Investigating the Use of Buckwheat Strips To Attract Beneficial Insects for the Management of Colorado Potato Beetles

Final Report for Organic Farming Research Foundation
Robert Hadad
Cornell Vegetable Program Team
Fresh Market Vegetable Specialist
4487 Lake Ave.
Lockport, NY 14094
Rgh26@cornell.edu
585-739-4065\\\

1. Project Summary

This research project is a continuation of one undertaken in 2008. Results indicated that using buckwheat strips attracted beneficial predatory insects that fed on Colorado potato beetle larvae (CPBL) on potato plants. There were significant differences between control and treatment plots where buckwheat strips were grown beside potatoes or not grown beside potatoes. Four rows of potatoes were planted in replicated plots. Several species of predatory insects were observed eating CPBL on potato plants that were grown next to buckwheat strips. There was more than 95% reduction of CPBL on the potatoes and this provided enough protection so that farmers did not require any further management practices.

The research project undertaken in 2009 focused on trying to determine a planting strategy with the potatoes and buckwheat strips to maximize the beneficial insect effects. In the 2008 research, four rows of potatoes were grown next to a single strip of buckwheat. The strips were as wide as the farmers' equipment or approaches for seeding buckwheat. On average, the strips were 3-5 ft wide. In the 2009 research trials, I investigated a series of planting patterns with buckwheat strips planted between varying numbers of potato rows. One location had one strip of buckwheat and 8 rows of potatoes. A second location had one strip of buckwheat alongside of 6 rows of potatoes, another strip of buckwheat and 3 more rows of potatoes. A third location had one strip of buckwheat with 4 rows of potatoes, a strip of buckwheat, 4 rows of potatoes and then another strip of buckwheat. The fourth location had a strip of buckwheat, 12 rows of potatoes, and a strip of buckwheat.

What the results indicate is that the configuration of the field layout makes a difference. There seems to be correlation between the number of rows of potatoes to the number and location of the buckwheat strips. One strip of buckwheat next to 4-5 rows of potatoes seems to be the limit for attraction of beneficial insects and the effective management of CPBL.

2. Introduction to Topic

Cover crops have great benefits for vegetable production. Cover crops can suppress weeds, reduce erosion, act as a green manure providing nutrients, and add organic matter back to the soil. Still, with all of these fine properties, cover crops are not as commonplace on an organic farm as they should be. Many small growers have land restrictions so that every piece is needed for production. Having some tied up in cover crops means reduced sales potential in the short run.

What if a cover crop could also help in reducing pests in a crop or could improve pollination of another crop? Adding more value to a cover crop by making it perform double duty might provide a greater incentive for farmers to begin using cover crops more extensively on their farm.

Pest management is another main concern for organic growers. Substituting one off-farm purchased pesticide for another purchased off-farm organically approved pesticide does not address enhanced sustainability. If you could use a cover crop to be a tool in pest management, this does enhance sustainability on the farm.

3. Objectives Statement

The project objectives are:

a) To try to further quantify the extent to which buckwheat strips will affect beneficial insect control of Colorado potato beetle in a larger plot.
b) To develop a field design that will be a template for a strategic approach to managing insect pests. Part of this strategy would involve the establishment of semi- or permanent beneficial habitats on-farm.
c) To show that using in-season cover crops can provide multi-purpose benefits and be used as part of an active rotation plan. In-season cover crops can be cost effective and not tie up a lot of valuable production land.

4. Materials and Methods

Potato plots. Buckwheat seed was broadcast into strips based on the rate for heavy seeding for weed suppression of 96 lbs./acre (Managing Cover Crops Profitably, Sustainable Agriculture Network, 2000). This came out to be roughly 1.5-2.5 lbs per 100 ft of 4-6 ft-wide strip. There were four locations with each location hosting a different planting scenario.

