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Value Added Agriculture Program

Weed Management in Flax Production On-farm Trials – 2005 - 2006

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Practical Farmers of Iowa

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Project Need

With increased demand for flax in human and feed markets, both organic and conventional farmers have shown interest in growing flax in Iowa. A new crushing facility for flax in northwestern Iowa has provided a nearby market for organic producers. Because flax is not highly competitive with weeds, farmers need effective weed management strategies, particularly where herbicide use is not an option.

Project Summary

Six certified organic farmers and one conventional farmer tested three weed management strategies for flax at nine sites in 2005 and 2006. Drilled flax with no underseeding was compared to flax grown with alfalfa and with red clover underseedings. Flax grain and oil yields, omega-3 fatty acid content and weed growth were measured. Flax yields, measured by hand harvesting, differed due to underseeding and were 1,634 lbs/A where no underseeding was planted, 1,510 lb/A with alfalfa underseeding and 1,484 lb/A with red clover underseeding. Machine-harvested yields were approximately 20 percent less than hand-harvested yields. Slight differences in flaxseed oil content due to underseedings were not economically significant. Underseedings did not suppress weed growth during the flax growing season, but legume underseedings were effective at suppressing weed regrowth 60 days following flax harvest. Red clover provided the most biomass regrowth, 1,692 lb/A, and alfalfa produced 1,043 lb/A. Where flax was grown without an underseeding, weed growth was greatest both before and after flax harvest. Results are similar to those from research trials at two Iowa State University experiment stations in 2005 and 2006. Results indicate that seeding legumes with the flax crop does not provide much competition with weeds until after the flax has been harvested. By late summer, established legume stands are very effective at preventing weed regrowth.

Project Description

Three weed management strategies for flax were compared at nine farm sites in 2005 and 2006. Oilseed flax was drilled with: 1) no underseeding, 2) an alfalfa underseeding or 3) a red clover underseeding. On each farm, these treatments were randomized and replicated six times. Practical Farmers of Iowa member cooperators were: Doug Alert, Hampton; Art Behrens, Carroll; Ken Choquette, New Virginia; Paul Mugge, Sutherland; Dan Parizek, Tama; Ron Rosmann, Harlan and John Veith, Mt. Pleasant. Alert and

John Veith of Mt. Pleasant, Iowa, visits with Iowa State University graduate student Sarah Carlson in Veith's flax field.

Mugge conducted trials in both years of the study.

Flax production practices, crop rotations and fertility histories varied from farm to farm (Table 1). Each farmer planted a different flax variety, but all varieties were brown-seeded. Crops preceding flax in the rotation were soybeans at five sites, triticale at two sites, corn at one site and alfalfa at one site. Manure was applied to the plot areas on four of the eight organic farms and small amounts of commercial N, P, K, and lime were applied on the conventional farm. The other four organic farm sites did not provide any supplemental fertility. Flax and underseedings were drilled between April 8 and April 14, depending on site-specific conditions. Flax seeding rates ranged from 47 to 84 lbs/A, alfalfa from 10 to 19 lbs/A, and red clover from 13 to 18 lbs/A (Table 1).

In the week before mechanical harvest, plots were hand sampled for flax grain and straw, underseeding legume biomass, and weed biomass. Eight, one-foot square samples were selected randomly from within each plot and all plant growth was cut at ground level. Legume biomass and weed vegetation were separated by hand from the flax. Flax grain was threshed and cleaned in the laboratory. The weed and legume biomass and flax straw were dried at 140ºF for three days and weights reported on a dry matter basis. Following hand sampling, farmers windrowed their flax experiments between July 25 and August 5. Flax and other cut vegetation dried in the windrow five to 12 days before farmers combine harvested the grain. John Veith harvested his flax without windrowing. Flax seed samples were analyzed for total oil content with a nuclear magnetic resonance (NMR) spectroscope and for omega-3 fatty acid content using gas chromatography. Flax grain weights and oil percent are expressed at eight percent grain moisture.

