

Evaluation of Varieties, Fertility Treatments, and Red Clover Underseeding For Certified Organic Production Flax Production—Neely-Kinyon Trial, 2007

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Introduction

Flax (*Linum usitatissimum* (Linaceae) – Linen family) is an ancient crop that had been grown in Iowa for many years. Flax has many uses, including industrial oils from oilseed flax, food-quality flaxseed oil, and linen products, fiberboard and paper products from the straw. Flaxseed oil is high in omega-3 fatty acids, which are associated with lowered risk of heart disease and lowered blood cholesterol levels. Flax has a 50-day vegetative period, a 25-day flowering period, and a 35-day period to maturity. Seeds are produced in bolls that contain 6–10 seeds. Seed color can be brown, golden, or yellow. Early seeded flax generally produces the highest yields, using the same planting dates as small grains. Frost seldom kills flax seedlings. Non-uniform maturity and ripening is a problem in late-seeded fields. With the introduction of an organic flaxseed oil processing facility came a need for increased organic flax production in Iowa.

Materials and Methods

In 2007, the experiment was repeated with identical treatments as in 2005 and 2006, with plots measuring 19 x 76 ft in a split-split-plot design. Compost was applied at 4 tons acre⁻¹ on April 4, 2007. ‘Norlin’ and ‘CDC Bethune’ were drilled on April 17 at 50 lb/acre. ‘Cardinal’ red clover was underseeded at 8 lb/acre on April 17. Flax height, flax population counts and weed counts were taken on June 14 following similar methods as in 2005 and 2006. Weed counts were taken on June 14

within a 1-square-meter quadrat. On June 21, biomass samples were taken. Flax was windrowed on July 26 with a 20-foot, self-propelled windrower; turned with an inverter on August 15 and 17; and harvested with a combine on August 20, 2007. Soil samples were taken on August 20, 2007.

Results and Discussion

Similar to 2006, flax production was reduced because of the cool, wet spring, and dry weather in June and July. Yields at the N-K Farm averaged 10 bu/acre compared to the excellent yields of 26 bu/acre in 2005 (Table 1). There was no significant difference between varieties. Compost and red clover had a limited effect on yield, contrary to 2006 and 2005 results. Red clover decreased broadleaf weed populations (Table 1). The red clover crop also produced significant biomass after the flax harvest, serving as a soil-building crop in the rotation—a requirement for certified organic production. The compost and red clover did not appear to impact soil fertility, similar to 2006 results. In the four years of organic flax production at the Neely-Kinyon Farm, yields have ranged from 16 bu/acre in 2004 to 26 bu/acre in 2005 and 14 bu/acre in 2006. Lower yields may be associated with the drought-like conditions during boll-filling. Recommendations developed from all years of research include the use of compost for maximum yield. Red clover is also encouraged to keep legumes in the soil-building crop rotation requirement for certified organic farms. Organic flax was sold for \$0.32/lb in 2006, with net returns in high yield areas reported at \$419/acre, significantly greater than conventional prices.

Table 1. Flax performance and soil quality by variety, compost, and red clover interaction in the organic flax trial, Neely-Kinyon, 2007.

| Parameters | CDC Bethune variety | | | | Norlin variety | | | | LSD _(0.05) |
|----------------------------------------------|----------------------|------------|---------------|------------|----------------|------------|---------------|------------|-----------------------|
| | Compost | | No Compost | | Compost | | No Compost | | |
| | No Red Clover | Red Clover | No Red Clover | Red Clover | No Red Clover | Red Clover | No Red Clover | Red Clover | |
| Population (plants/m ²) | 437.75a ^z | 373.16bc | 383.02abc | 414.42ab | 337.28c | 342.66c | 354.33bc | 340.87c | 54.40 |
| Plant height (cm) | 69.42bcd | 66.25d | 68.42bcd | 68.67bcd | 71.33abc | 73.83a | 67.58cd | 71.58ab | 3.77 |
| Broadleaf weeds/m ² | 49.42a | 30.42bc | 19.75c | 20.25c | 36.75ab | 26.17bc | 27.67bc | 18.67c | 15.58 |
| Grass weeds/m ² | 1.83 | 1.83 | 0.92 | 0.58 | 1.58 | 2.17 | 1.92 | 2.50 | NS |
| Flax dry weight (lb ac ⁻¹) | 4529.58 | 4436.93 | 4645.40 | 4984.07 | 4359.46 | 4884.22 | 4069.52 | 4446.51 | NS |
| Red clover dry weight (lb ac ⁻¹) | 0.40b | 6.39b | 2.80b | 6.79b | 0.00b | 12.38ab | 0.00b | 25.16a | 105.08 |
| Weeds dry weight (lb ac ⁻¹) | 779.96ab | 1418.54a | 199.28b | 450.88b | 742.02b | 670.93b | 680.12b | 634.19b | 639.00 |
| Yield ¹ (lb ac ⁻¹) | 508.43 | 578.39 | 641.16 | 546.13 | 551.57 | 436.67 | 363.92 | 546.42 | NS |
| NO ₃ -N (ppm) | 7.63 | 6.25 | 7.00 | 7.75 | 6.25 | 8.13 | 7.25 | 6.88 | NS |
| NH ₄ -N (ppm) | 4.63ab | 4.00bc | 4.63ab | 5.13a | 4.13bc | 4.63ab | 3.63c | 4.63ab | 0.86 |
| K (ppm) | 292.50 | 288.88 | 255.50 | 299.31 | 268.63 | 265.00 | 267.75 | 287.25 | NS |
| Ca (ppm) | 3012.63 | 3005.63 | 2979.75 | 2992.38 | 3032.75 | 2935.50 | 3044.00 | 2939.25 | NS |
| Mg (ppm) | 358.13 | 353.25 | 333.38 | 334.50 | 355.75 | 334.00 | 342.13 | 334.50 | NS |
| Na (ppm) | 22.38 | 23.75 | 19.25 | 19.88 | 20.25 | 22.50 | 20.88 | 20.13 | NS |
| Total N (%) | 0.214 | 0.208 | 0.203 | 0.212 | 0.210 | 0.214 | 0.219 | 0.206 | NS |
| Bray-P (ppm) | 88.63ab | 79.94abc | 66.56c | 97.75a | 73.50bc | 82.63ab | 80.25abc | 90.75ab | 18.55 |

^zMeans across rows with different letters are statistically different at $P \leq 0.05$.

Table 2. Significance of P value interactions in the organic flax trial, Neely-Kinyon, 2007.

| | Popu- lation | Plant height | Weeds: broadleaf | Weeds: grass | Flax dry weight | Red clover dry weight | Weeds dry weight | Yield | NO ₃ -N | NH ₄ -N | K | Ca | Mg | Na | Total N | B-P |
|---------------------------------------------------|-----------------|-----------------|---------------------|-----------------|--------------------|--------------------------|---------------------|--------|--------------------|--------------------|--------|----|----|----|------------|--------|
| P Value*: Variety x compost | NS | NS | NS | NS | NS | NS | 0.0267 | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| P Value*: Variety x red clover | NS | 0.0148 | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| P Value*: Compost x red clover | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | 0.0469 | NS | NS | NS | NS | 0.0300 |
| P Value*: Variety x compost x red clover | NS | NS | NS | NS | NS | NS | NS | 0.0288 | NS | 0.0350 | NS | NS | NS | NS | NS | 0.0423 |