Location 1 had one strip of buckwheat and 8 rows of potatoes. Location 2 had one strip of buckwheat alongside of 6 rows of potatoes – another strip of buckwheat and 3 more rows of potatoes. Location 3 had one strip of buckwheat with 4 rows of potatoes – a strip of buckwheat – 4 rows of potatoes and then another strip of buckwheat. Location 4 had a strip of buckwheat – 12 rows of potatoes – and a strip of buckwheat. Due to a late planting because of extreme wet conditions and the outbreak of late blight, the location 4 trial was not completed until 2010. There were 4 replications for Location 1, 3, and 4 while only three replications for Location 2.

The buckwheat strips were as wide as the seeding equipment of each farm – averaging about 48 inches wide (or broadcast). Each potato plot planted had at least 16 plants per row so we were able to select 10 plants per row for sampling. Red Norland potato was used.

Sampling of the potato plants took place when the plants got to be 4" high. All sampling occurred close to the same time of day – between 9-10 am when insect activity is high and the heat of the day hasn't built up (there weren't many warm days in central New York during the summer of 2009 but it was very warm in 2010). A sample of 10 plants per row was used. The number of CPBL was counted; the observed larvae that were being attacked by predators were counted; the number of dead larvae found and the number of observed predators on the potato plants was also noted. The same methodology was used on the control plot. Data were collected over a three - four week period (for as long as there were changes in insect counts). Comparison differences between the treatment and controls were statistically compared.

Sampling with the sweep nets in the potatoes was done in the morning to identify beneficial insects. A sampling using the sweep net in the buckwheat was done several times during the project to see if there were any differences in the beneficial insect populations between the buckwheat compared to the potatoes.

5. Project Results and Discussion

Table 1. Location 1, number of CPBL per replication at beginning and end of trial. Treatment = one strip of buckwheat and 8 rows of potatoes

	Treatment		Control	
Replication	# CPBL alive at start	Total CPBL alive at end	# CPBL alive at start	Total CPBL alive at end
1	70	N = 11; 16%	67	N = 60; 90%
2	50	N = 17; 34%	52	N = 47; 90%
3	38	N = 6; 16%	94	N = 89; 94%
4	58	N = 11; 19%	61	N = 56; 98%

Treatment by replication significantly different at $P < 0.01$


Potato rows


Buckwheat strips

The results of the trial at Location 1 show that the rows of potatoes grown next to a strip of buckwheat had significantly fewer CPBL left alive than rows of potatoes grown without buckwheat nearby (Table 1).

 CPBL feeding on potato leaves in control plot

These results have shown a distinct advantage for the treatment rows. However, compared to the results from the previous year's results where the treatment rows had less than 8% left alive, the management of the CPB was less in 2009-10 than in 2008.

In 2008, we looked at 4 rows of potatoes next to a strip of buckwheat. In the 2009 trial, Location 1 had 8 rows of potatoes. This begs the question, did the buckwheat strip not provide adequate supply of beneficial insects or does the number of rows of potatoes away from the buckwheat strip have an impact?

Table 2. Location 1, number of CPBL alive per row at end of trial. Treatment: one strip of buckwheat and 8 rows of potatoes.

	Rep 1		Rep 2		Rep 3		Rep 4	
Potato row	Trt	Control	Trt	Control	Trt	Control	Trt	Control
1	0	4	0	6	0	10	0	3
2	1	8	0	8	2	14	1	9
3	1	5	0	11	2	19	0	5
4	0	10	1	6	0	15	0	10
5	0	7	1	3	1	8	0	5
6	2	8	2	0	3	9	2	13
7	3	13	6	6	8	8	5	3
8	4	5	7	7	4	6	3	8

For the rows of potatoes #1-5 in the treatment plots, there are 1-2 CPBL left alive in each replication. In the corresponding control plots, there are 3-19 left alive in each replication. In the treatment rows #6-8, however, there are 2-8 CPBL left alive in each replication. This may indicate that not enough beneficial insects were present. Are the rows too far away from the buckwheat strips?

