1. Project Name and Contact Information

Project Title: Using Chickens and a Cover Crop Barrier for Weed Control in Organic Asparagus
Grant Number: FNE09-671

19 Waldo Way
Wells, ME 04090
207-985-2787
info@chickfarm.com

2. Goals

The goal of this project was to evaluate the effectiveness of controlling weeds in organic asparagus with the use of chickens and a cover crop barrier. Although organic asparagus is a high-value crop that grows well in the Northeast, weed control is a significant challenge, particularly with a perennial crop such as asparagus. We took a two-pronged approach to this problem: first, after the asparagus harvest season ended, we allowed laying hens to range freely in the asparagus patch by using a "chicken tractor" (a portable chicken pen) and a moveable fence. Secondly, we established a weed barrier, a tilled buffer zone 10 feet wide around the perimeter of the asparagus patch. This weed barrier was intended to keep perennial weeds such as quack grass (*Agropyron repens*) from working their way into the asparagus from the surrounding sod.

Secondary objectives included evaluating the use of cover crops (oats and winter rye) seeded into the weed barrier in the fall, comparing the use of two types of organic mulch (straw and waste hay), determining guidelines for the recommended number of chickens per acre, comparing insect pressure between the experimental and control plots, and evaluating different methods for incorporating the cover crops in the spring.

3. Farm Profile

Chick Farm is a small diversified farm with 10 acres of pasture, a 160-acre woodlot, and just over an acre of cultivated land. We produce certified organic mixed vegetables, strawberries, eggs, and poultry, all marketed through a nearby farmers' market, a wholesale account, and on-farm sales. We are a husband-and-wife operation, with Rick farming full-time year-round and Marilyn working full-time during the growing season and part-time in the winter. We have been farming since 2001.

Since the project began we have changed a few aspects of our operation: our eggs, which were our only non-organic product, are now certified organic; we also ended our CSA program and now sell most of our products at a nearby farmers' market. We are gradually shifting our crop production away from mixed vegetables and toward a few select crops that favor our sandy soil, such as asparagus and berries.

4. Participants

Our technical advisor is Dr. Eric Sideman of the Maine Organic Farmers & Gardeners Association (MOFGA). Dr. Sideman provided valuable feedback on our grant proposal, visited our farm during the 2010 growing season, helped arrange our outreach, and has been available to answer questions throughout the project.

5. Project Activities

Season One (2009)

Ground Preparation and Planting

We planted our asparagus in two separate but similar plots. Both plots are 5000 sq ft (50'x100'), have been in use for organic vegetable production, and are on level ground with light, sandy, well-drained soil. The two plots are roughly 200 yards apart. In early May 2009 we applied soil amendments based on soil test recommendations. Using our tractor, we made 8 trenches in each plot, leaving a tilled 10' weed barrier around the entire perimeter of each plot. The trenches were 80 feet long and spaced 4 feet apart, giving us a total of 640 row feet per plot. We used "Jersey Supreme" hybrid asparagus, planting the crowns by hand at a depth of roughly 8 inches with 15-inch spacing between crowns.

Getting the Planting Established

As the asparagus grew, we gradually filled in the trenches with a soil and compost mixture and installed drip tape four inches below soil level. Throughout the rest of the summer we weeded mechanically and by hand, keeping the plantings as weed-free as possible until the plants were big enough to handle the chickens.

It was interesting to note the difference in weed populations between the two plots. The plot we call Front Field 1 (FF1) had a well-established seed bank of annual weeds such as lamb's quarters, purslane, and pigweed. Front Field 4 (FF4), which had been in production for only a year, had fewer annual broadleaf weeds but more grasses, including quack grass.

Data Collection

We evaluated asparagus growth, weed growth, and insect numbers twice during the first season, just before the chickens were deployed and again after the chickens had been removed. To evaluate asparagus growth, we chose two crowns at random within each row and measured for crown circumference, height of tallest shoot, and number of shoots. We evaluated insect numbers by examining the same randomly-selected plants and counting adult insects and eggs present for each insect species found. We then counted the number of weeds within a 20" radius circle around each selected crown.