Approximately 60 days following harvest, plots at six sites were sampled again for weed and legume biomass regrowth. John Veith had tilled his field, Ron Rosmann had grazed cattle on his plot area following harvest, and Art Behrens had taken an additional hay cutting before

Table 1. Field operations for flax weed management trials at nine Iowa farm sites during 2005 and 2006.

	2005				2006				
Farm cooperators	Alert	Mugge	Rosmann	Veith	Alert	Behrens	Choquette	Mugge	Parizek
Area in Iowa	northcentral	northwest	southwest	southeast	northcentral	west central	south	northwest	east
Flax cultivar	York	Bethune	Norlin	Webster	York	Bethune/Norlin	York	Bethune/Norlin	Bethune/Norlin
Previous crop	soybean	triticale	soybean	soybean	corn	soybeans/rye – fall planted	alfalfa	triticale	soybean
Nutrients added	none	liquid swine manure	none	N-P-K fertilizer and lime	6 T/A cattle manure in late March	3,500 gal/A liquid swine manure	none	solid beef manure	none
Planting date	10 April	9 April	8 April	10 & 16 April	13 April	14 April	14 April	10 April	13 April
Flax seeding rate	47 lb/A	49 lb/A	51 lb/A	50 lb/A	52 lb/A	45 lb/A	50 lb/A	70 lb/A	84 lb/A
Alfalfa seeding rate	15 lb/A	19 lb/A	14 lb/A	14 lb/A	11 lb/A	18 lb/A	15 lb/A	19 lb/A	15 lb/A
Red clover seeding rate	15 lb/A	16 lb/A	13 lb/A	14 lb/A	13 lb/A	18 lb/A	15 lb/A	14 lb/A	15 lb/A
Packed after planting	yes	yes	yes	no	yes	yes	yes	no	no
Weed pressure*	XXX	XXX	XX	X	XXX	XXX	X	XXX	X
Predominant	giant foxtail, smartweed	lambs-quarter	Giant and common ragweeds	ragweed, lambsquarter	foxtail, Giant ragweed, waterhemp, smartweed	foxtail, waterhemp, pigweed	foxtail	lambsquarter, smartweed	foxtail
Cutting date	5 August	27 July	29-30 July	--------	31 July	25 July	29 July	25 July	25 July
Cutting height	4"	6"	4-8"	--------	4"	8"	2"	6"	8-10"
Combine harvest date	17 August	8 August	3 August	29-30 July	12 August	N/A†	N/A†	31 July	1 August

*** Key:**
XXX= much heavier weed pressure; XX = heavier weed pressure; X= comparable weed pressure
† Combine-harvested samples were not weighed

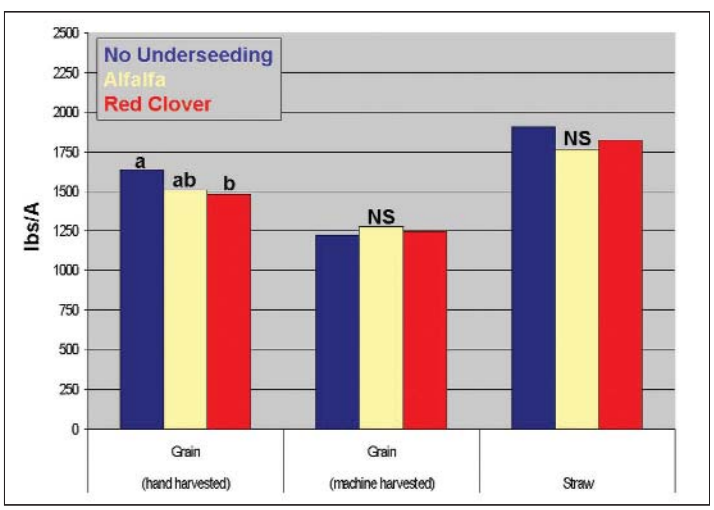
60 days, so these sites could not be sampled. Again, eight, one-foot square samples were selected randomly from within each plot and all plant growth was cut at ground level. Legume biomass and weed vegetation were separated, dried at 140ºF for three days and weights reported on a dry matter basis. For the growing season, farmers provided a visual assessment of weed growth by comparing it with weed competition they have experienced in their current and previous small grain crops (Table 1).

