Evaluation of Previous Rotation on Flax Performance in Certified Organic Production—Crawfordsville Trial, 2005

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Introduction

Flax (*Linum usitatissimum* (Linaceae) – Linen family) is an ancient crop that had been grown in Iowa for many years, but was displaced by the emphasis on commodity corn and soybeans. 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. The seed is covered with a mucilaginous coating. The flax crop responds to up to 50 lb/acre nitrogen, similar to organic small grains. Mycorrhizal association may increase the ability of flax to take up phosphorus from the soil, so growing flax after mycorrhizal wheat rather than after non-mycorrhizal canola may improve phosphorus uptake by flax. 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.

In 2003, an organic flaxseed oil processing facility began operations in Iowa. With the introduction of this plant came a need for increased organic flax production in Iowa for flaxseed oil to be sold around the world.

Materials and Methods

In the Crawfordsville organic flax trial, 'Norlin' flax was seeded on March 29–30, 2005, at 60 lb/acre with 'Multi-Year' red clover underseeded at 14 lb/acre. Flax was seeded into three blocks: 2004 crop of corn; 2004 crop of soybean; and 2004 crop of barley/red clover. Flax plant populations were counted on May 25, and flax height and weed populations were counted on May 25 and June 29, 2005. Flax height was taken by measuring 3 random plants in each plot, and flax population counts were taken by placing a 1-square-foot quadrat in three areas of each plot and counting the number of plants inside the quadrat. Weed counts were taken by placing a 1-square-meter quadrat in three areas of each plot and counting the number of broadleaf and grass weeds. Biomass samples were taken on June 1 and July 12. Biomass samples were taken by randomly clipping three 1 ft^2 sections from each plot. The biomass samples were weighed, separated into flax, red clover, and weeds, and placed in a dryer at 155 °F for 48 hours, after which time, separate dry weights were taken for each group. Twelve random 1-ft^2 flax harvest plots per block were cut on July 25 at ground level and hand-threshed. The remainder of the flax was harvested with a combine on July 25–29, 2005. Soil samples were taken on June 1 and August 11, 2005, from five random locations within each plot at a depth of 6 inches.

Results and Discussion

Yields were significantly different based on the crop of the previous year. The flax field that was in barley/red clover in 2004 yielded 33.14 bu/acre, followed by the flax that was in soybean (25.79 bu/acre), and finally the flax that followed corn (13.60 bu/acre) (Table 1). Stand counts were higher in the flax following soybean, though the flax following corn and barley/red clover had similar stand counts (Table 1). Red clover biomass was higher in the flax following soybeans than the other two trials (Table 1). No significant difference was observed in plant height on May 25, but on June 29, the flax following corn was found to be significantly shorter than the other two varieties (Table 1). The flax following barley/red clover had significantly higher flax biomass (Table 1) despite having higher numbers of grass weeds than the other two blocks (Table 2). Broadleaf weeds (mainly lambsquarters) were more abundant in the flax following corn than in the other two trials, however, and contributed to the greatest weed biomass (Table 2). Significantly higher levels of NO_3-N were found in soils where barely/red clover were grown in 2004. Recommendations from this study include the need for a nitrogen-fixing crop in the rotation prior to flax planting for maximum yield.

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Table 1. Organic flax plant performance, Crawfordsville, 2005.

2004 Crop	Stand plants/ft^2	Plant height (cm) May 25	Plant height (cm) June 29	Flax dry weight (lb/ac)	Red clover dry weight (lb/ac)	Yield (bu/ac)
Barley/red clover	89.75b	31.75	61.92a	3,554a	0.00b	33.14a
Corn	91.18b	30.46	52.58b	1,639c	31.6ab	13.60c
Soybeans	114.33a	30.67	61.67a	2,784b	115.0a	25.79b
LSD 0.05	15.78	NS	3.01	727	104.5	3.71

Table 2. Weed populations in organic flax, Crawfordsville, 2005.

2004 Crop	Broadleaf weeds/m^2	Grass weeds/m^2	Broadleaf weeds/m^2	Grass weeds/m^2	Weed weight
	May 25, 2005		June 29, 2005		(lb/ac)
Barley/red clover	4.83a	142.75b	5.00a	32.67b	2.9a
Corn	27.46b	10.27a	48.25c	6.00a	527.1b
Soybeans	11.50a	0.08a	19.92b	0.00a	70.0a
LSD 0.05	8.71	30.38	9.87	6.73	330.6

Table 3. Soil quality in organic flax, Crawfordsville, 2005.

2004 Crop	Bray-P (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)	NO_3-N (ppm)	NH_4-N (ppm)	pH
Barley/red clover	18.50	181.50	3558.6b	640.13c	11.50a	6.13	6.54b
Corn	17.75	169.38	3878.8a	731.25b	1.38b	5.13	6.89a
Soybeans	19.13	183.63	3858.0a	783.13a	1.75b	5.63	6.78a
LSD 0.05	NS	NS	153.8	51.87	1.49	NS	0.22