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Final Project Report
NE SARE Program
Project # FNE-93-14
Increasing Options for Cover Cropping in the Northeast

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Objective:

Our objective was to evaluate the suitability of several cover crop species and practices for vegetable growers interested in integrating cover crops into their production systems.

Experiments:

We established two cover crop trials at Porter Farms in Elba, NY. The first included fast growing fall cover crops which winter-kill: oats, phacelia, oilseed radish, white senf mustard, and a bare control. These were planted in replicated plots measuring 25 x 10 ft^2 at three planting dates (Aug. 25, Sept. 8 and Sept. 22). Seed was broadcast by hand into newly disked soil and was then covered using a cultipacker. Seeding rates were 112 lbs/acre for oats, and 15 lbs/acre for the other three cover crops.

Samples of aboveground biomass were collected periodically during the fall using a 2 ft^2 quadrat, weighed, and analyzed for nitrogen content at Cornell University labs. Measurements of % groundcover were made during the fall using the "beaded string" method. In spring, biomass samples of cover crop residues and of weed growth were collected, and visual weed ratings were made to determine the degree of weed control by each cover crop. During fall and spring, soil samples (0-12 in. depth) were collected for nitrate analysis.

The second trial looked at overseeding cover crops (alsike clover, red clover, white clover, rye, annual ryegrass, vetch, and a bare control) into a standing cabbage crop. Replicate plots measuring 9 x 15 ft^2 were overseeded by hand just prior to the final cultivation of the cabbage crop, which occurred on August 26th. Seeding rates, in lbs/acre, were as follows: clovers, 15; ryegrass, 35; vetch, 45; and rye, 112 lbs/acre. Long strips of the same cover crops were planted outside the trial area and were grazed by sheep in late fall and early spring.

Cover crop growth was observed through the fall and following spring, and aboveground biomass samples taken as in the first trial. Groundcover was measured

using the beaded string method in the fall. Cabbage yields were measured by weighing 10 heads from each plot. The degree to which each cover crop regrew throughout the plot was evaluated at plowdown (May 19) using a visual estimate of the percentage of the plot covered by the cover crop. Soil samples were collected for nitrate analysis.

Results:

1. Fall Cover Crop Trial

How well did the cover crops grow? Oilseed radish, white senf mustard, and phacelia, all planted on August 25th, produced over 1.25 tons of dry matter per acre in about ten weeks, compared to oats, which produced just over three quarters of a ton (Figure 1). Cover crops planted two weeks later produced less biomass, ranging from about a half a ton for oats to just under a ton for oilseed radish (Figure 2). The September 22nd planting resulted in unacceptably low amounts of growth.

By early spring, cover crop residues left on the soil were considerably lower than biomass measurements in November. The difference was greatest in the oilseed radish, phacelia and mustard, which lost more than half of their accumulated biomass between November and April. Oats, on the other hand, lost less than 25% of its accumulated biomass.

How well did the cover crops capture leachable nitrogen? Although quantifying N leaching was beyond the scope of this trial, our data give some clues indicating that the cover crops lowered N leaching losses. By Nov. 10, cover crops in the first planting had accumulated between 72 and 96 lbs N/acre in the aboveground biomass, and between 50 and 90 lbs/acre in the second planting (Table 1). This is N that did not leach during fall rains. A look at soil nitrate concentrations during the fall also shows that the cover crops depleted soil nitrate levels below that found in the bare plots (Figures 3 and 4). Falling nitrate concentrations in bare plots were likely due to leaching during fall rains.

Although these winter-killing cover crops accumulated significant amounts of N during the fall, not much of that N remained in the residues by springtime (13-27 lbs N/acre in the first planting; and 2-12 lbs in the second planting). The fate of the rest of the accumulated N is unknown. Data on springtime soil nitrate concentrations may give some indication of where the N went, but these samples cannot be analyzed until next fall.

