



MIXED CROP OPTIONS FOR MARITIME ORGANIC GROWERS

Interim Research Report E2006-11

INTRODUCTION

High protein organic feed for livestock production is costly for farmers to purchase. The on-farm production of a high protein crop may be a better option for organic livestock producers. The use of field peas with cereals such as oats, wheat, and barley in mixtures is a common practice among organic dairy farmers in Québec¹. In Atlantic Canada, field peas have been replaced largely by soybeans, which remain difficult to produce organically. While mixed crops have much potential for livestock feed production, there is a need to evaluate crop performance and quality under organic management, with respect to protein and feed quality.

Mixed crops may have improved pest and weed control, improved use of nutrients, light, and water, and reduced lodging in comparison to a stand of field pea. However, growing these mixtures poses some production challenges, such as different maturation rates, shattering losses, risk of lodging, and challenges in combining and storage. A good pea-grain mixture that would provide a protein benefit for maritime organic farmers has not been determined.



Oat and field pea mixed crop (D. Lynch)

The objective of this trial is to assess the efficacy of combining field pea with oats and barley in mixtures for production of a high protein grain supplement for organic producers. Experiments were conducted at research stations in Nova Scotia and PEI, and on organic farms in New Brunswick and PEI.

CHOOSING CULTIVARS

In Atlantic Canada, there are currently no recommended field pea varieties. When developing a mixed crop, the ultimate percentage of peas in the stand will vary depending on the seed weight, referred to as 'Thousand Kernel Weight' or TKW. As shown in Table 1, there are a range of sizes between pea cultivars. For instance, Carrera seeds were 60% heavier than the lightest pea, line 746-3. For cultivars with a smaller TKW, the same seeding rate will provide a higher proportion of peas in the mix. Larger peas (with a higher TKW) will need to be seeded at a heavier rate to achieve the same ratio of peas to grain.

The mixed cropping trials conducted from 2003-2005 tested a range of mixtures of field pea with barley, covered oat (with hull) and hull-less oat. Hull-less oats are a crop of interest as feed for poultry and swine producers. They have good quality protein and high protein content (14 - 20%), but because there is no hull, care must be taken during planting, harvest and storage².

Table 1. Thousand Kernel Weight of field pea cultivars for mixed crop production

Field Pea Cultivar	TKW (g)	Percent pea seeds in 1:1 mixture (by wt.)*
746-3	188	20%
Mozart	219	17%
Lenca	220	16%
Miami	260	14%
Carrera	310	12%

*Mixture with a grain of 35g TKW

STATION RESEARCH

In small plot trials at Brookside (NS) and Harrington (PEI), two and three-way mixtures of field pea, oat (Nova) and barley (AC Westech) were grown at different rates of combining in the mixture, and compared with peas and grain crops grown alone. The pea cultivars Miami, Carrera, and 746-3 (a line selected at NSAC) were chosen for the trial. As shown in Table 2, a wide range of mixtures were grown to try and determine the best mix for compatibility, yield, protein content, and lodging resistance. This research was repeated at both sites in 2003 and 2004, and at Harrington in 2005. Weeds were managed through pre- or post emergent finger weeding.

Table 2. Mixed crop treatments for Harrington and Brookside, 2003-05

Treatments as a percentage of monocrop seeding rate	Peas	Oats (seeds m ⁻²)	Barley	Approximate percentage of peas in mix
100%	90	375	350	
Monocrop				
Two-way mixture				
90%-30%	81	105		44%
60%-60%	54	210		20%
90%-30%	81		113	42%
60%-60%	54		225	19%
Three-way mixture				
40%-40%-40%	27	140	150	9%

Generally, these trials demonstrated that there is both a yield and a protein benefit from mixed cropping systems as compared with oat and barley grown alone. Barley and oat monocrops yielded between 2 to 3 t ha⁻¹, whereas peas alone or in mixtures yielded from 3 to 4 t ha⁻¹. Among pea varieties, greater protein content (~25%) and lower lodging was observed in the NSAC-selected line (746-3) compared to the varieties Miami and Carrera. Unfortunately, this line is not yet commercially available.

The protein content of mixed crop treatments increased with greater proportion of pea, as shown in Figure 1 for the 2003 trial at Harrington. Mixed crop protein content ranged from 15% (3-way mixture) to over 20% (2-way mixture). Oat or barley monocrops (not shown) contained less than 12% protein.

