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Production and Use of Flax and Field Peas in Iowa

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Introduction

Most Iowa crop producers now rely on only two crops, corn and soybeans, for their livelihood. This has led to many challenges, including increased pest problems, such as bean leaf beetles and soybean aphids, a skewed distribution of labor throughout the year, and vulnerability to adverse weather and poor prices. It has also become increasingly difficult to compete in the world market when these commodities can be produced at a lower cost in other countries, such as Brazil. Crop producers are continually looking for a third crop to include in their rotation, but either the economics are not favorable or there is not a local market for the crop. It is not likely that only one crop will emerge as the elusive “third crop” for Iowa. But, it is possible that various third crops are suited to our growing conditions and may be integrated on some farms. The key to adoption will be viable markets for these niche grains, forages, and oilseeds. A change in farm policy, so that integrating additional crops would not threaten long-term profitability and land values would also speed adoption of alternative crops for feed and for niche markets.

Flax

Growing flax in the upper Midwestern U.S. is not a new phenomenon. Flax was widely grown in Iowa in the first half of the 20th century. In 1943, flax production peaked in Iowa when 330,000 A were planted. After WWII, acreage of flax rapidly declined with decreased demand for paint for military equipment and flax cake for livestock overseas. With the addition of synthetic fibers, latex paints and increased production of soybeans, flax almost disappeared from the upper Midwestern landscape. Before these recent studies, the last Iowa State University (ISU) research trial conducted with flax was in 1972. In 2004, organic grain producers in Iowa began experimenting with flax on about 100 A.

Demand for organic flax in the upper Midwestern U.S. has risen due to consumer demand for flaxseed to improve diets and with the recent construction of a certified organic oilseed expelling facility in northwestern Iowa. The organic flaxseed market for human consumption has market standards for oil percentage, alpha-linolenic fatty acid (ALA, an omega 3 fatty acid) content, and free fatty acid (FFA) content (an indicator of seed coat damage and fatty acid degradation).

Challenges exist to raising flax in Iowa, in part, because limited modern production information is available. The majority of available production recommendations are from pre-1950, or from the cooler and drier climates of North Dakota and Canada. In addition, because the majority of modern production is managed using pesticides and synthetic fertilizers, few recommendations exist for organic flax.

Organic farmers’ biggest questions have been about weed management techniques for this
relatively non-competitive crop, providing adequate fertility, appropriate cultivars, and harvest methods. In 2005, Iowa State University (ISU) initiated flax research both on Iowa State University experimental research stations and on farm in conjunction with commercial farmers.

**Overview**

Growing flax is much like growing oats, barley, or spring wheat. Flax is planted early in the spring and is harvested in midsummer. It is not clear where flax fits best in crop rotations. Organic growers in North Dakota often plant flax following alfalfa, both for the N contribution from the legume and because weed pressure is the lightest in that year. In 2005 on a demonstration site in southeastern Iowa, flax was grown following three previous crops: barley with a red clover underseeding, soybean, and corn. Flax grain yield was highest following barley and lowest following corn. Conversely, a commercial farm documented higher yields when flax followed corn compared with following soybeans. Research is needed to answer this question for flax rotation options in Iowa.

**Insects and Diseases**

Flax fields should be rotated to other crops to aid in weed, disease and insect management. Flax should not be grown in the same field more than once every three or four years. A few diseased plants have been observed in flax fields in the three years that it has recently been grown in Iowa, 2004-2006. Powdery mildew (Oidium lini) and (Rhizoctonia solani) have been identified as the causal organisms. No widespread incidence of disease or insect pests have been observed, likely because of our limited production area. Several diseases are common on flax in the major growing areas, though breeding for resistance has lessened the effects of these on yields. Whether or not we see greater incidence of disease on flax remains to be seen in the future.

**Planting**

As with small grains, early planting is needed for highest flax yields. A frost in the spring of 2005 had no impact on seedling flax. It appears that these seedlings are as tolerant, or more so, than oat seedlings in the early spring. Research was conducted at two Iowa sites in 2005 and 2006 to evaluate the effects of planting date on flax grain and oil yield. Planting was delay in 2006 compared with 2005, due to cold, wet conditions in early spring. Flax grain yield was highest in both years with early planting (Figure 1). Although yield loss with delayed planting leveled somewhat between mid and late planting in central IA in 2006, grain yield at all locations was reduced an average 36 lbs/Â for each day that flax planting was delayed. At this time, oil content of the flaxseed has been analyzed for 2005, but not for 2006. Oil content of the seed averaged 41.9% in 2005 and was not affected by planting date.

Growers should finish flax planting by March 20 in southern Iowa and by April 1 in northern Iowa.
Figure 1. Flax grain yield response to planting date at two Iowa locations for two years.

**Cultivar selection**

Flax cultivars differ in grain yield potential. Five flax cultivars were evaluated at two sites in Iowa in 2005 and 2006. Four brown seeded cultivars were: Norlin, Hanley, CDC Bethune, and York. Carter, a golden-seeded cultivar was also included. In 2005, grain yields were similar at the two locations. Hanley and York had highest yields; Norlin and CDC Bethune had the lowest yields of the cultivars grown (Figure 2). Oil content of the flaxseed averaged 41.9 % and was not different among the cultivars. Data for 2006 is not available at this time.
The current market in northwestern Iowa specified cultivars Norlin and Bethune for the 2005 and 2006 crop years. Additional data provides input on improved cultivars for Iowa production.