How well did the cover crops suppress weeds? Visual weed ratings in April showed that cover crops suppressed weed growth from 10-80%, depending on the planting date and cover crop (Table 2). While bare plots in the first planting contained an average of 840 lbs of weed dry matter per acre, cover crop plots contained only 40-143

lbs (Table 3). A similar trend was seen in the second planting, although there was considerably more weed growth in the cover crop plots compared to the earlier planting.

Conclusions: Oilseed radish, white mustard, and phacelia all grew faster and accumulated more N than oats. They also did a better job suppressing weeds. However, much more of the residues of these three cover crops were lost over the winter compared to oats, probably because of their finer leaf structures. August 25th appears to be the optimum planting date, although significant benefits could still be gained by early September plantings. Mid to late September are too late to plant these cover crops. The residues proved to be very easy to disk under in the spring. The major drawback to white mustard and phacelia is the extreme difficulty in acquiring seeds since the only sources to date are in Europe. Oilseed radish is somewhat more accessible because it is produced in Canada. Other species which are more readily available but fit this same cropping window should also be evaluated.

2. Cabbage Overseeding Trial

How well did the cover crops grow? All of the planted cover crops became established during the fall, mostly growing between the cabbage rows, with few plants growing in the cabbage rows. By mid-October, rye and ryegrass covered between 70 and 80% of their plots, and had accumulated 735-1050 lbs of aboveground biomass per acre between the cabbage rows (Table 4). Vetch growth provided 30% groundcover and 500 lbs of biomass per acre by this date. By mid-November, there were 1300-1400 lbs/acre of dry matter between the cabbage rows in rye and ryegrass plots, vetch growth had increased somewhat, but the clovers remained small (235-350 lbs/acre). Differences in spring regrowth were dramatic. By the plow down date of May 19, rye had produced almost two and a half tons of dry matter per acre within the 80% of the plots which it covered, and had accumulated 80 lbs of nitrogen per acre. Vetch regrowth was not very uniform, covering an average of 53% of the plot area. Where vetch regrew, it accumulated about a half a ton of biomass/acre which contained approximately 50 lbs of N/acre. Ryegrass, which seemed to have mostly winter-killed, did grow back to some extent, but regrowth was very patchy. Alsike clover also regrew in patches, but very little red or white clover survived the winter.

Was cabbage growth affected? Yields of cabbage in plots with and without cover crops were not significantly different, indicating that in this trial the cover crops did not compete too stongly with the cabbage crop for water, nutrients or light. The average cabbage head size was 2 lbs.

What effect did sheep grazing have on the cover crops? Sheep grazed the long cover crop strips from early December through March. They showed a strong preference for the clovers, vetch and ryegrass, and grazed the rye only after the others had been stripped. As a result, the rye grew back far better than the other cover crops. Annual ryegrass, alsike and vetch regrew in scattered patches, but no regrowth of red or white clover was found in the sheep strips.

Conclusions: The timing of overseeding into storage cabbage seems to be a critical element in the success of this practice. Because rye and ryegrass grow so quickly in the fall, August 25 may be too early a planting date for these cover crops. Although yields were not adversely affected in this trial, rye and ryegrass may well have been too competitive in a higher-yielding stand of cabbage. Vetch seedlings became established in the fall but grew little until the following spring. The August 25th planting date was probably optimum for vetch. The clovers, however, were planted too late to establish well and therefore did not grow back well in the spring. Planting clovers earlier, if feasible, might improve their chances for success.

Sheep grazing will have a significant effect on how well a cover crop regrows in the spring, depending on which species is used. Rye seems to respond better to sheep grazing than the other cover crops tested, but if sheep are not given a choice of other forages, they might graze the rye more closely. Harvest traffic did do some damage to cover crops in the fall, and this was one factor that lead to the patchiness in spring regrowth.

Figure 1.