Results

Grain and Oil Yield

Flax grain yields, determined by hand harvesting, differed among the three underseeding treatments. Yields were highest where no underseeding was planted (1,634 lbs/A), intermediate where alfalfa was underseeded with the flax (1,510 lb/A) and lowest where red clover was seeded with the flax (1,484 lbs/A). Machine-harvested yields were approximately 20 percent less than hand-harvested yields, indicating some grain loss during windrowing, curing in the windrow and combining (Figure 1). The apparent reduction in yield from the flax that was grown (as reflected by hand-harvesting) to the net grain yield collected during machine harvesting obscured differences among the three treatments (Figure 1).

Figure 1. Effect of three underseeding treatments on hand-harvested and machine-harvested* flax grain yields and flax straw yield from nine Iowa farm sites in 2005 and 2006.



* Machine-harvested grain yield from seven farm sites

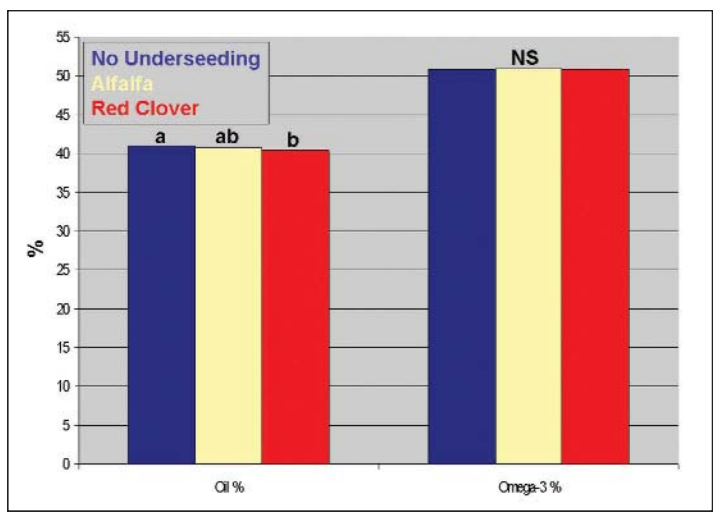
Straw Yield

Flax straw yields ranged from approximately 0.7 ton/A to 1.5 ton/A when averaged among all treatments (Figure 1) and did not differ significantly among treatments. Feasible current uses for flax straw include livestock bedding, mulch, windbreaks (big round bales) and straw bale building material. Flax straw can be fed to livestock, but measured values of 3.4 percent protein and a Relative Feed Value (RFV) of 47, indicate a very low quality feed. Straw is slow to break down due to its high fiber content and high carbon to nitrogen ratio of 97:1. The value of flax straw is not well established, but may range from one half to equal the value of oat straw.

Total Oil and Omega-3 Fatty Acid Content

The oil percentage of flax grain grown without an underseeding was 0.5 percent higher than grain grown with a red clover underseeding. Although statistically different, differences among underseeding treatments were small and likely not economically significant (Figure 2). These values indicate sufficient levels of oil to meet the requirements for the current organic flax oil market. The percentage of the oil which was omega-3 fatty acid did not differ among the treatments and averaged 50.9 percent (Figure 2). This level of omega-3 fatty acid could limit acceptance by buyers of food-grade flax.

Figure 2. Effect of three underseeding treatments on flax seed oil content and percentage omega-3 fatty acid of the oil. Values are averaged among nine Iowa farm sites in 2005 and 2006.