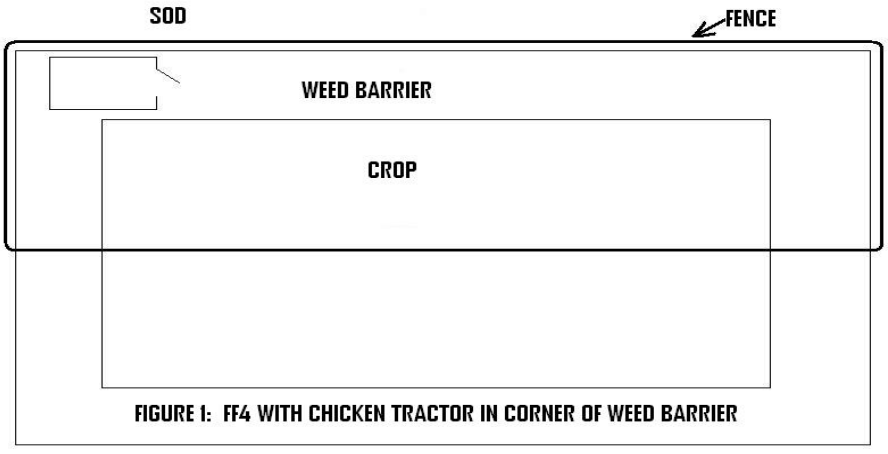

FIGURE 1: FF4 WITH CHICKEN TRACTOR IN CORNER OF WEED BARRIER

Putting the Chickens to Work

Our 2009 work force consisted of 24 five-month-old Buff Orpington laying hens. The hens were housed in a "chicken tractor", a moveable pen/shelter we built in 2008. We positioned the chicken tractor in a corner of the 10-foot weed barrier and set up fencing around one half of the plot with the chicken tractor inside the fence (Figure 1). Each morning we opened the pen door and let the hens roam within their fenced-in area. At

dusk the hens went back into the shelter; we would go out after dark and shut the door behind them. For fencing we used portable electrified poultry netting to confine the hens and protect them from predators. In the past we have used a solar fence charger for powering this type of fence, but we ran an electric line out to the field for this project. It was early September before the asparagus plants were big enough to handle the chickens, so the hens were only on the job for about four weeks.

Fall Maintenance

In August 2009 we took soil samples in both plots. In early September we planted oats in one quarter of the weed barrier in FF4, applied at the rate of 4 lbs per 1000 sq ft. Later that month we planted winter rye at the same rate in one quarter of the FF1 weed barrier. Both cover crops showed good growth before winter. In the fall we left the asparagus ferns standing instead of mowing them down.

Season Two (2010)

Spring Maintenance

Based on the 2009 soil test results, we applied soil amendments and fertilizer (lime, sul-po-mag, and soybean meal) in mid-April 2010. After recording early spring weed counts (see "Data Collection" below), we used mechanical and hand weeding as needed to maintain both plots before and during the harvest period. Given the number of early weeds we were seeing in the 10-foot weed barrier around the perimeter of each plot, we decided to till in the cover crops rather than let the chickens incorporate them later. We used a disk harrow to till the weed barrier.

Data Collection

Each plot was evaluated three times in 2010: (1) early spring, (2) just before deploying the chickens, and (3) after removing the chickens.

Harvest

Since asparagus season typically starts in mid-May in our area, our plan was to harvest for two weeks[1] and sell the crop at our local farmers' market, which opens on the first Saturday in May. But Mother Nature threw us a curveball: unusual warmth in February and March had our asparagus emerging in early April. Having no market for our crop so early in the season, we decided to let the asparagus fern out and mow it down later for a delayed harvest. Then a second curveball arrived – a hard freeze in mid-May. One of our plots was damaged by the freeze, while the other was unscathed.[2] In effect, the freeze did our mowing for us, prompting the asparagus in the damaged plot (Front Field 4) to start sprouting again.

We harvested from FF4 for two weeks starting on May 22. We left the other plot alone through May and June, then mowed the ferns down in mid-July and harvested for two weeks. The different activity timetables for the two plots are shown in Table 1.

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[1] New plantings can only be harvested for two weeks, compared to 6 to 8 weeks for established plantings.

[2] Our two asparagus plots are only about 200 yards apart and at roughly the same elevation. We suspect that the undamaged plot benefited from some sheltering trees and from being only about 20 feet from the lip of a steep gully, which may have allowed the cold air to drain away.

Table 1: Schedule of 2010 Activities

Activity	Front Field 1 (FF1)	Front Field 4 (FF4)
Apply soil amendments	Mid-April	Mid-April
Till weed barrier & cover crops	Late April	Late April
Mow down ferns	Mid-July	Ferns killed by frost in mid-May
Harvest (two weeks)	July 20 to July 30	May 22 to June 4
Apply mulch	August 2	None applied
Deploy weeder chickens	August 3 to October 10	June 18 to August 3

Applying Mulch

After the harvest in FF1 was complete, we used a straw chopper to apply mulch over the entire planting area (not including the weed barrier) to a depth of about 4" (roughly one bale per 200 sq ft), using straw on one half of the plot and mulch hay on the other. We had originally planned to use mulch on both plots but decided to leave FF4 bare as a comparison. We kept the mulch watered with overhead sprinklers to encourage the germination of any weed seeds it contained.