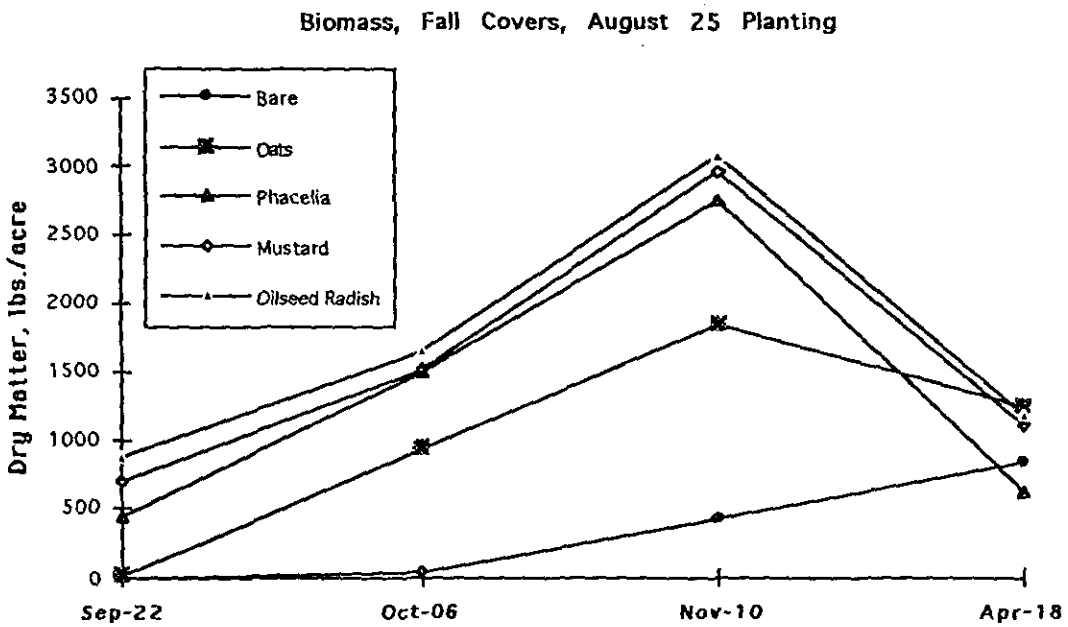

Figure 2.

