

Variation in Soybean Variety Oil Content

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The soybean oil market is likely to receive a big boost in North Dakota over the next few years with one or more new crushing facilities opening. The new demand for soybean oil is driven by the commercial scale-up of renewable diesel. This is a separate product and market than the more familiar biodiesel. Any crop oil can be used in the production of renewable diesel, but at the moment, soybeans provide the most volume. As oil becomes a larger focus in marketing soybeans, it is important to take inventory of our current oil production potential by looking at genetic and environmental variability. This is especially important in markets such as renewable diesel which monitors the carbon cost of production versus per acre oil output.

At the Carrington Research Extension Center, we conduct 10 public soybean variety trials each year, consisting of public and private entries for GM and non-GM varieties. A wide range of data are collected from these trials each year, such as plant and pod height, maturity date, lodging, kernel weights, yield, test weight, and importantly here, seed oil and protein content. There were 238 soybean variety entries in 2021 (including duplicates tested at multiple environments) in our public trials, each replicated four times within environment. This season provided a good opportunity to evaluate oil content of varieties in good, average, and poor yielding environments. The environments included in this analysis are Carrington (dryland and irrigated), Oakes, Wishek, Dazey, and Lamoure.

Figure 1 shows the mean oil content values of each variety. Each bar is a compilation of variety performance at a single location. There was no clear correlation between variety yield and oil content, which is understandable as oil content is often not a trait used in breeding programs so its distribution is likely to be random. Across all trials the average oil was 19.75%. The difference between varieties within a single location ranged from 1.11% to 6.13%. Across all trials the lowest value was 15.23% and the maximum was 26.39%.

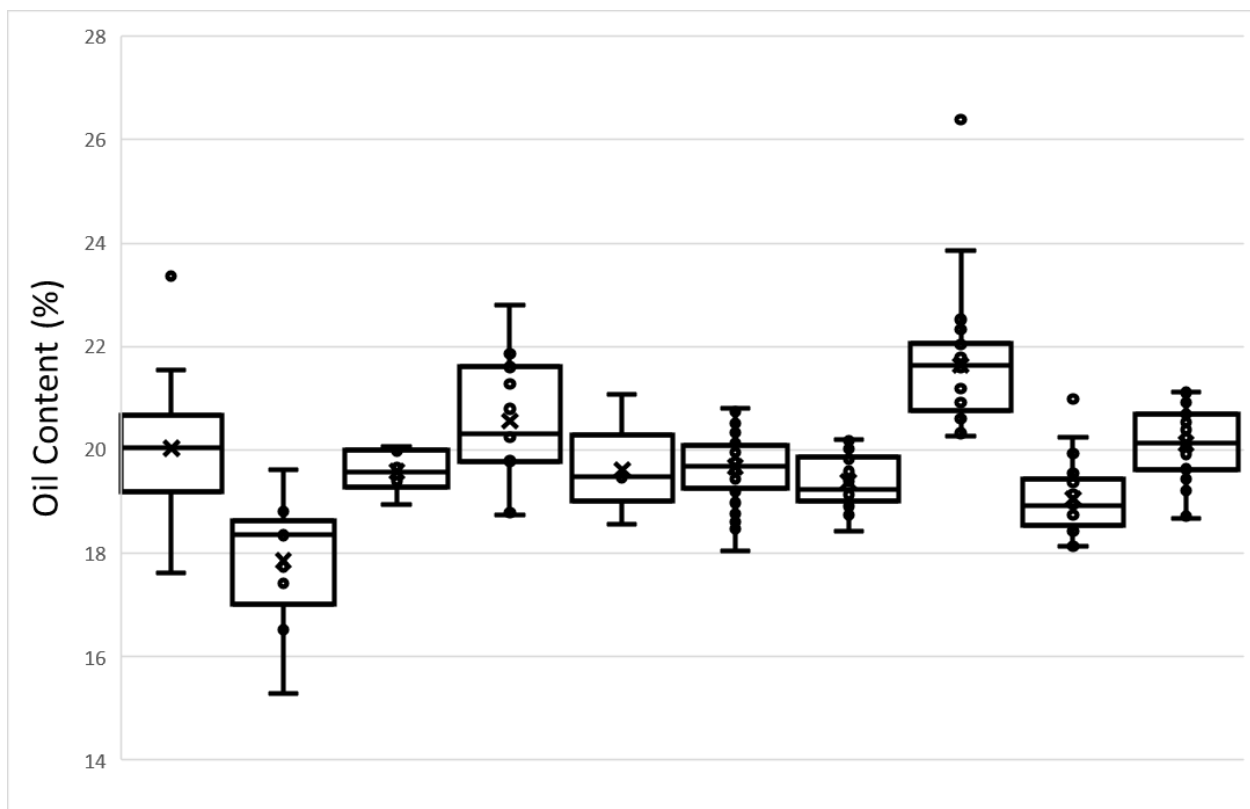


Figure 1. Oil content range in 10 variety trials across eastern North Dakota.

