

Flax Seeding Date Has Minimal Effect on Water Use Patterns

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Water is the most common limiting factor for crop growth in semiarid areas such as the MonDak region (western North Dakota and eastern Montana). The effect on water use efficiency is an important consideration when selecting crop management practices. An on-going, multiyear, project aimed at determining the optimal seeding date and rate for flax was started at the Williston Research Extension Center in 2019. As part of this experiment, soil water content has been measured weekly throughout the growing season. This provided data to evaluate the effect of seeding date on the crop water use of flax.

Methods and Materials

In the experiment, six seeding dates (April 24, May 2, 8, 15, 22, and 29) and four seeding rates (15, 25, 35, and 45 lb/a) for flax were investigated. Additional agronomic details of the experiment are presented in another report of this publication. Soil water data were collected from a subset of the study plots, specifically the plots planted to Gold ND at the 25 or 45 lb/ac seeding rate. Soil water content was measured weekly using a non-destructive, minimal disturbance soil moisture gauge. Measurements were taken at depths of 6, 18, 30, 42, and 54 inches, representing 1-foot depth intervals of the 5-ft soil profile. The weekly measurements commenced 3 or 4 days after the seeding of each plot and continued in all plots until August 24 when water use of all seeding dates had ceased due to crop maturity or drought. Rainfall data was obtained from an NDAWN station located ½ mile northeast of the agronomic plots. Crop water use (i.e., the sum of the soil water depletion and rainfall) was determined for each interval between the soil water measurement dates. No water depletion from the 4-5 foot depth was observed, so soil water data from that depth was not included in the analysis. To provide additional information, the water source was partitioned into rainfall and each of the 1-ft soil increments. Crop water use amounts were accumulated over all the intervals to determine crop water use for the entire growing season. Water use efficiency was calculated as a ratio between flax yield and crop water use.

Results

Greater than normal precipitation occurred in September 2019, resulting in ample soil moisture at the start of the 2020 growing season. However, only 4.15 inches of rain occurred between April 24 and August 24. Crop water use was greatest for flax planted on April 24 and decreased fairly steadily as the seeding date was delayed (Table 1). This decrease was primarily due to rainfall missed by delayed seeding. However, the amount and the fraction of water obtained from the soil increased for the last two seeding dates (Table 1) suggesting a compensation for decreased rainfall. As seeding date was delayed, the fractional decrease in water use was less than the fractional decrease in growing season length, so that the water use per week increased as seeding date was delayed (Table 1).

Table 1: Crop water use amount, source, and rate; and water use efficiency.

Seeding date	Crop water use	Water from rain	Water from soil	Fraction of water from soil	Water use per week	Flax yield	Water use efficiency
	----- inches -----				inches	bu/a	bu/inch
April 24	8.36	4.09	4.27	51%	0.50	19.7	2.4
May 1	7.97	3.94	4.03	51%	0.50	21.8	2.7
May 8	7.78	3.83	3.95	51%	0.52	23.4	3.0
May 15	7.86	3.81	4.05	52%	0.56	22.8	2.9
May 22	7.82	3.46	4.36	56%	0.61	22.5	2.9
May 29	7.81	3.46	4.35	56%	0.65	19.2	2.5

Daily water use increased greatly after June 22 for all seeding dates (Fig. 1). This was the first time water use exceeded 0.1 inch per day for any of the treatments. Water use remained greater than 0.1 inch per day until July 22 for all seeding dates. After July 22, daily water use decreased to less than 0.1 inch per day for the first three seeding dates, however, daily water use by the last three seeding dates remained greater than 0.1 inch per day for one week longer. There did not appear to be sufficient differences in the soil water content among the seeding dates to account for the earlier decrease in water use by the earlier seeding dates. The decreased water use after July 22 for the first three seeding dates was likely due to the crop reaching maturity whereas the later seeding dates had not.

Daily water use was influenced much more by calendar date than by the number of days after seeding. All seeding dates had water use exceeding 0.1 inch per day between the June 22 and July 22 measurement dates, even though this was 59 to 89 days after seeding for the first seeding date and only 24 to 54 days after seeding for the last seeding date. This suggests that daily water use may be influenced more by weather conditions than by crop growth stage.

Flax yield first increased then decreased as seeding date was delayed (Table 1). Water use efficiency, in terms of bushels produced per inch of water used, followed a similar trend (Table 1).

The 2020 growing season was a drought year, with only 4.09 inches of rain between April 24 and August 24, the starting and ending dates of this study. The drought not only reduced the flax yield, it undoubtedly affected the water use patterns presented in this report. Greater rainfall likely would decrease the fraction of water obtained from the soil. However, greater rainfall also likely would have increased crop growth and thus increased water use, so that the amount of water obtained from the soil may have been similar to the amounts observed this year.

Other research conducted at the Williston Research Extension Center has found that, in the majority of years, spring wheat depletes all plant available water in the upper three feet of soil by the end of the growing season. This happens regardless of the soil moisture level at the beginning of the growing season and occurs every year except for those with extremely rainy growing seasons. This suggests that the patterns of soil water use by wheat also may not be affected by seeding date.

Soil water use by various crops and how it is influenced by crop management practices will remain an on-going research topic at the Williston Research Extension Center.