The beneficial insects we decided to concentrate on were the ones found with the most regularity. There were quite a number of spiders on the potato plants that could have contributed to predation but we never saw spiders and CPBL close together to actually give the impression that the spiders were hunting the larvae. There were a wide variety of spiders and also daddy longlegs (harvestmen). Crab spiders, wolf spiders, and jumping spiders made up most of the types of spiders seen. Minute pirate bugs were often seen near CPB eggs or newly emerging larvae but actual predation was not witnessed. Assassin bugs were seen with regularity and in numbers that might suggest attraction but, again, no actual predation were seen. Shield bugs, predatory stink bugs, and adult spined soldier beetles were seen feeding.

Table 3. Location 1, total # of beneficial insects per row. Treatment: one strip of buckwheat and 8 rows of potatoes.

	Rep 1		Rep 2		Rep 3		Rep 4	
Potato row	Trt	Control	Trt	Control	Trt	Control	Trt	Control
1	10	4	11	6	4	2	8	0
2	7	2	8	0	6	1	6	1
3	7	0	6	2	4	1	9	1
4	6	2	10	1	6	1	5	0
5	5	2	5	3	1	2	2	0
6	3	1	4	1	3	0	0	0
7	3	3	1	0	1	1	1	1
8	4	1	0	0	2	1	0	0

Treatment versus control plots significantly different at $P < 0.01$.

Total number of predators found during data collection tend to drop off at the 6th row for the treatment plots while for the control plots the numbers show no discernible pattern.


Predatory Stink Bug (*Perillus*)


Shield Bug (*Elasmostethus)*

Adult Spined Soldier Bug (*Podisus maculiventris)*

Minute Pirate Bug (*Anthocoris nemoralis)*


Assassin Bug (*Reduviidae*)

Table 4. Location 2, number of CPBL per replication at beginning and end of trial. Treatment = One strip buckwheat - 6 rows potatoes – one strip buckwheat – 3 rows potatoes

	Treatment		Control	
Replication	# CPBL alive at start	# CPBL alive at end	# CPBL alive at start	# CPBL alive at end
1	74	4	93	85
2	58	8	36	33
3	42	2	73	70

Treatment versus control plots significantly different at $P < 0.01$.

For the second location, the field set-up had a strip of buckwheat followed by 6 rows of potatoes, a strip of buckwheat then another 3 rows of potatoes. The number of CPBL left alive in the treatment plots totaled 14 while in the control plots, there were 188. This is a significant difference ($P < 0.01$).

Table 5. Location 2, number of CPBL alive per row at end of trial. Treatment = One strip buckwheat - 6 rows potatoes – one strip buckwheat – 3 rows potatoes

	Rep 1		Rep 2		Rep 3	
Potato row	Trt	Control	Trt	Control	Trt	Control
1	0	10	0	3	0	6
2	0	10	0	0	1	12
3	1	8	2	0	0	3
4	0	8	1	8	0	8
5	0	14	3	2	0	8
6	1	14	1	3	1	4
1a	0	6	0	8	0	13
2a	2	6	0	5	0	7
3a	0	9	1	4	0	9

Treatment versus control plots significantly different at $P < 0.01$.

There weren't as many CPBL on these plants at this location and the farmer didn't plant a fourth replication; however, significant differences were detected between treatment and control plots.

Looking for any pattern in the data that might suggest a correlation between the control of CPBL in relation to the position of the buckwheat strip as observed in Location 1, there doesn't seem to be anything noticeable. The six rows of potatoes between the two strips of buckwheat show only a small number of CPBL left on the plants while the control plots have many alive. The numbers of CPBL were reduced in all of the potato rows whether it was the group of 6 rows or the other set of 3 rows.