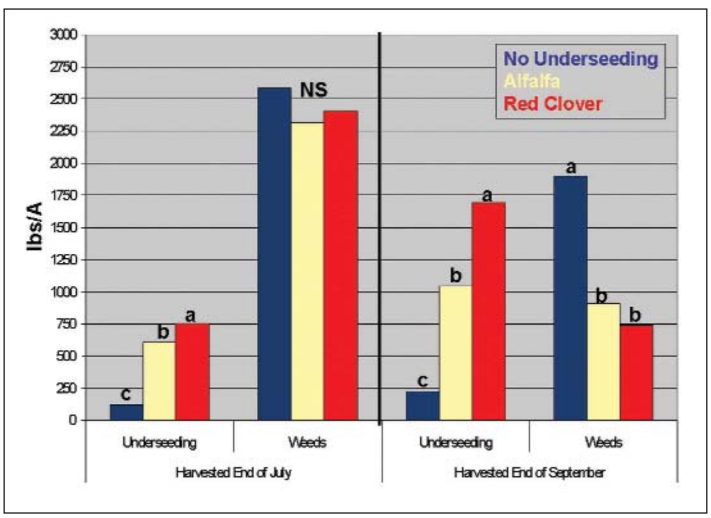
Weed Growth

Weed biomass production was higher on all of the certified organic farms compared with John Veith's conventional farm. John's flax followed a long-term hay seeding which may have contributed to fewer weeds. Predominant weed species varied from farm to farm

(Table 1). Despite these differences, weed growth was similar in both alfalfa and red clover underseeding treatments on all the farms and was not different among the three underseeding treatments up to the time of flax grain harvest in late July (Figure 3). At flax harvest, weed biomass weight, averaged across all farms, was 2,351 lbs/A. For weed management in crop years following flax, the amount of viable weed seed produced up to the time of grain harvest may be critical. Researchers observed many developing weed seed heads at the time of harvest, but did not assess the viability of any weed seeds.

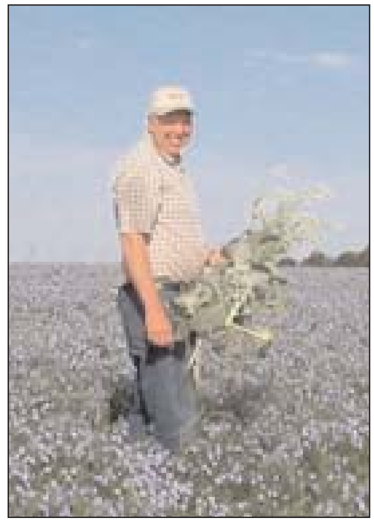
Following flax harvest, weed regrowth differences among the underseeding treatments were easily visible in the field. Sixty days after grain harvest, weed biomass regrowth and establishment of new weed seedlings were highest where no underseeding was planted. Weed regrowth biomass was the same for both the alfalfa and red clover underseedings and less than half of that where underseedings were planted (Figure 3).

Figure 3. Effect of three underseeding treatments on legume underseeding and weed biomass growth during the flax season and 60 days after flax harvest. Values are averaged among six Iowa farm sites in 2005 and 2006.



Legume Underseeding Growth

Seedling legume biomass production was low up to the time of flax harvest (Figure 3). On all farms, we found small amounts of volunteer legumes where no underseeding had been planted, due to either previous crop or contamination with seed from neighboring plots. In the legume underseeding treatments, the average production of 608 lbs/A of alfalfa and 752 lbs/A of red clover did not suppress weed growth (Figure 3). In fact, during the crop growth period, weeds produced five times as much dry matter as the newly seeded legumes.



Predominant weed pressure in Art Behrens' field was foxtail, waterhemp and pigweed.

Following flax harvest, there were distinct differences in the amount of legume regrowth. Alfalfa production was 0.5 ton (1,043 lbs) and red clover produced more than 0.75 ton (1,692 lbs) of dry matter/A (Figure 3). Legume regrowth did suppress weed regrowth during this time period. The greatest legume dry matter production (red clover) was associated with the least amount of weed regrowth (Figure 3).

Conclusions

Legume underseedings, planted with flax in the early spring, did not compete with the flax nor did they help suppress weeds up to the time of flax harvest. Flax grain yield, oil content and weed biomass were not affected by underseedings. Both alfalfa and red clover regrowth following flax harvest did compete with weed regrowth and suppressed weed biomass production. Legume underseedings were easily established with flax and it appears that either a hay seeding (alfalfa or mixed alfalfa/grass) or a green manure (red clover) may be successfully planted with flax depending on the farmer's need or the sequence of flax in the crop rotation.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture.
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