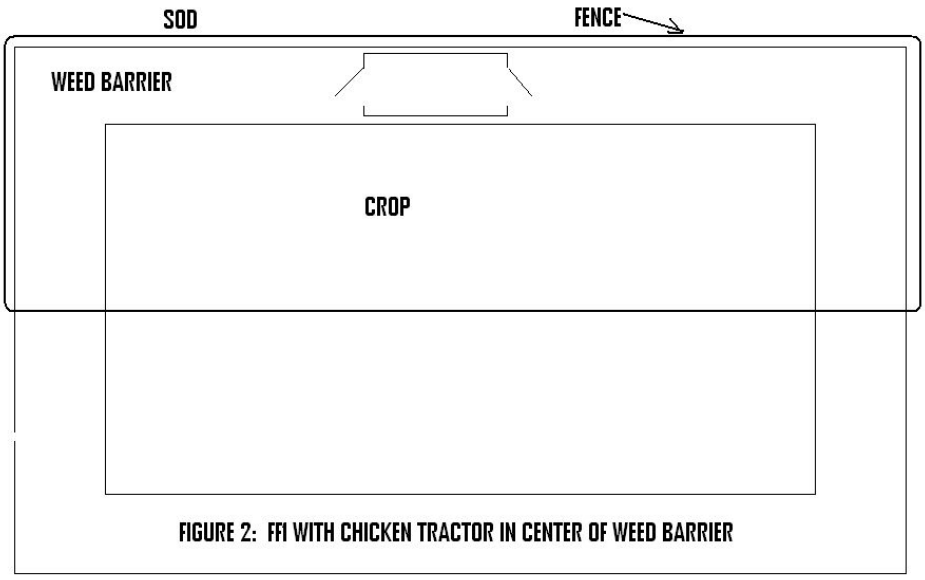

FIGURE 2: FFI WITH CHICKEN TRACTOR IN CENTER OF WEED BARRIER

Putting the Chickens to Work

In mid-June we moved 18 Production Red laying hens into the chicken tractor in Front Field 4, with the same setup we had used the previous year. They were on the job for about six weeks, until it was time to move the chicken tractor to Front Field 1. We had noticed with this flock and with the Buff Orpingtons in 2009 that the hens tended to spend most of their time near the chicken tractor, resulting in less effective weed control at the far end of the plot. With this in mind, when we moved the chicken tractor to Front Field 1 we positioned it in the middle of the weed barrier, as shown in Figure 2.

In early August we moved 50 two-month-old Black Australorp pullets into the chicken tractor in Front Field 1. At first we used only the front door of the chicken tractor, as we had in Front Field 4. Soon we could see a problem, though: the pullets seemed reluctant to go behind the chicken tractor, even though we had the fencing set up so

they could go all the way around it. They were spending most of their time in just one half of their area. Opening doors on both sides of the chicken tractor solved the problem.

Fall Maintenance

In August 2010 we took soil test samples in both plots. In the fall we left the asparagus ferns standing.

6. Results

Weed Barrier

Our 10-ft weed barrier was very effective at keeping quack grass from working its way into the asparagus. Oats and winter rye both worked well as cover crops and we also found that the ground in the weed barrier can be used for annual crops, provided the barrier is tilled at least twice a year.

Weeder Chickens

Overall we were pleased with the performance of our weeder chickens. As shown in the tables below, although the hens did not completely eliminate the weeds, they kept them down to a manageable level. The hens seemed to enjoy being in the asparagus patch. The ferns provided shade and also seemed to give the hens a sense of security, keeping them somewhat hidden and less vulnerable to attack from above by hawks and owls, although as mentioned earlier, the hens can sometimes be reluctant to venture too far from the chicken tractor.

Table 2 shows the results for Front Field 4[3] (FF4) just before we put the chickens in. Up until that point we had spent roughly 27 hours weeding both plots, using a rototiller, wheel hoe, and some hand weeding within the rows. We chose two crowns at random within each row and measured for crown circumference, height of tallest shoot, and number of shoots. We evaluated insect numbers by examining the same randomly-selected plants and counting asparagus beetles found. We then counted the number of weeds within a 20" radius circle around each selected crown.