Table 6. Location 2, total # of beneficial insects per row. Treatment = One strip buckwheat - 6 rows potatoes – one strip buckwheat – 3 rows potatoes

	Rep 1		Rep 2		Rep 3	
Potato row	Trt	Control	Trt	Control	Trt	Control
1	14	1	3	0	5	0
2	9	1	1	0	6	2
3	5	0	1	1	4	4
4	10	2	6	1	3	2
5	7	0	6	0	10	0
6	3	1	6	1	7	1
1a	4	0	5	0	7	2
2a	5	4	8	0	11	0
3a	9	0	5	2	6	0

The number of beneficial insects counted during the data collection period show a larger number in the treatment plots than the control plots as it did for the trial at Location 1.

Table 7. Location 3, number of CPBL per replication at beginning and end of trial. Treatment = One strip buckwheat – 4 rows potatoes – 1 strip buckwheat – 4 rows potatoes – 1 strip buckwheat

	Treatment		Control	
Replication	# CPBL alive at start	# CPBL alive at end	# CPBL alive at start	# CPBL alive at end
1	69	3	72	67
2	56	6	48	44
3	18	2	47	40
4	70	4	39	41

Treatment versus control plots significantly different at $P < 0.01$.

Table 8. Location 3, number of CPBL alive per row at end of trial. Treatment = One strip buckwheat – 4 rows potatoes – 1 strip buckwheat – 4 rows potatoes – 1 strip buckwheat

Potato row	Rep 1		Rep 2		Rep 3		Rep 4	
	Trt	Control	Trt	Control	Trt	Control	Trt	Control
1	0	8	0	3	0	5	0	5
2	0	13	0	6	0	2	0	3
3	1	9	2	4	0	2	2	2
4	0	8	0	11	1	6	0	7
1b	0	6	0	6	0	4	2	7
2b	1	9	0	7	0	3	0	5
3b	0	8	2	3	0	8	0	6
4b	3	6	2	4	1	10	0	6

At Location 3, a different planting configuration was used. The numbers of CPBL left alive in the treatment was significantly less than that in the control plot (Table 7). Across the rows, the numbers left alive were equally scattered. No pattern was found. The reduction of numbers of CPBL in the treatment plot was fairly consistent.

Table 9. Location 3, total # of beneficial insects by row. Treatment = One strip buckwheat – 4 rows potatoes – 1 strip buckwheat – 4 rows potatoes – 1 strip buckwheat

	Rep 1		Rep 2		Rep 3		Rep 4	
Potato row	Trt	Control	Trt	Control	Trt	Control	Trt	Control
1	2	6	6	2	14	8	10	6
2	11	5	9	5	11	3	11	5
3	6	0	6	0	7	4	3	0
4	4	0	9	5	10	2	10	0
1b	7	4	11	0	6	3	11	4
2b	5	2	11	8	7	0	12	4
3b	7	4	13	0	3	0	11	4
4b	5	0	10	3	14	8	6	0

Treatment versus control plots significantly different at $P < 0.01$.

The number of beneficial insects shows a distinct difference between the treatment and control plots. The number of CPBL left alive on the treatment plots was significantly less than the number on control plots while at the same time the number of beneficial predator insects were significantly greater in the treatment plots than the control plots.

Table 10. Location 4, number of CPBL per replication at beginning and end of trial. Treatment = one strip of buckwheat, 12 rows of potatoes, one strip of buckwheat

	Treatment		Control	
Rep	# CPBL alive at start	# CPBL alive at end	# CPBL alive at start	# CPBL alive at end
1	116	10	116	107
2	95	14	111	101
3	48	9	102	94
4	141	12	160	148

Treatment versus control plots significantly different at $P < 0.01$.

Location 4 was replanted in 2010 due to having a portion of the trial damaged in 2009 by late blight. CPBL were in greater numbers than at the other locations. As with the other locations, the treatment rows had significantly less CPBL left alive than the control rows (Table 11).

