



## Forage brassicas as a component of organic production systems

**F**orage brassicas have shown potential as high nutrient, cold-tolerant crops for grazing season extension and to enhance soil fertility and nutrient uptake by subsequent crops. Managed as green manures, forage brassicas can be highly efficient in nutrient uptake and increase yields of subsequent crops, especially in nutrient deficient soils. Brassicas can contribute to phosphorus availability by storing P in plant tissue, which is subsequently released upon decomposition. In cool environments, forage brassicas may contribute to more flexible livestock grazing systems.

In this study, the performance of forage brassicas was tested on three organic farms in Montana and at the Montana State Western Agricultural Research Center (WARC).

Cooperators grew replicated plots of a forage brassica, 'Barnapoli' rape, and one other non-brassica green manure of their choice. Green manure dry matter production and tissue nitrogen were measured, and growers completed a questionnaire on crop growth, weed suppression, pest incidence, and observations on suitability to their cropping system. On one farm crops were grazed by cattle, and at WARC, grazing was simulated to test crop regrowth, with the harvested forage dried like hay and fed to sheep.

Crop success was highly dependent on soil fertility, particularly nitrogen levels. In a dryland situation, crop establishment was highly variable due to limited soil moisture. In locations with adequate moisture, a suffi-



'Barnapoli' rape and berseem clover stand at WARC, Corvallis, Montana, 2001. A vigorous stand is shown to the left of Sue Wall-MacLane and Sharon Luibrand, weak growth on the right.

ciently high seeding rate, and adequate soil fertility, the brassica crop produced abundant biomass and provided good weed suppression. At one site, soil sulfur content was increased. On low fertility soils or where soil moisture was inadequate, the brassica did not produce sufficient biomass to be considered a viable crop for forage or green manure. As a forage crop, it was shown to have a high feed value and palatability.

### Objectives

- ❖ To identify organic farming systems that will benefit from the introduction of brassicas.
- ❖ To gather farmer input on the practical concerns regarding incorporating forage brassicas into their grazing and cropping practices.
- ❖ To evaluate the effects of brassica crops on soil nutrients.

### Methods and Results

Replicated plots were established in a randomized complete block design at WARC and in paired comparisons at three organic farms. Comparison crops included Berseem clover, oats, winter rye and peas. Farm plots were long strips located side-by-side in the field, replicated four times. Cooperators based their seeding rates on past experience, ranging from 7 lbs to 40 lbs per acre for the 'Barnapoli' rape. Rainfall ranged from 2.2" to 10.6" per site during the growth period. Irrigation was provided at three sites, but not at the Alger dryland farm located in Stanford.

### Western Agricultural Research Center

(WARC) - Corvallis At WARC, 'Barnapoli' rape was compared with Berseem clover. Two plantings were made on May 7 and June 8, with each crop planted at 10 lbs/ac. Irrigation was applied at ½" to 1" per week, May through August. Emergence and stands of the brassica and clover were

### Project Notes

**Principal investigators:** Dr. Nancy W. Callan, Western Agricultural Research Center, Montana State University, Corvallis, MT

**Organic grower-collaborators:** Western Agricultural Research Center, Corvallis, MT; Rod Daniel, Montana Arnica, Grantsdale, MT; Nancy Matheson, Matheson Farm, Helena, MT; Jess Alger, Alger Farm, Stanford, MT

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**Project period:** 2001, reported June 2003



Replicated strips of 'Barnapoli' rape alternated with oats at Montana Arnica, Hamilton, Montana. Stand establishment of both crops was excellent in most of the planting.

good for both early and late plantings, though flea beetle were a problem in each brassica planting. Stunting of rape but not of clover was observed in mid-season at one edge of the early planting, due to nitrogen deficiency where previous corn plots had been located. Grazing was simulated by cutting the early planting at 8" from the ground on August 6, and regrowth was harvested at ground level on October 2. The forage was dried and fed to sheep. Growth of the late planting was healthy and uniform. The late planting was harvested once, on October 2. Biomass of the early planting of rape was much higher at first cutting than that of the clover, but the difference was not evident when the regrowth was harvested. The forage rape crop contained more nitrogen than did the clover because of its greater biomass, but the clover green manure resulted in higher soil nitrate-N after incorporation. A significant increase in soil sulfur was seen after the 'Barnapoli' rape green manure was incorporated.

**Grower comments - Nancy Callan:**

The rape crop showed good potential for biomass and forage production. The greatest disadvantages were insect problems, poor growth in areas of low soil fertility, problems with wilting and a high water requirement during the intense heat of summer. Performance could be improved by adjusting timing of planting to avoid flea beetle. The sheep showed a liking for the brassicas that were harvested and dried like hay.

**Montana Arnica - Grantsdale** - Rape was compared with oats. Both were seeded on May 29; the rape at 40 lbs/ac. Crops were irrigated at  $\frac{3}{4}$ " to 1" per week. Stand establishment and initial plant growth were good. Variability in residual soil fertility led to plant growth differences similar to those observed at WARC. Montana Arnica is located on the Bitterroot River bottom in an area crossed by several old gravel bars, and both rape and oats showed reduced growth in those areas, with the rape affected more than the oats. Both crops suppressed weeds in vigorous stands. In contrast to observations at WARC, no differences in soil fertility were seen after the rape and oat green manure crops.

**Grower comments - Rod Daniel:**

Advantages were weed control in areas where soil was fertile and moist, and the rape is a great indicator of soil fertility. Flea beetles and intolerance to drought were the greatest disadvantages. Could improve performance with more uniform soil fertility; the addition of a legume in the mix might minimize dependence on soil fertility.