[3] We had not realized how long it would take for the new asparagus plants to get big enough to handle the chickens. Given the short time the chickens were in the asparagus in 2009, we chose to put them only in FF4 and therefore did not record any data for FF1 in 2009.

Table 2: Front Field 4 on 8/31/09 – Just before deploying chickens

We chose two crowns at random within each of the 8 rows and measured crown circumference, height of tallest shoot, number of shoots, and insects found. We counted the weeds within a 20" radius circle around each selected crown. Averages are shown for each measurement.

Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	AVG
Weeds	12	20	27	37	6	3	7	8	10	7	12	1	6	6	27	2	12
Crown Circ (in)	15	13	14	10	12	9	14	14	12	19	17	13	9	11	12	10	13
Height (in)	59	64	54	50	60	55	63	53	53	62	58	61	53	62	55	57	57
Shoots	12	16	13	8	9	6	19	8	14	24	11	12	11	15	12	11	13
Beetles	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

It was early September before the asparagus plants were big enough to handle the chickens, so the hens were only on the job for about four weeks. We were concerned that we might not see any conclusive results in such a short time, but within a couple of weeks the hens had pretty much eliminated the weeds on their half of the plot. They continued to keep the weeds under control until we took them out in early October. Table 3 shows the weed counts for the two halves of the FF4 plot after the chickens had completed their work.

Table 3: Front Field 4 on 10/8/09 – After removing chickens

Average number of weeds within a 20" radius circle around each selected crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	1	0	2	0	1	2	0	1	1	9	2	16	8	13	6	9	17	10

One other finding was very clear: 24 Buff Orpington hens were too many for 2500 square feet of asparagus. By the end of their four weeks in the asparagus, the hens had essentially eliminated the weeds inside their fence and had started looking for other things to do, such as digging around the crowns. A couple of them even started flying over the fence to get at the weeds and grasses on the other side.

Probably because these were new plantings, we saw very few asparagus beetles or other insect pests in 2009.

Tables 4-6 show the results for Front Field 4 in 2010. Table 4 shows the early spring weed count. Tables 5 and 6 show the full results before and after the chickens did their work. It is important to note that while the chickens were on the job, we spent about 6 hours hand-weeding on the "no-chickens" side of FF4.

Table 4: Front Field 4 on 4/18/10 – Early spring weed count

Average number of weeds within a 20" radius circle around each selected crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	3	8	1	6	12	7	5	2	6	16	22	17	7	29	18	19	15	18

Table 5: Front Field 4 on 6/22/10 – Before deploying chickens

Sample crowns chosen at random. Measurements and averages shown for crown circumference, height of tallest shoot, number of shoots, insects found, and weeds within a 20" radius circle around each crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	37	29	30	17	14	22	22	20	24	43	92	36	44	38	21	52	34	45
Crown Circ (in)	24	12	17	22	8	12	16	17	16	17	19	19	7	21	14	14	19	16
Height (in)	63	80	75	72	50	55	81	65	68	68	82	77	69	73	64	45	76	69
Shoots	13	3	4	3	4	4	3	5	5	4	14	6	2	4	2	6	7	6
Beetles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 6: Front Field 4 on 8/2/10 – After removing chickens

Sample crowns chosen at random. Measurements and averages shown for crown circumference, height of tallest shoot, number of shoots, insects found, and weeds within a 20" radius circle around each crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	19	16	24	17	18	10	23	12	17	48	36	29	47	51	39	43	18	39
Crown Circ (in)	12	23	13	19	12	13	16	9	15	7	18	20	14	16	15	17	11	15
Height (in)	67	68	57	66	60	69	49	61	62	67	72	64	69	68	68	67	58	67
Shoots	7	13	3	8	7	8	7	3	7	4	7	12	6	5	5	12	5	7
Beetles	3	1	1	8	4	2	2	0	3	5	7	1	4	6	3	2	2	4

Tables 7 and 8 show the results for Front Field 1 (FF1) before and after the chickens did their work. As explained earlier, weather conditions in early 2010 prompted us to delay the harvest in FF1 until late July, which meant that

the chickens were not put to work in that plot until August. As the results show, FF1 started out with a higher weed population compared to FF4.