Table 11. Location 4, number of CPBL alive per row at end of trial. Treatment = one strip of buckwheat, 12 rows of potatoes, one strip of buckwheat

	Rep 1		Rep 2		Rep 3		Rep 4	
Row	Trt	Control	Trt	Control	Trt	Control	Trt	Control
1	0	11	0	5	0	6	0	12
2	0	14	0	6	0	7	0	2
3	1	11	2	9	0	5	3	14
4	0	9	0	11	1	7	0	15
5	0	8	0	14	1	6	2	13
6	4	11	3	6	2	9	2	6
7	3	10	4	5	2	7	5	20
8	0	8	2	7	1	12	0	11
9	2	7	2	5	1	6	1	9
10	0	6	1	7	0	9	0	17
11	0	4	0	8	0	7	0	5
12	0	8	1	18	1	13	1	24

Treatment versus control plots significantly different at $P < 0.01$.

One point to mention with this plot design, the middle rows in the treatments had more CPBL left alive than the rows closer to the buckwheat strips. Statistically, the numbers were not significantly different but observed plant feeding damage seemed to be greater. This might indicate that having 6 rows of potatoes per one strip of buckwheat might be the limit for attraction of adequate numbers of beneficial predators.

Another aspect of the experiment centered on the beneficial predators. There were a number seen in the buckwheat as it started to grow. Many spiders, assassin bugs, soldier beetles, predatory stink bugs, shield bugs, and lady bird beetles were seen in the foliage. On the ground, ground beetles, spiders, and toads were present. From the previous project, we saw four main predators. This project we added assassin bugs because of their numbers seen at all locations. Data were taken on the number of beneficial insects found in treatment and control potato rows.

Table 12. Location 1, beneficial insects found per replication.

	Treatment					Control				
Rep	ASSB	MPB	PSB	SB	ASSN	ASSB	MPB	PSB	SB	ASSN
1	9	2	15	7	12	0	1	2	7	1
2	6	6	14	11	7	4	1	2	5	1
3	4	0	16	0	7	0	1	5	2	1
4	13	0	13	2	3	1	1	0	0	1
total	32	8	58	20	29	5	4	9	14	4

ASSB = Adult Spined Soldier Bug; MPB = Minute Pirate Bug; PSB = Predatory Stink Bug; SB = Shield Bug; ASSN = Assassin Bug

Treatment versus control plots significantly different at $P < 0.01$.

For Location 1, the largest number of predatory insects were found in the treatment plots, with abundance in decreasing order being Predatory Stink Bug, Adult Spined Soldier Bug, Assassin

Bug, Shield Bug, and Minute Pirate Bug. Active predation was witnessed with Adult Spined Soldier Bug, Shield Bugs, and Predatory Stink Bugs.

For the control plots, predatory insects were found in decreasing order of abundance: Soldier Bug, Predatory Stink Bugs, Adult Spined Soldier Bug, and equal numbers of Minute Pirate Bug and Assassin Bugs.

Minute Pirate Bugs (MPB) were seen mostly early on when Colorado potato beetle (CPB) eggs were found. By the week after hatching, MPB were not seen. Feeding on eggs by MPB was not witnessed as it was last season in our trials. This begs the question of whether or not MPB feed on CPB eggs.

Assassin Bugs (ASSN) were seen in larger numbers in treatment plots for Location 1, Location 2, and Location 4. Location 3 only had 3 ASSN. There were no witnessed attacks by ASSN on CPB that we saw.

Table 13. Location 2, beneficial insects found per replication.

	Treatment					Control				
rep	ASSB	MPB	PSB	SB	ASSN	ASSB	MPB	PSB	SB	ASSN
1	13	6	21	9	19	3	0	1	1	4
2	0	0	23	14	4	2	1	0	1	1
3	20	0	16	13	10	1	0	2	7	1
total	33	6	60	36	33	6	1	3	9	6

ASSB = Adult Spined Soldier Bug; MPB = Minute Pirate Bug; PSB = Predatory Stink Bug; SB = Shield Bug; ASSN = Assassin Bug

Treatment versus control plots significantly different at $P < 0.01$.

