6 | Proseed 30-60 | 35.7 | 33.5 | 16.5 | 55.7 |
| Normal | 19-May | 0.2 | Proseed 10-20 | 35.1 | 33.3 | 16.0 | 55.4 |
| 19-May | 0.4 | Ashtabula | 33.4 | 32.8 | 17.6 | 55.3 |
| 19-May | 0.6 | Proseed 30-60 | 36.4 | 33.8 | 16.6 | 56.0 |
| Normal | 27-May | 0.2 | Proseed 10-20 | 29.3 | 33.4 | 16.0 | 56.3 |
| 27-May | 0.4 | Ashtabula | 29.0 | 32.9 | 17.4 | 55.0 |
| 27-May | 0.6 | Proseed 30-60 | 36.0 | 33.8 | 16.3 | 54.9 |
|   | Sig of F. |   |   |   |   |   |   |
|  | PD |  |  | \* | ns | ns | \* |
|  | MG |  |  | \* | \* | \* | ns |
|  | MG x PD |  |  | \* | ns | ns | \* |
|   | SE+ |   |   | 1.02 | 0.23 | 0.14 | 0.34 |
| +Standard error |

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| **Table 3. Effect of soybean planting date and maturity group on soybean seed performance at Hettinger, ND** |
| Planting Date | Yield | Protein | Oil | TWT |
| bu/ac | % | lb/bu |
| 5-May | 29.7 | 33.2 | 16.8 | 54.7 |
| 13-May | 27.7 | 33.2 | 16.6 | 55.5 |
| 19-May | 35.0 | 33.3 | 16.7 | 55.6 |
| 27-May | 31.4 | 33.4 | 16.6 | 55.4 |
| Mean | 31.0 | 33.3 | 16.7 | 55.3 |
| HSD | 2.23 | ns | ns | 0.57 |
| Maturity Group  |   |
| 0.2 | 30.0 | 33.2 | 16.0 | 55.3 |
| 0.4 | 26.6 | 32.8 | 17.5 | 55.2 |
| 0.6 | 36.2 | 33.7 | 16.5 | 55.5 |
| Mean | 30.9 | 33.2 | 16.7 | 55.3 |
| Tukey (HSD) | 2.95 | 0.19 | 2.89 | ns |

 \*Identical upper case letters across planting dates are not significantly different from each other (*p<0.05*)

 Identical lower case letters within respective planting dates are not significantly different from each other

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|  | **Table 4. Effect of soybean planting date and maturity group on seed yield, protein, oil content, and test weight (Carrington, ND)** |
|   |  Planting Date | MG | Cultivar | Yield | Protein | Oil | TWT |
|   |   |   |   | bu/ac | % | % | lb/bu |
| Early | 5-May | 0.2 | Proseed 10-20 | 42.8 | 16.7 | 33.8 | 57.4 |
| 5-May | 0.4 | Ashtabula | 41.0 | 17.3 | 34.1 | 57.1 |
| 5-May | 0.6 | Proseed 30-60 | 50.9 | 16.6 | 34.0 | 57.0 |
| 5-May | 0.7 | Prosoy | 38.3 | 15.4 | 37.8 | 57.7 |
| Normal | 20-May | 0.2 | Proseed 10-20 | 37.2 | 16.3 | 34.8 | 57.6 |
| 20-May | 0.4 | Ashtabula | 34.0 | 17.0 | 34.4 | 57.3 |
| 20-May | 0.6 | Proseed 30-60 | 46.2 | 16.4 | 34.4 | 57.3 |
| 20-May | 0.7 | Prosoy | 34.9 | 15.3 | 37.7 | 57.8 |
| Late | 1-Jun | 0.2 | Proseed 10-20 | 41.3 | 16.3 | 34.3 | 57.4 |
| 1-Jun | 0.4 | Ashtabula | 40.7 | 17.2 | 34.4 | 57.1 |
| 1-Jun | 0.6 | Proseed 30-60 | 53.9 | 16.5 | 33.8 | 57.7 |
| 1-Jun | 0.7 | Prosoy | 45.2 | 15.4 | 37.4 | 57.9 |
| Very late | 16-Jun | 0.2 | Proseed 10-20 | 40.1 | 15.5 | 35.8 | 57.8 |
| 16-Jun | 0.4 | Ashtabula | 44.6 | 16.7 | 34.1 | 56.8 |
| 16-Jun | 0.6 | Proseed 30-60 | 43.2 | 15.7 | 34.8 | 57.4 |
| 16-Jun | 0.7 | Prosoy | 45.3 | 15.8 | 34.6 | 57.4 |
|   | Sig of F. |   |   |   |   |   |   |
|  | Planting Date (PD) |  |  | \* | ns | \* | ns |
|  | Maturity Group (MG) |  |  | \* | \* | \* | \* |
|  | PD x MG |  |  | ns | \* | \* | ns |
|   | SE |   |   | 3.4 | 0.62 | 0.24 | 0.30 |