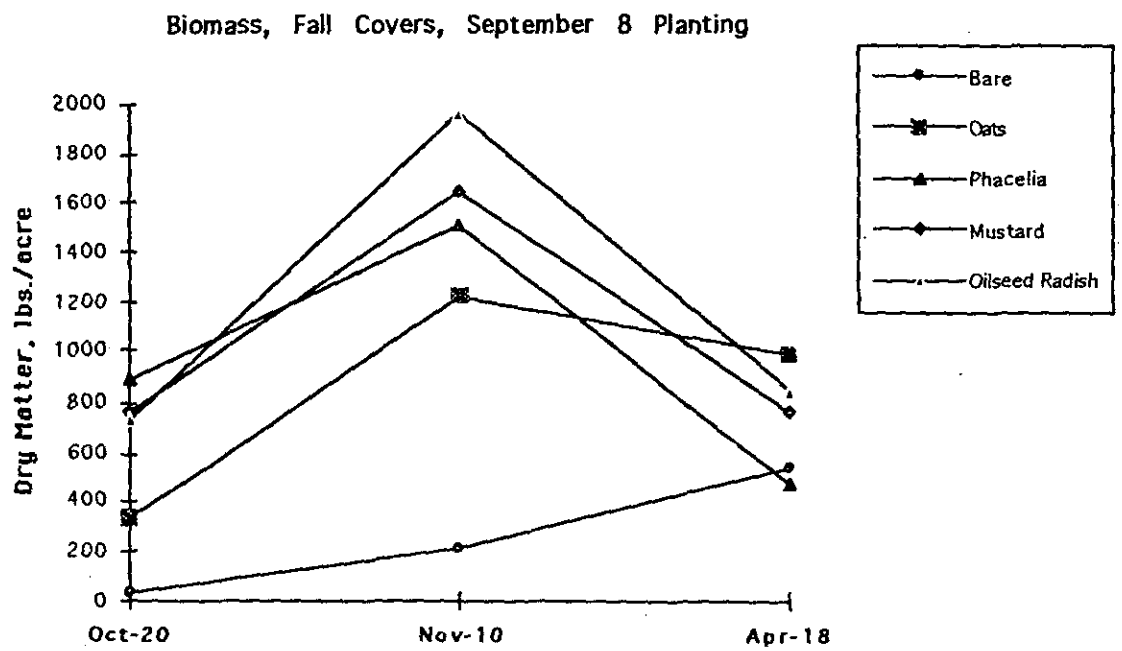

Figure 3.

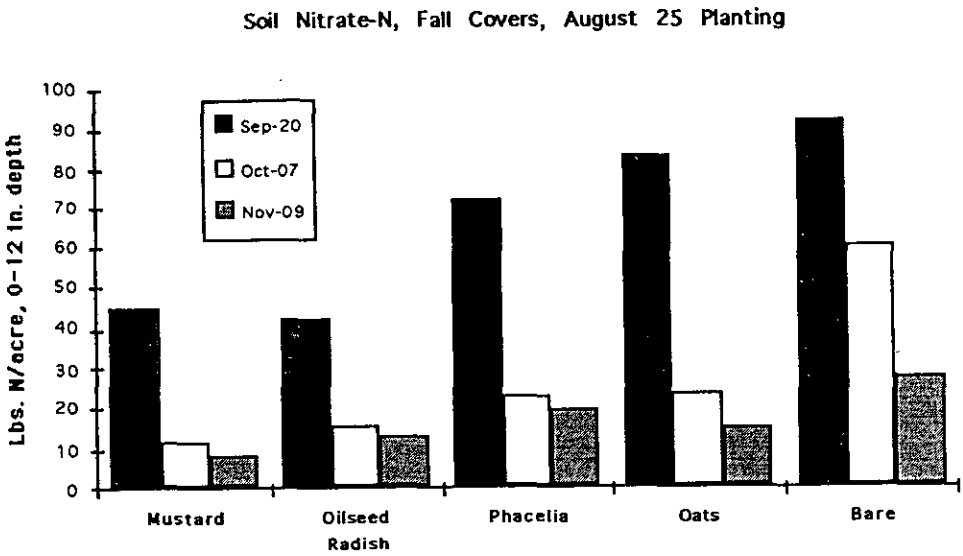

Figure 4.

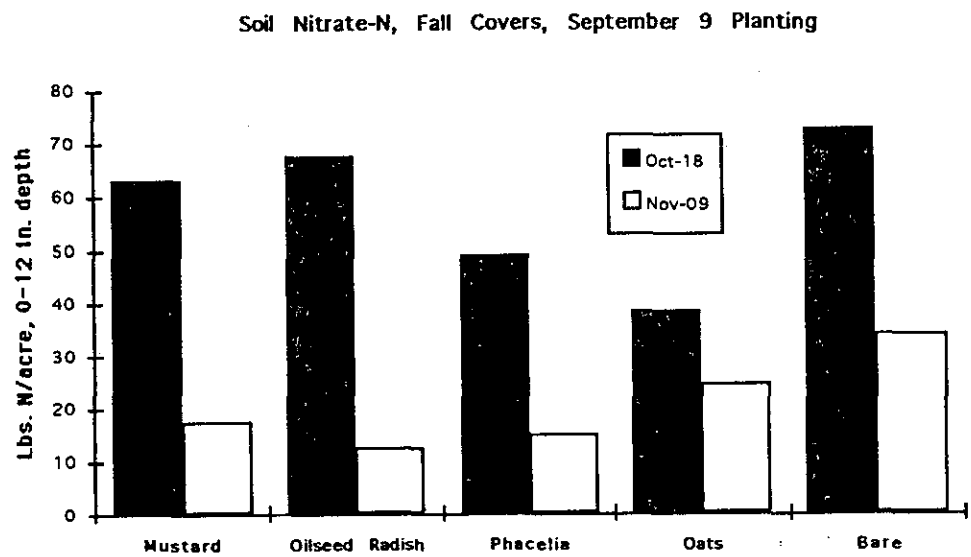

Table 1.