The Predatory Stink Bug had the highest number in the treatment plots with MPB having the least while the others were mid-range. There was a big difference between the Stink Bug numbers in the treatment plot vs. the control plots.

Table 14. Location 3, beneficial insects found per replication.

	Treatment					Control				
rep	ASSB	MPB	PSB	SB	ASSN	ASSB	MPB	PSB	SB	ASSN
1	14	9	13	4	0	5	6	4	2	4
2	30	0	8	21	0	0	8	2	3	10
3	7	0	10	12	3	4	6	5	5	8
4	28	3	8	10	0	2	0	9	7	4
total	79	12	39	47	3	11	20	20	17	26

ASSB = Adult Spined Soldier Bug; MPB = Minute Pirate Bug; PSB = Predatory Stink Bug; SB = Shield Bug; ASSN = Assassin Bug

The overall number of beneficials in the treatment vs. control plots was significantly different but the differences were not significant for specific species between treatment and control plots. At this location, the control plots had more MPB and ASSN than the treatment plots.

Table 15. Location 4, beneficial insects found per replication.

	Treatment					Control				
rep	ASSB	MPB	PSB	SB	ASSN	ASSB	MPB	PSB	SB	ASSN
1	40	8	32	38	21	7	2	5	8	6
2	59	5	62	56	11	32	0	8	29	4
3	40	6	54	75	6	2	5	11	13	13
4	50	10	48	55	12	5	2	2	13	19
total	189	29	196	224	50	46	9	26	63	42

ASSB = Adult Spined Soldier Bug; MPB = Minute Pirate Bug; PSB = Predatory Stink Bug; SB = Shield Bug; ASSN = Assassin Bug

Location 4, which was replanted in 2010, had the largest number of beneficial insects of any location for both the treatment and control plots. The difference between total number of beneficials in the treatment plots compared to the control plots was significant. The numbers of beneficials by species were significantly different between the treatment and control plots except for the ASSN.

We looked closely at the plots trying to figure why there were so many beneficial predators present at this location. The most obvious hypothesis would be the large number of CPBL present. Location 4 had more CPBL than field plots at the other locations. It was nearer to potato-planted acreage than the other locations.

Sweep net counts of the buckwheat strips had more beneficial predators in the canopy than the other sites (observational data only; we did not keep a count of collected insects in the buckwheat strips). The strips were 60” wide, thickly planted, and had a long flowering period.

Buckwheat flowers

This site had ground in cover crops on two sides, a pasture on a third side, and was near an uncultivated buffer strip with natural habitat of herbaceous plants, brush, and small trees on the fourth side.

6. Conclusions and Discussion

The conclusions drawn from this research are as follows:

a) Buckwheat has a positive influence on attracting beneficial predators.
b) Beneficial predators found in the surrounding farm environment are drawn to buckwheat and the surrounding crop plants.
c) Beneficial predators will feed on CPBL.
d) Plots of potatoes by themselves attract CPBL but, when not near buckwheat strips, the number of predators is quite low.
e) Predatory feeding will reduce the numbers of CPBL and it appears that buckwheat strips are a catalyst.
f) Having strips of buckwheat grown beside potato rows is important for attraction of predators, but this effect may only reach across not much more than 4 to 6 rows.
g) A field planting design of a strip of buckwheat followed by 8 rows of potatoes then another strip of buckwheat may be the most suitable set up providing adequate protection (assuming that predators will be attracted 4 rows out in both directions from the buckwheat strip).
h) This field trial was with a short season potato variety. For longer season potatoes, replanting of buckwheat would be necessary.

Obviously a lot is going on with the micro-ecosystem in and around a field plot of buckwheat and potatoes. We couldn't be there all day watching all the plants to see what was going on. We took a 'snapshot' of activity on given days across a number of weeks. We could not and did not witness large-scale feeding by predators on CPBL. As shown in the data, we reported on the number of larvae left alive. We did witness some feeding. We did see and count the predators on the plants in the rows.