**Matheson Farm - Helena** - Winter rye was planted as a comparison with the 'Barnapoli' rape; the rape was seeded on April 30 at 18 lbs/ac. Early irrigation only was provided, about 2" in mid-May. The rye was planted the previous fall and survived the winter. The brassica did not emerge well in the spring, and required irrigation for establishment. Full emergence finally occurred by the end of May. Seedling stand and productivity of rape was substantially lower than at WARC or Montana Arnica. Weed competition was severe. No differences in soil fertility between rape or rye green manures were observed.

**Grower comments - Nancy**

**Matheson:** I would have obtained a better stand by using a higher seeding rate and drilling the seed instead of broadcasting it. Previous experience on this farm with canola, a related crop, indicates that there is potential for obtaining an excellent stand



Nancy Matheson in her planting of 'Barnapoli' rape (center) and winter rye, Helena, Montana, July 19, 2001.

by making these improvements. I will not use canola any more because of the danger of transgenic contamination, so this would be a good substitute. If I had livestock I would graze the crop, and I would like to try it again.

**Alger Farm - Stanford** - Spring pea was planted as the comparison crop. 'Barnapoli' rape was seeded on April 17 at 7 lbs/ac. No irrigation was provided at this dryland farm; 10.6" rainfall was received from May - September. Seedling emergence was slow and spotty and substantial germination was not achieved until mid-summer. A flush of emergence was observed after three inches of rainfall in July. Dry matter production in the best parts of the Alger planting matched the comparison crop of field peas. The area was grazed and the cows found the rape to be highly palatable.

**Grower comments - Jess Alger:** The seed is so small it is hard to plant at accurate rates-adding ground cobs to the seed would help dispersal. The seed needs good moisture to establish itself and it took until August to consider it a worthwhile crop. An early hail storm set the peas back but did not bother the brassica, and in fact the moisture seemed to improve the stand. The brassica stand had no problems with flea beetle. One rape/pea plot was grazed for a little over two weeks in late June/early July. The cattle love peas but they grazed the brassica first, even though the stand

*A note on tables: Nancy Callan's project report includes six data tables. Tables 1, 3 and 5 are presented here. Please refer to the complete project report at ofif.org for additional data.*

**Table 1. Dry matter production and tissue nitrogen in 'Barnapoli' rape and berseem clover at the Western Agricultural Research Center, Corvallis, Montana, 2001.**

	May 7 planting			June 8 planting	
	First harvest			Second harvest (regrowth)	Dry weight (lb/a)
	Dry weight (lb/a)	Nitrogen (%)	N (lb/a)	Dry weight (lb/a)	
'Barnapoli' rape	7563	2.2	208	3794	4461
Berseem clover	3954	2.6	86	4359	3309
Significance	*	*	**	ns	ns

\* = significant at 0.05, \*\* = significant at 0.01

**Table 3. Dry matter production and tissue nitrogen in 'Barnapoli' rape and oats at Montana Arnica, Hamilton, Montana, 2001.**

Crop	Vigor	Dry weight (lb/a)	Nitrogen (%)	Nitrogen (lb/a)
'Barnapoli' rape	good	6731 c	2.2 b	148 c
	poor	2279 a	1.5 a	33 a
Oats	good	7287 c	1.4 a	105 b
	poor	4543 b	1.1 a	48 a
Significance crop		**	**	*
Significance vigor		**	**	**
Crop * vigor interaction		*	**	**

Means within a column followed by the same letter are not different by interaction LSD (0.05)

\* = significant at 0.05, \*\* = significant at 0.01

**Table 5. Dry matter production of 'Barnapoli' rape and comparison crops at the Matheson and Alger farms, 2001.**

Location	Planting date	Harvest date	'Barnapoli' rape		Comparison crop	
			Dry weight (lb/a)		Crop	Dry weight (lb/a)
Matheson	May 30	July 15	2019 a		Winter rye	3673 b
Alger	April 17	October 15	2635 a		Spring peas	3088 a

Means within a row followed by the same letter are not different by interaction LSD (0.05)

Samples were taken from areas in which the crop established satisfactorily.

was poor at that time. Another plot of rape and peas was grazed in October, and the cows found the rape to be highly palatable because it was green and everything else was brown. It stayed green clear up to the end of October. Timely rains and a wet spring would improve the performance of this crop. It could be used for fall grazing to put weight on calves, or keep the cows in good shape for the winter. With good moisture you would probably want to hay it. I'd like to test it more for weed suppression.

**Conclusions**

In this study we were able to assess performance of 'Barnapoli' rape in a wide variety of farming situations. The success of the crop was highly dependent on soil fertility, particularly nitrogen levels. In a dryland situation, crop establishment was highly variable because of limited soil moisture. In locations with adequate moisture, a sufficiently high seeding rate, and adequate soil fertility, the brassica crop produced abundant biomass and provided good weed suppression. There appears to be a great deal of potential for improving stand establishment by adjusting seeding methods, rates and timing.

Our initial results indicate that under conditions of adequate soil moisture and nitrogen fertility, rape would be an excellent choice for either forage or green manure. As a forage it has a high feed value and palatability. As a green manure crop, the high nitrogen levels of the rape would aid its breakdown when incorporated. On low fertility soils or where soil moisture was inadequate, the brassica did not produce sufficient biomass to be considered a viable crop for forage or green manure.

While the contribution of the forage rape green manure to a subsequent crop is not yet known, the sulfur content of the soil at WARC was increased. This is significant because sulfur is deficient in many western Montana soils.

All cooperators said they would be willing to work with forage brassicas again.