The second factor important to renewable diesel production is yield. Figure 2 shows the yield variability across the ten locations this season. Average yield of all trials was 36.7 bu/ac. The minimum yield was 9.9 bu/ac and the maximum was 72.7 bu/ac.

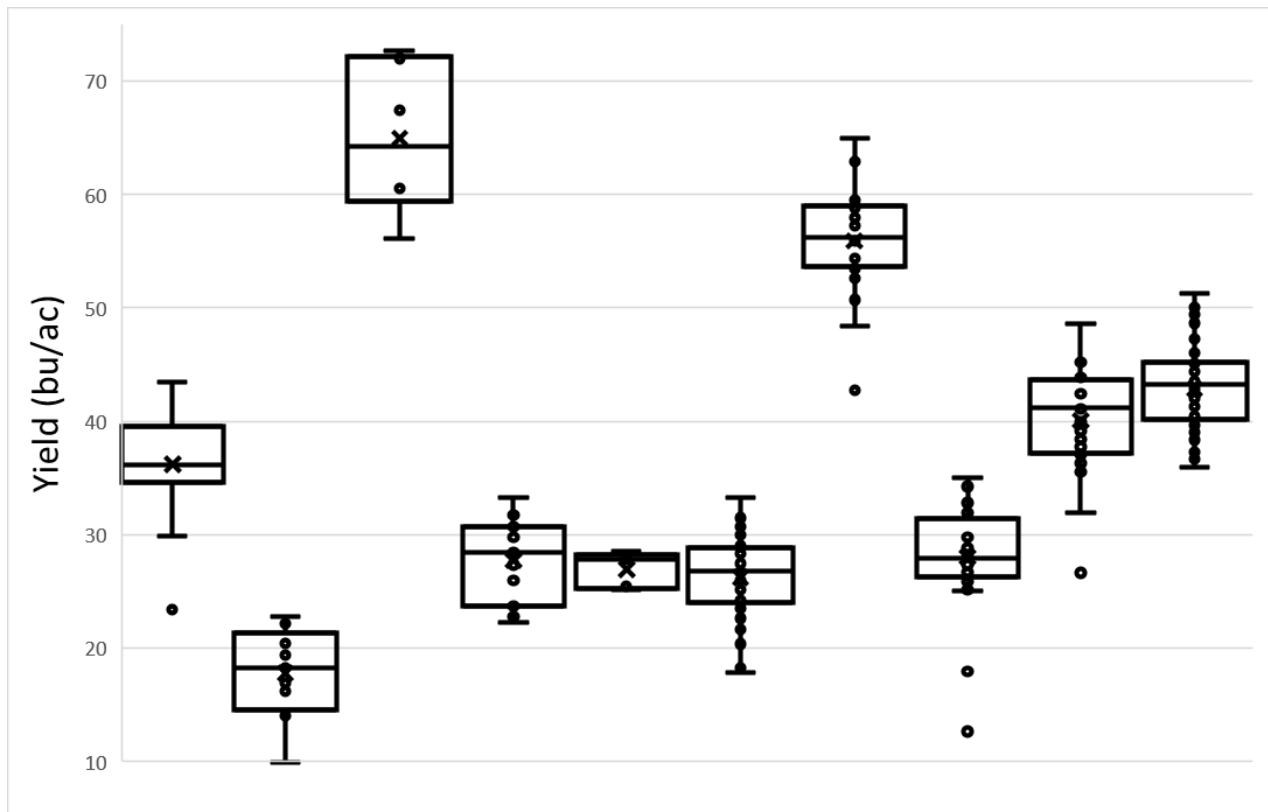


Figure 2. Yield range of 10 variety trials from across eastern North Dakota.

When considering average production of oil and yield ($19.75\% \times 36.7$ bu/ac) we end up with 2,202 lbs of soybeans producing 47.2 gal (7.6 lb/gal) of oil per acre for 2021. It is important that more work is devoted to understanding the limits of oil partitioning in soybean seed. To demonstrate, review the variables at specific sites. The site with the lowest average oil content had 17.85% oil content vs. the high of 21.63%. Using the average yield of 36.7 bu/ac production could be either 52 or 63 gal/ac (17.5% difference). Using the extreme oil values with average yield, production is 44 or 76 gal/ac. Right now, this difference is paid uniformly based only on bu/ac.

The ramifications of these differences are unknown at this time. At some point it is possible that premiums (or subsidies) will be paid for renewable diesel with the lowest carbon footprint. This is achieved through a combination of achieving higher yields and/or higher oil content. Currently, we are already able to demonstrate a 17.5% increase in efficiency of oil production without increasing yield. This increase is solely based on a combination of genotype and environment which can be improved further through monitoring of breeding material in current public and private programs.