Table 7: Front Field 1 on 8/2/10 – Before deploying chickens

Sample crowns chosen at random. Measurements and averages shown for crown circumference, height of tallest shoot, number of shoots, insects found, and weeds within a 20" radius circle around each crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	41	38	59	28	47	29	42	55	42	33	37	41	28	46	49	45	39	40
Crown Circ (in)	14	17	14	19	18	12	24	15	17	21	13	16	9	22	11	17	19	16
Height (in)	66	67	59	71	66	69	57	68	65	65	69	66	68	72	68	67	71	68
Shoots	6	11	12	9	6	10	8	9	9	5	7	12	10	9	4	8	11	8
Beetles	3	2	5	8	6	1	7	5	5	6	0	2	4	1	3	5	3	3

Table 8: Front Field 1 on 10/12/10 – After removing chickens

Sample crowns chosen at random. Measurements and averages shown for crown circumference, height of tallest shoot, number of shoots, insects found, and weeds within a 20" radius circle around each crown.

	With Chickens									Without Chickens								
Sample	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**AVG**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**AVG**
Weeds	14	22	29	11	38	12	7	19	19	44	43	51	37	46	42	35	41	42
Crown Circ (in)	13	18	19	15	21	24	12	15	17	19	16	22	12	23	17	16	21	18
Height (in)	62	72	69	60	71	69	66	67	67	65	72	59	64	64	67	71	68	66
Shoots	5	9	5	11	12	8	9	10	9	8	10	11	9	8	12	9	11	10
Beetles	0	0	1	4	2	2	0	1	1	0	4	0	2	1	2	4	3	2

Based on our experience with this project, we have the following recommendations for anyone who would like to implement this practice:

- We suggest 8 to 15 chickens per 1000 sq ft, depending on your weed population and the age and breed of your chickens. Observe their behavior and make adjustments as needed, watching especially for digging around the crowns, which they may do if there are not enough weeds to keep them busy.
- Because the chickens cannot go into the asparagus planting until quite late in the first season, it is important to start with a plot that is as weed-free as possible. Weeds will have to be managed by other means during most of the first growing season.

- Be sure your ground is free of quack grass and other perennial weeds before you plant.
- Depending on the weed population, it may be necessary to do some weeding by hand or mechanical means during the harvest season, to keep the weeds at a level that the chickens can handle when they arrive. Do not let the weeds get too tall; chickens tend to look down at the ground while foraging and will often ignore weeds that are above their heads.
- Position the chicken tractor so the chickens feel safe roaming through the entire planting. If this is not possible, divide the planting into sections and move the chickens from one section to the next to get complete coverage.
- Consider your predator situation when choosing your fence materials and chicken tractor design. Because we have a lot of woodland predators such as foxes and raccoons, we built a very secure chicken tractor to keep the chickens safe at night. Our only real problem turned out to be a neighbor's dog that was curious about the chickens and knocked down our portable fence a few times. If dogs are a problem in your area, you may want to consider a sturdier fence than the type we used.

Insects

Other than some cutworm damage in the spring, asparagus beetles (both striped and common) were the only insect pests we observed. The results show no obvious difference in asparagus beetle numbers between the "chickens" and "no chickens" sides of either plot. We suspect this is because the beetles could easily fly from one side of the plot to the other, making it difficult to know whether the chickens had any impact on beetle populations. We hope to be able to study this further in future years.

Crown Growth

We could see no clear difference in crown growth between the "chickens" and "no chickens" sides of either plot. It may be that the added fertility provided by the chickens is not enough to show a measurable effect, or perhaps any effect is more long term.

Mulch Comparison

We had hoped to see whether the chickens could control the added weeds that would be expected when using hay mulch compared to straw mulch. We decided not to use mulch the first year, mainly because FF4 had more quack grass than expected and we wanted to dig that out by hand before adding any mulch. (This highlights the importance of starting with plots that are as weed-free as possible.) We ended up adding mulch to FF1 only, after the 2010 harvest, splitting the plot crosswise and applying straw to one half and waste hay to the other.

In the end, our straw-versus-hay mulch comparison was a disappointment. In an ironic twist that any farmer could appreciate, we were unable to get the weed seeds in the mulch to germinate, despite careful watering. We are still hopeful that waste hay could be used effectively; we plan to study this further in future years.

Other Lessons Learned

- The hens sometimes feed on the asparagus ferns, but it did not appear to damage the plants.
- The buried drip tape did not work well for us. Rodents damaged it, the chickens dug it up in places, and it got tangled in the bush hog when we were mowing down the ferns.

