2011 VERMONT SUNFLOWER SEEDING RATE X NITROGEN RATE TRIAL

Because the majority of sunflowers in the United States are grown in the Great Plains, recommendations for plant populations and fertilization rates are limited to this specific region and climate. Due to the temperate climate of the northeast, it is likely that optimal seeding rates and nitrogen (N) rates for sunflower production will differ from the Great Plains. A crop's N requirements are often linked to population; this study attempts to evaluate the impact of both seeding rates and N rates on sunflower yield and quality.

MATERIALS AND METHODS

The study was conducted at Borderview Farm in Alburgh, VT. The experimental design was a randomized complete block with a split plot arrangement and four replications. Main plots were comprised of four N application rates; subplots consisted of five seeding rates (Table 1).

Table 1. Seeding and nitrogen rate treatments.

Seeding rates plants acre^{-1}	Nitrogen rates lbs acre^{-1}
20,000	0
24,000	60
28,000	90
30,000	120
32,000	

Prior to harvest, each plot was evaluated for height, head width, white mold incidence, lodging, and bird damage. Plants were examined for signs of white mold (Sclerotinia sclerotiorum) at three locations: on the sunflower head, along the stalk, and at the base. White mold has been known to contribute to lodging, plant rot, and decreased seed and oil yields in the Northeast. Bird damage was estimated using guidelines provided by North Dakota State University Extension, based on the estimated percentage of bird-pecked or missing seeds on a sampled number of whole sunflower heads.


Figure 2. Kern Kraft KK40 press.

Plots were harvested on 12-October with an Almaco SPC50 plot combine with a 5' head equipped with sunflower pans. At harvest, test weight and seed moisture were determined for each plot with a Berckes Test Weight Scale and a Dickey-John M20P moisture meter. Seeds were cleaned with a Clipper fanning mill to remove debris and plant material. Oil from each seed sample was extruded on 20-October with a Kern Kraft KK40 oil press, and oil content was measured (Figure 2). The average moisture level at the time of pressing seeds was 4.8%, which is lower than the recommended level of 6 to 10%.

All data was analyzed using a mixed model analysis where replicates were considered random effects and treatments were fixed effects. The LSD procedure was used to separate cultivar means when the F-test was significant ($P < 0.10$).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. All data was analyzed using a mixed model analysis where replicates were considered random effects. At the bottom of each table a LSD value is presented for each variable (e.g. yield). Least Significant Differences (LSD's) at the 10% level (0.10) of probability are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two values. Treatments listed in bold had the top performance in a particular column; treatments that did not perform significantly lower than the top-performer in a particular column are indicated with an asterisk. In the example at right, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 400, which is less than the LSD value of 500. This means that these treatments did not differ in yield. The difference between A and C is equal to 650, which is greater than the LSD value of 500. This means that the yields of these treatments were significantly different from one another.

Variety	Yield
A	**1600***
B	1200*
C	950
LSD (0.10)	500

RESULTS

Weather information was collected from a station in close proximity to Borderview Farm in Alburgh, VT, and data is summarized in Table 3. The 2011 growing season was wetter than normal, with very heavy precipitation in the spring and fall. However, the months of June and July were close to average in rainfall, and average temperatures were near normal. There were an accumulated 3,886 Growing Degree Days (GDDs) at a base temperature of 44°F, 544 more GDDs than the 30-year average.

Table 3. Summarized weather data for 2011 – Alburgh, VT.

Table 4. Impact of seeding rate on plant and yield characteristics.

Seeding rate	Height	Head width	White mold incidence			Lodging	Bird damage	Seed yield	Harvest moisture	Test weight	Oil content	Oil yield	
			Head rot %	Stalk rot %	Base rot %								
plants ac^{-1}	inches	inches				%	%	lbs ac^{-1}	%	lbs bu^{-1}	%	lbs ac^{-1}	gal ac^{-1}
20000	52.7	**5.9***	3.1	3.8	2.5	**3.1**	**1.4***	**3666***	16.5	27.6	29.3	1065	140
24000	53.3	5.3	**2.5**	5.6	2.5	8.1	2.7*	3080	**17.1**	**28.0**	30.9	936	123
28000	54.7	4.9	4.4	5.0	**0.6**	8.1	3.8	3362*	15.1	27.3	**33.0**	**1098**	**144**
30000	**55.9**	5.0	3.8	**3.1**	1.3	9.4	4.1	3341*	15.5	27.8	29.5	966	127
32000	54.8	4.5	4.4	5.0	1.3	10.0	4.8	3014	14.6	27.8	31.2	952	125
LSD (0.10)	NS	0.3	NS	NS	NS	NS	2.1	386	NS	NS	NS	NS	NS

Figure 5. Impact of seeding rate on bird damage in sunflowers. Treatments with the same letter did not differ significantly (p=0.10).

Seed yield differed by seeding rate, with the highest yield (3,666 lbs acre^{-1}) in the 20,000 plants acre^{-1} treatment (Table 4; Figure. 6). This was not significantly higher than yields from the 28,000 or 30,000 plants per acre treatments. Average seed yield for the study was 3,293 lbs acre^{-1}. Oil yields did not differ significantly by seeding rate. The average oil yield for the study was 131 gals acre^{-1} (Table 4). Oil content did not vary significantly by seeding rate (trial average, 30.8%).

Figure 6. Impact of seeding rate on seed and oil yields. Treatments with the same letter did not differ significantly in seed yield

Impact of Nitrogen Fertilizer Rate

Nitrogen application rate did not significantly impact height and head width of sunflower plants (Table 5). White mold incidence on sunflower heads or stalks did not vary by N rate. However, there was a significant difference by N rate in the incidence of base rot. The least amount of white mold base rot was observed in the 90 or 120 lbs N $acre^{-1}$ treatment. Lodging varied by N rate and was lowest in plots receiving 0 lb N $acre^{-1}$. Bird damage was also significantly lowest in the treatment with 0 lbs N $acre^{-1}$ (Figure. 6).

Table 5. Impact of nitrogen rate on selected plant and yield characteristics.

Nitrogen rate	Height	Head width	White mold incidence	Lodging	Bird damage	Seed yield

rates do not necessarily yield greater amounts of sunflower seed. This has obvious implications on seed costs and can have an impact on overall farm viability.

Nitrogen rates had a slightly different impact on overall characteristics and yields of sunflowers in this study. The only significant differences in crop stand characteristics by nitrogen rate were in white mold base rot (lowest in the treatment fertilized with 120 lbs N per acre), lodging (lowest in the unfertilized treatment), and bird damage (lowest in the unfertilized treatment). There were no significant differences in seed yield, oil yield, or oil content by nitrogen rate, though yields were higher in treatments fertilized with 120 lbs N per acre. Other studies have linked high N rates with increase white mold incidence in sunflowers and other susceptible crops. High rates of N can also weaken crop stems and cause lodging. It is unclear why bird damage would increase with higher N rates. Although not significant, plant heights tended to be taller with higher N rates. Birds may be more drawn to taller plants and hence cause greater damage. Overall, it does appear that residual soil N rates need to be determined for sunflower fields. This is important so that N applications are reasonable and over t