**Weed management for organic flax**

To provide organic producers with information about a variety of weed management strategies that could complement their farming systems, five organic strategies and one chemical strategy for comparison were assessed in both 2005 and 2006 at two locations in Iowa. Treatment were:

- **Control**
  - Drilled flax
- Mechanical methods
  - Broadcasted flax
  - Two-way cross drilled flax
- Biological methods
  - Red clover + drilled flax
  - Alfalfa + drilled flax
  - Grass/Legume + drilled flax
- Chemical method
  - Herbicide + drilled flax
Results-2005

In 2005 at central IA, the broadcast treatment yielded significantly less flax grain than the other treatments (Fig. 3). Additionally, the weed biomass at the central Iowa site was lower compared to NW IA except in the broadcast treatment. Despite this difference, the average grain yield was higher in NW IA than at central IA and there was no effect of any of the weed management strategies on grain yield. (Fig. 4).

Results-2006

In 2006 at central IA, flax grain yielded similarly for all treatments. Weed biomass was significantly lower in the herbicide treatment, but this did not affect grain yield (Fig. 5). At NW IA the alfalfa, grass/legume, 2-way and broadcast treatments were not significantly different. The red clover treatment yielded the least grain and the control and herbicide treatments produced the highest yields even though only the herbicide treatment had significantly less weed biomass (Fig. 6).

Overall results are not conclusive for best weed management strategies when chemical control is not an option.
The effect of legume underseedings was measured on late-season weed growth 60 days following flax harvest at five sites over two years in related experiments conducted on organic farms. Data in on-farm comparisons of legume underseeding indicated that red clover was more effective at suppressing late-season weed regrowth than was alfalfa and alfalfa was more effective than no underseeding with flax (data not shown).

Additional information about flax production in Iowa can be found in *Flax Production Guidelines for Iowa* online at: www.extension.iastate.edu/Publications/PM2020.pdf.

**Field Peas**

Field peas are another option for Iowa, but they have not been widely grown, partly because of the lack of a local market. Iowa pork producers have used soybean meal in swine diets for many years as the primary source of protein to balance diets. Research from Canada and Europe indicates that field peas can be substituted in swine diets with no adverse effects on pig performance (Zijlstra et al., 1997 and Kehoe et al., 1995). Thus there is a huge potential market for the crop in Iowa. Unlike soybeans, field peas do not have to be processed before feeding, so can be fed right off of the farm, thus adding value to the crop. And, because it is a short season crop, it offers the opportunity of double cropping, thus increasing potential profits.

Field peas are usually planted in early spring so that they flower during cool weather (McKay et al., 2003). Recently there has been some success in planting peas in July following a wheat crop, so they flower when temperatures are becoming cooler in the fall. If farmers could plant field peas soon after the winter wheat harvest, profits could increase and agricultural production could become more sustainable by having more crops in the crop rotation. Another possible fit of field peas into a crop rotation is to plant the peas in the early spring and follow them with soybeans in June. An additional benefit to fitting field peas into a corn-soybean rotation is that the same equipment that is used for soybeans can be used for peas.

**2005-2006 Trials**

The research consists of a small-plot crop rotation trial located on the SE Iowa Research and Demonstration Farm near Crawfordsville and large field-scale double-cropping trials in farmers’ fields. The small-plot research trial consists of three crop rotations that were established in 2005 and will continue through at least 2007. One of the crop rotations includes field peas double cropped after winter wheat and another rotation includes soybeans double cropped after field peas. These rotations will be compared to the standard corn-soybean rotation. The three crop rotations are; 1) corn-soybean, 2) corn-field peas/soybean, and 3) corn-soybean-winter wheat/field peas.

Three varieties of field peas were planted after a winter wheat harvest with a drill on three planting dates in 2005 and two planting dates in 2006 in plots arranged in a randomized complete block design with 4 replications. Two varieties of field peas were planted in the early spring in 2005 and 2006 followed by double cropped soybeans.

In 2005, a 74-acre field was planted to two varieties of field peas in mid-March and soybean planted on July 1 after the field pea harvest. The peas in this trial were used in a large swine feeding trial. Two pea varieties were also planted in July after a winter wheat harvest on two farmer’s 15-acre fields. In 2006, three pea varieties were planted in early April on a farmer’s 30-acre field followed by double cropped soybeans. In addition, two pea varieties were planted on
another farmer's 30-acre field followed by double cropped milo. In 2006 three farmers planted three varieties of field peas in July following a winter wheat harvest on 20-40 acre fields. Yields of peas planted in July after a winter wheat harvest were poor in 2005, probably partly due to the hot, dry conditions that summer. Yields averaged 13 bu/A in the small plots and were less than 10 bu/A in the large fields. At the time of this writing the summer planted peas in 2006 had not been harvested, although it appears that yields may not be much better than in 2005.

The spring planted peas followed by double-cropped soybeans or milo showed more promise. In 2005, the 75-acre field yielded an average of 40 bu/A of field peas followed by 26 bu/A of soybeans. The field had very poor fertility levels and there was a plant stand problem with one of the pea varieties, so the yield potential of the peas was probably not met. The same two varieties yielded 52 bu/A in the small plots at the research farm, although the double-cropped soybeans only yielded 9 bu/A due to harvest problems.

Yields of spring planted peas were generally in the 25-40 bu/A range in 2006. The poorer yield in 2006 compared to 2005 may have been due to problems with achieving desired plant stands, the later planting date in 2006, and some unusually hot days in May of 2006. Double cropped soybeans yielded 20-25 bu/A and double cropped milo yielded over 50 bu/A in 2006. Swine feeding trials conducted with peas from these trials have shown no statistical change in average daily gain or in feed efficiency by replacing part of the corn and soybean meal in the diets with field peas.

It is not likely that winter wheat followed by double cropped field peas will be an economically viable cropping system in Iowa. However, spring planted peas followed by double cropped soybeans or milo warrants further investigation.

References

