



Integrated flax agronomy

CATEGORY [agronomy](#) | July 12, 2022

Using fungicide and a high nitrogen (N) rate most consistently increased flax yield (11% increase). The combination of high plant density, narrow row spacing, high N fertilizer, and fungicide produced the highest yield response (23% more), but not in unfavorable growing environments. The most well-rounded combination for moderate yield gains, yield stability, and seed cost management for flax production was low plant density (190 plants/m²), narrow row spacing (20 cm or 8"), high N rate (130% soil test recommendation), and fungicide (fluxapyroxad + pyraclostrobin) application.

Integrating good agronomic practices can improve flax yields. Unlike other crops, past research in flax identified inconsistent responses to different agronomic practices, particularly to increasing N application and seeding rates. Using higher nitrogen rates can increase flax yields, but when combined with higher seeding rates, the risk of pasmo (*Septoria linicola*) also rises. Therefore, understanding the interactive/additive effects of different combinations of agronomic practices under various environmental conditions is beneficial for flax growers.

Research was conducted to study the interactions between plant density, row spacing, N fertilizer, and fungicide application in order to identify the best agronomic combination for the highest and most stable flax yields. The experiments took place at 2 sites near Saskatoon, Saskatchewan (2015 to 2018 at Kernen Research Farm and 2018 at Goodale Research Farm) and at Carman, Manitoba (2015 and 2016), for a total of 7 site-years. Four main treatments were studied in combination with each other, allowing for 16 treatment combinations. The 4 treatments were:

- (1) Seeding density – 45 vs. 90 seeds/ft² (450 vs. 900 seeds/m²)
- (2) Row spacing - narrow row (NR) vs. wide row (WR): 8 vs. 16 inches (20 vs. 40 cm) at Saskatoon, 7.6 vs. 15.2 inches (19 vs. 38 cm) at Carman.
- (3) N fertility - low N (LN) vs. high N (HN): 65 vs. 130% of soil test recommendation for a yield target of 35 bu/ac. Nitrogen fertilizer was side or mid-row banded; phosphorus, potassium and sulfur (P, K, and S) fertilizers, if required, were applied in seedrow according to soil test recommendations.
- (4) Fungicide - fungicide application (FA) vs. no fungicide application (NFA); fungicide used was Priaxor (fluxapyroxad + pyraclostrobin) applied at 10 to 30% flower (7 to 10 days after the first flower).

The Flax Council of Canada recommends a plant stand density of 30 to 40 plants/ft² (300-400 plants/m²). The average plant stand densities achieved were 19 plants/ft² (190 plants/m²) for the low seeding rate and 32 plants/ft² (320 plants/m²) for the high seeding rate. Because the optimal density of 40 plants/ft² was not achieved, the 45 seeds/ft² seeding rate was considered “low density” (LD) and the 90 seeds/ft² rate was considered to be “moderate density” (MD).

Highest input level had highest yields

The highest yielding combination was achieved with the 90 seeds/ft² seeding rate, 8 inch row spacing, high N rate, and fungicide application (MD-NR-HN-FA), which yielded 23.6 bu/ac. This was a 23% yield increase over the lowest yielding combination of 45 seeds/ft², 16 inch row spacing, low N rate and no fungicide application (MD-WR-LN-NFA) with a yield of 19.2 bu/ac.

Individually, none of the single management treatments significantly affected flax yield. The only interaction to consistently increase yield across all environments was using high N and a fungicide application, resulting in 11% more yield compared with other combinations.

Fungicide was a determinant in achieving high yields since the seven highest-yielding combinations all included a fungicide application. Although the disease incidence of pasmo was quite low throughout the study, the researchers suggested that the fungicide was providing additional benefits to the crop besides disease control. While there was little lodging present in this study, pasmo has contributed to lodging and reduced yields in other studies. Other studies have also found that pyraclostrobin (strobilurin) fungicides can delay flax maturity by 3 to 5 days, allowing for more seed fill and increasing yields.

Yield stability results

The growing environment of each site-year was categorized as being “unfavorable” or “favorable” based on the mean crop yield of all treatments in a given site-year. Multiple factors, mainly driven by rainfall, determined the environment. Of the seven site-years, 4 were deemed as unfavorable environments, producing yields ranging from 7 to 20.3 bu/ac, and 3 were considered favorable environments with yields from 27.3 to 37.1 bu/ac.

A stability analysis was conducted in order to determine which of the treatment combinations performed best under the different environments. The most stable and relatively productive treatments were moderate density/wide row/high N/fungicide (MD-WR-HN-FA), and low density/wide row/high N/fungicide (LD-WR-HN-FA).

The highest yielding combination of 90 seeds/ft² seeding rate, 8 inch row spacing, high N rate, and fungicide application (MD-NR-HN-FA) was only moderately stable, but under favorable environments, it performed better than 90 seeds/ft² seeding rate, 16 inch row spacing, high N rate, and fungicide application (MD-WR-HN-FA). Of the four agronomic factors tested, high N and fungicide contributed to both yield and yield stability under all environments, but seeding density and row spacing were variable in different environments.

The study concluded that the use of a high rate of nitrogen along with a fungicide application was the most important agronomic combination to consistently maximize yield. Using either a low or moderate seeding density with wide rows, high N, and fungicide provided high and stable yields, and are good options to use under a wide range of growing conditions.

Since flax is more vulnerable to unfavorable environments and non-normal growing conditions are expected to occur more in the future with changes to the climate, agronomic combinations that produce stable yields could be preferred over strictly targeting maximum yield. However, if growing conditions are predicted to be favorable (taking into account soil fertility history and expected normal weather conditions) and if fields have a high weed pressure, using a moderate seeding density and narrow rows along with high N and fungicide can be a good guideline to follow for high yield and moderate yield stability.

Funding was provided by BASF Corporation, Saskatchewan Agriculture Development Program, Western Grains Research Foundation, FMC Corporation, and the Saskatchewan Flax Growers Commission.

Benaragama, D.I., Johnson, E.N., Gulden, R.H., and Willenborg, C.J. 2022. Integrated agronomy for high yield and stable flax production in Canada. *Agronomy Journal* (early view). 1-13.
<https://doi.org/10.1002/agj2.21078>

Photo by Jennifer Bogdan