N in Biomass
Fall Covers Trial

	August 25 Planting			
	N in Biomass, lbs./acre			
	September 22	October 6	November 10	April 18*
Oilseed Radish	41.5	55.7	96.3	27.0
Phacelia	21.5	60.9	96.0	14.3
Mustard	39.3	59.0	82.2	13.3
Oats	17.6	47.8	71.7	18.3
Bare	0	2.0	12.2	21.9 (weeds)

*cover crop residues only; does not include weeds

	September 8 Planting		
	N in Biomass, lbs./acre		
	October 6	November 10	April 18*
Oilseed Radish	38.4	64.8	13
Phacelia	32.3	50.8	2.2
Mustard	37.2	91.4	11.8
Oats	18.7	76.5	11.8
Bare	1.6	6.7	15 (weeds)

*cover crop residues only; does not include weeds

Table 2.

Ground Cover and Weed Cover, Fall Covers Trial

	-----% Ground Cover; Beaded String-------		----Weed Ratings---
	September 14	October 13	% of Weedy Check* April 18
August 25 Planting:			
Bare	8.3	18.3	100
Oats	15.8	100	61
Oilseed Radish	22.5	100	18
Phacelia	28.3	100	33
Mustard	32.5	100	23
September 8 Planting:			
Bare		8	100
Oats		32	90
Oilseed Radish		27	67
Phacelia		57	88
Mustard		43	67

*Weed growth in bare plots set at 100%; values represent the proportion of weeds in cover crop plots compared to the bare plots.

Table 3.

Weed Biomass in Spring, Fall Covers Trial

	----------Weed Biomass, April 18, lbs./acre----------	
	August 25 Planting	September 8 Planting
Bare	839.5	534.2
Oats	143.1	432.2
Oilseed Radish	0	198.9
Phacelia	42.9	335.3
Mustard	38.2	76.3

Table 4.

Cover Crop Biomass and N
Cabbage Overseeding Trial

	Cover Crop Biomass and N					
	--------October 20-------		------November 10------		----------May 19--------	
	lbs/acre+	lbs N/acre	lbs/acre	lbs N/acre	lbs/acre	lbs N/acre
Bare	118.8 a*	3.6	195.6 a	7.0	612.9 a	21.8
Vetch	511.3 ab	23.1	623.9 b	26.2	1158.2 a	50.4
Ryegrass	734.6 bc	29.1	1445.3 c	52.4	849.1 a	22.6
Rye	1051.8 c	50.2	1330.8 c	55.2	4759.5 b	79.9
White Clover			234.7 a	9.5	496.1 a	14.3
Red Clover			352.0 ab	13.7	577.2 a	22.5
Alsike Clover			280.5 a	10.9	1000.7 a	41.9

+Data represents between-row areas where cover crops were growing, not in-row areas. Estimates of cover crop coverage in the plots can be found in Table 5.

*Letters indicate within-date mean separation by LSD at the P=0.05 probability level.

Table 5.

Cover Crop Ground Cover
Cabbage Overseeding Trial

	----------% Ground Cover----------		
	Beaded String, Cover Crop + Weeds		---Visual Estimate,-- --Cover Crop Only--
	September 14	October 13	May 19
Bare	13.8	21.3	0
White Clover	52.5	51.3	<5
Red Clover	29.4	52.5	17.5
Alsike Clover	35.0	62.5	38.8
Ryegrass	50.6	79.4	46.3
Vetch	26.3	52.5	53.8
Rye	28.1	69.4	81.3