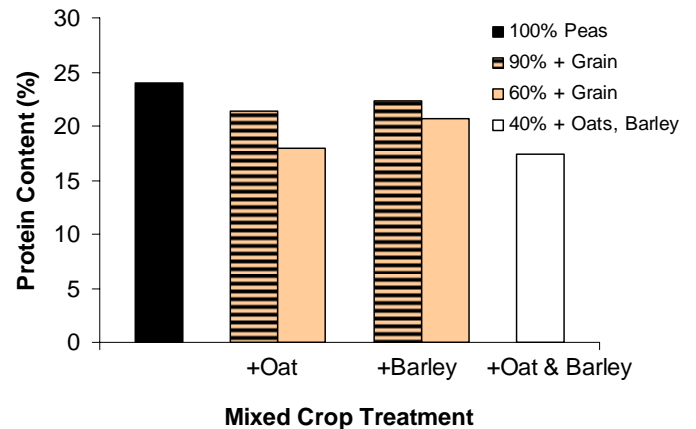


Figure 1. Protein content for mixed crop treatments at Harrington PEI, 2003

The risk of including a high percentage of pea in the mixture is that lodging may be greater. Lodging was consistently severe when peas were present at 20% or greater at seeding, and slightly lower for oat mixtures (Figure 2). Keeping pea less than 20% of the stand appears to be the best method to reduce lodging and still attain a protein benefit.

Establishing a good pea stand may depend on the use of an appropriate seeding depth. In 2005 at Brookside, we tested an oat-pea mixed crop treatment seeded at two depths (3 cm and 5 cm). The pea emergence and establishment rate of the mixed crop was reduced at a 5 cm depth, although there was no difference in yield or protein content. The greater depth may have reduced pea vigour or slowed emergence.

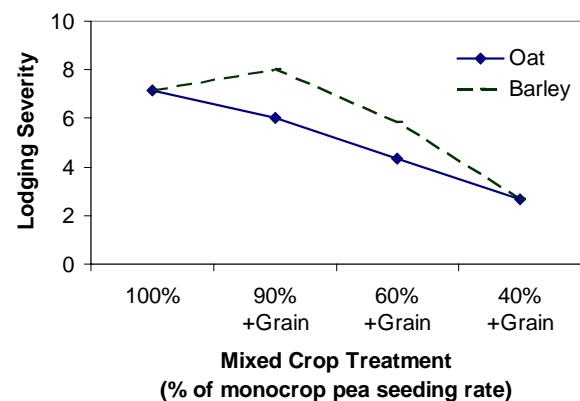


Figure 2. Average lodging severity for mixed crop treatments at Brookside NS, 2003-04

ON FARM

From 2003 to 2005, four producers from New Brunswick and one from PEI participated in on-farm trials of mixed crops of field pea, oat and/or barley. While the station based trials are useful to test multiple combinations and new cultivars, on-farm trials are essential to testing mixed crops in commercial organic farm conditions. To achieve an optimum percent of pea in the mixed crop stand, the ratio of peas to grain (by weight) in the seeding mixture will vary considerably depending on pea cultivar chosen (Table 1). The cultivars Miami and Lenca were used in the 2003 trials. Lenca was an indeterminate cultivar that posed maturity and harvesting difficulties. Miami is a determinate cultivar that has a large TKW and established poorly in the field, leading to low pea stands. CDC Mozart was the commercially available field pea cultivar with the lowest pea TKW, providing a high percentage of peas in the mix. It was used in the on-farm mixed crop trials in both 2004 and 2005.

In 2003, three farmers tested a variety of crop mixtures (barley, oat, hull-less oat) at 25% pea and 50% pea by weight. They found that the 25% wt:wt rate of peas always reduced the amount of peas in stand to only 7-8% with no benefit to protein. Of all the grains tested, hull-less oat had high protein and decent yield, both as a monocrop and in mixtures.

In on-farm trials in 2004, producers seeded a pea:cereal mixture that was 50% Mozart peas by weight with either oats or barley. Lodging was not a problem for any of the treatments at the farm sites. As shown in Table 3, the hand samples (quadrat) collected before harvest showed that the protein content of the mixed crop was 2.3% higher than the monocrop, but the samples taken from the combine showed a protein increase of 1.2%. The lower level at harvest may be due to shattering or pea loss. Protein benefits from mixed crops were obtained when the intended target pea content of stand (15%) was achieved. Failure to consistently achieve a good pea stand was linked to challenges related to seedbed preparation and seeding depth influencing pea establishment.