- Foraging behavior can vary quite a bit between chicken breeds. Of the three breeds we used, the Buff Orpingtons were the best at controlling weeds. The Production Reds did not forage as vigorously. The Black Australorps foraged well, but were more timid than the Orpingtons and preferred to stay within sight of the chicken tractor, reducing their effectiveness at the far edges of the plot. It is important to observe your flock's behavior and adjust your setup if needed.
- A delayed asparagus harvest – in late summer or fall – is possible and can help extend the harvest season.

7. Conditions Affecting Results

Maine's 2009 growing season featured a record-setting stretch of rainy weather starting in late May and continuing right through July. We might have lost the entire asparagus planting were it not for our very sandy well-drained soil. As the rains continued into July, the asparagus ferns started showing signs of nitrogen deficiency, with the new growth a pale yellow-green color. Figuring the rain had leached away a lot of nitrogen, we side-dressed both plots with blood meal and chicken manure, which seemed to correct the problem.

Our 2010 growing season was excellent overall, the only exception being the unusually warm early spring followed by the mid-May freeze. This caused us to adjust our schedule of activities, but we do not feel that it had any adverse effect on our results.

8. Economic Findings

Our primary economic finding is that using weeder chickens does in fact reduce the amount of labor required to control weeds in asparagus. It would be difficult to put a dollar value on the labor savings, since so much depends on the weed seed bank and other conditions on each individual farm.

The endless rains of 2009 prompted an "Ah ha!" moment that improved the economics of our asparagus project in another way. As the rains continued and our lower gardens remained too wet to plant, we found ourselves eyeing those empty 10-foot-wide weed barriers on either side of the asparagus plots. Thinking it through, we realized that planting short-duration annual crops in those empty spaces would not compromise the purpose of the barriers, which is to prevent quack grass from migrating into the asparagus from the surrounding sod. We did not end up using the barrier space in FF4, but in FF1 we planted lettuce, beets, cabbage, and broccoli, with good results. Care must be taken, of course, to keep the chickens out of the annual crops.

9. Assessment

Our project generated several new ideas we would like to try:

- Using weeder chickens after harvest in summer raspberries.
- Using weeder chickens around grapevines. Because grapes are harvested in the fall, the chickens would have to be used in the spring and removed at least 90 days before harvest to comply with the NOP waiting period.
- Planting legume crops between the asparagus rows, to provide nitrogen for the asparagus and forage for the chickens.

- Using broilers rather than laying hens in asparagus. We do not believe the standard Cornish X Rock broilers would work well (they do a lot of sitting around and not much foraging), but we are interested in trying some of the alternative meat breeds that grow more slowly and are reported to be more active than Cornish X Rocks.

We considered trying weeder chickens in high-bush blueberries, but because chicken manure tends to raise the soil's pH level and blueberries prefer an acid soil, we decided against it. We did try putting our hens in the rhubarb patch, but it turns out that chickens really enjoy eating rhubarb! (They also seem to be quite fond of blueberry leaves, another reason why weeder chickens might not work with blueberries.)

10. ADOPTION

We were pleased with the results of our experiment and will definitely continue using both the weed barrier and the weeder chickens with our asparagus. We have also established a 10-ft weed barrier around our rhubarb patch. This spring we plan to plant summer raspberries using the same layout as with the asparagus; we hope to use the chickens to help control weeds in the raspberries as well.

11. OUTREACH

We presented our results at Maine's Farmer-to-Farmer Conference on November 6, 2010. The conference was sponsored by the Maine Organic Farmers & Gardeners Association (MOFGA) and the University of Maine Cooperative Extension. A summary of the presentation has been published in the spring 2011 issue of the *Maine Organic Farmer & Gardener*[4].

12. REPORT SUMMARY

The goal of this two-year project was to evaluate the effectiveness of controlling weeds in organic asparagus with the use of chickens and a cover crop barrier. We established two 5000 sq-ft asparagus plantings with a 10 foot tilled weed barrier surrounding each one. After the asparagus harvest was complete and the plants had ferned out, we allowed a flock of laying hens to range freely in one half of each plot. By counting weeds on both sides of each plot, before and after the chickens did their work, we were able to determine their effectiveness.

Our results show that using weeder chickens reduces the amount of labor required to control weeds in organic asparagus. Although the hens did not completely eliminate the weeds, they kept them down to a manageable level. We also found that our 10-ft weed barrier was very effective at keeping quack grass from working its way into the asparagus. We intend to continue using weeder chickens and weed barriers in our asparagus plantings. We also plan to try the same practice in a new planting of summer raspberries this year.

Marilyn Stanley

February 25, 2011

[4] An online version can be found at http://www.mofga.org.