In the plot design used at Locations 1 and 4, where there were more than 4 rows of potatoes between strips of buckwheat, the number of CPBL were greater as the distance from the buckwheat increased. After 4 rows, the number of predators started to drop. In the control plots, the number of CPBL left alive increases leaf damage (data not shown). Leaf damage increased in the treatment plots where the number of potato rows increased beyond 4 from the buckwheat strips.

The rows of potatoes grown near buckwheat strips had reduced numbers of CPBL on them and the feeding damage on those plants was minimized. For the farmers, this reduction was satisfactory compared to the alternative of growing potatoes and having to physically remove pests or come in with a number of sprays. Planting buckwheat saved them time and money when dealing with this pest.

The project used a short season potato variety. The buckwheat was seeded close to or at the same time that the potatoes were planted. The trial was conducted in the early part of the season when the first influx of potato beetle adults arrives to lay eggs. For later or longer season potatoes, a somewhat different strategy might have to be used to deal with later season, second-generation adult potato beetles. Two or more seedings of buckwheat would be necessary.

Buckwheat can be a nuisance when it is allowed to flower and drop seed. It can germinate over several seasons, becoming a weedy problem itself. To manage this, the buckwheat was cut down after the flowers started fading. We found that broadcasting buckwheat seeds in the standing crop of buckwheat was a good strategy for having continuous buckwheat. If this was planned to correspond to a rain event, the success of getting a good stand was better.

A few days after the buckwheat seed was broadcast, the standing buckwheat was mowed and left in the strip covering the seed. Buckwheat is succulent and breaks down quickly. In less than a week, the seed germinated and was pushing up through the debris, quickly forming a canopy.

The buckwheat strips did not seem to have an observed effect on another significant pest, the alfalfa leaf hopper, which is a tough pest on potatoes in the central New York region. They are more prevalent after alfalfa fields are cut and they fly or blow in from these other areas onto potatoes. Their feeding damage is caused by piercing and sucking plant sap. Enough of this type of feeding causes yellowing of leaves by reducing chlorophyll and photosynthesis (hopper burn). The leaf hopper damage in 2009 was observed to be much less than in 2010 in the 4^{th} location. This might be another area of research that could be investigated.

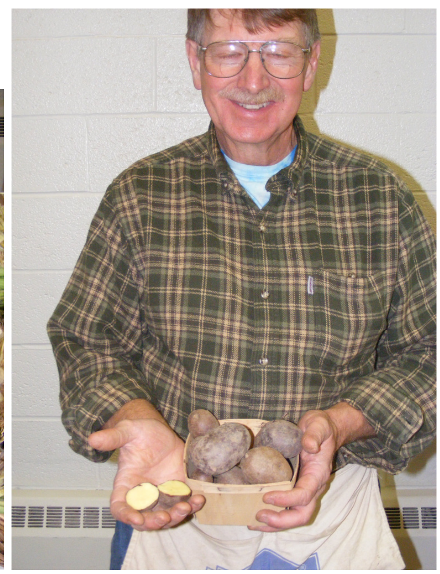
7. Outreach

Preliminary findings of this research project were shared with farmers at a workshop in November 2009. A presentation will be offered to the Northeast Organic Farming Assoc. of NY's conference committee for the winter gathering in Jan. 2012 in Saratoga Springs (attendance over 1000). Meanwhile, a write-up will be submitted for NOFA-NY's newsletter/listserve this winter. A web version of this report will be posted on the newly revised Cornell Vegetable Team's website sometime in December.

Addenda—photos

Buckwheat just heading into flower.

The farmers grew Red Norland for the trial but also had other varieties of potatoes grown with buckwheat strips. Kurt Forman pictured above. Ed Fraser pictured below.



Fred Frosburg with a wide variety of potatoes.