Table 3. Protein content (%) Prior to (quadrat), and at Harvest (combine) for On-Farm Mixed Crop Trial in 2004-05

Farm	Quadrat Sample		Combine Sample	
	Mixed Crop	Grain	Mixed Crop	Grain
2004				
A	-	-	13.8	13.6
B	11.8	9.0	11.8	9.1
C	14.4	12.6	15.3	14.4
Mean	13.1	10.8	13.6	12.4
2005				
A	14.3	12.9	15.0	13.0
B	15.6	12.7	14.1	12.8
C	15.2	14.5	16.4	14.3
D	14.0	11.8	13.0	12.1
E	14.6	11.7	14.5	12.6
Mean	14.7	12.7	14.6	13.0

In 2005, producers from New Brunswick and PEI continued the on-farm mixed crop trials. They compared a mixture of CDC Mozart field peas (TKW = 241 g) and AC Baton hull-less oats (TKW = 36 g) to a pure stand of oats. This year, the goal was to attain 20% peas in the stand, to achieve a protein benefit of 14-15%. To achieve this pea density, a mix of 60% pea to 40% hull-less oat (by weight) was premixed and provided to the farmers. This also helped researchers to compare between sites. The grains were seeded at 130 lbs acre⁻¹ (146 kg ha⁻¹).

Two weeks after emergence, the percentage peas in the stand was 21% (range: 13 -29%), which met the intended target density. Yields were lower than expected: the average mixed crop yield was 1.37 t ha⁻¹ and the monocrop oat yield was 1.22 t ha⁻¹. Data for each site is presented in Figure 3. Hull-less oats will yield 20-25% less than regular oat, because the hull adds weight and fibre but not additional nutrition. At one site, there was some lodging which can reduce yield if the combine is unable to pick up the crop. Also, if the combine knives were set high, some of the pea yield may have been reduced. Shattering can in some situations be a concern, as the pea tends to reach maturity earlier than the oat.

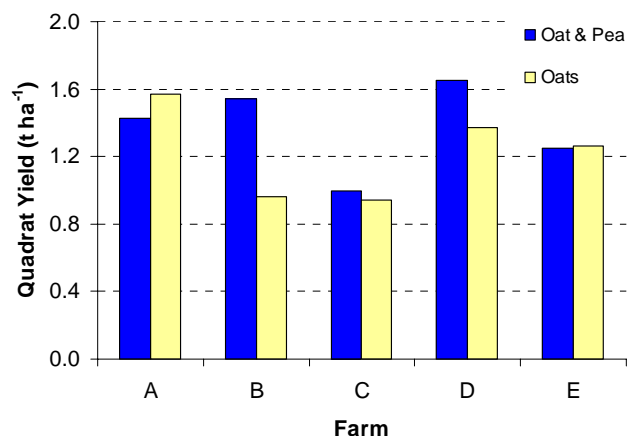


Figure 1. Yield of Mixed Crop and Oat Plots from 2005 On-Farm Trials as assessed by quadrat

Protein content for the mixed crop grain was significantly higher than the oat monocrop, as assessed by quadrat (2% higher) and combine (1.6% higher) (Table 3). The lower combine values may indicate that some of the pea component of the mixed crop is being lost. If producers don't see an increase in protein content at the combine, then the benefit of a mixed crop is lessened. Protein yields on-farm (not shown) were also 20-30% higher (~0.05 t ha⁻¹) for mixed crop than monocrop in 2005.

THE BOTTOM LINE...

Mixed cropping of pea and grains in organic agriculture does produce a benefit in protein content and a minor benefit in protein yield.

The use of a 60:40 ratio (by weight) of Mozart field pea to Baton hull-less oat produced over 20% peas in the crop stand, with lodging only a problem at one site. Mixed crops had grain protein that was 1.6 – 2.0% higher than a hull-less oat monocrop. Care must be taken during harvesting mixed crops to ensure that the pea component is not lost.

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A mixed pea –grain crop at maturity (K. Punnett)

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