Biological Methods, Mechanical Methods, and Yield

By
Collaborator/partner: Mr. Jerald Larson,
Retired Fort Valley Cooperative Extension
For the
Southern SARE Producer Grant Project:
Mechanical and biological strategies to remove invasive
Bermuda grass in preparation for organic vegetable production on raised beds

Lola's Organic Farm SSARE Field Day – June 11, 2015
Glenwood, GA

Spring 2014 Sapelo Onion Yields (Both Green and Dry Bulbs in Pounds)

Biological Subplot (1) (5/19-6/5)			**Mechanical Subplot (2) (5/19-6/14)**		
Bed	1	40.4	Bed	1	14.9
	2	26.7		2	30.9
	3	12.2		3	13.3
	4	15.8		4	16.5
	5	24.0		5	23.3
	6	25.5		6	30.0
Total:		144.6	Total:		128.9
Average:		24.1	Average:		21.5

1) Onion yields in the biological subplot were 11% higher than those in the mechanical subplot.

2) The marketable quality was rated excellent for both subplots.

3) In the fall of 2013 all of the transplants were well grown at the farm using good quality worm compost.

4) Compost and organic fertilizers were applied based on soil test results.

5) Plants were spaced 5" between plants, and 10" in between each of 3 rows, to equal 234 plants per 100 sq.ft. bed.

6) Micro sprinkler irrigation and hand weeding were practiced.

Spring 2014 Red Russian Kale Yields
(Leaf Bunches in Pounds)

Biological Subplot (1)
(3/10-5/19)

Bed	1	41.2
	2	5.2
	3	8.1
	4	12.7
	5	22.0
	6	20.4
Total:		109.6
Average:		18.3

Mechanical Subplot (2)
(3/29-5/20)

Bed	1	1.0
	2	4.2
	3	3.2
	4	12.4
	5	6.6
	6	5.5
Total:		32.9
Average:		5.5

1) The kale yields in the biological subplot were 70% higher than those in the mechanical subplot.

2) The marketable quality was rated as excellent for the biological and good for the mechanical.

3) In the fall of 2013 all transplants were well grown at the farm using good quality worm compost.

4) Compost and organic fertilizers were applied, based on soil test results.

5) Plants were spaced 12” in the row and 18” between 2 rows, to equal 66 plants per 100 sq.ft.bed.

6) Micro sprinkler irrigation and hand weeding were practiced.

Biological Subplot (1) Weed Counts and Weights (Totals for 3 sample sites for each date)

June 4, 2013

Common Bermuda		Yellow Nutsedge		Others- Annual Broadleaf	
Count	Weight (oz)	Count	Weight (oz)	Count	Weight (oz)
241	5.1	23	1.2	70	0.5

June 12, 2014

Common Bermuda		Yellow Nutsedge		O-Annual Crabgrass & Broadleaf	
Count	Weight (oz)	Count	Weight(oz)	Count	Weight (oz)
58	2.0	47	2.0	25	3.6
(% Increase or Decrease from 6/4/13)					
-76%	-61%	+104%	+67%	-64%	+80%

October 28, 2014

Common Bermuda		Yellow Nutsedge		O-Annual Broadleaf	
Count	Weight (oz)	Count	Weight (oz)	Count	Weight (oz)
18	0.4	39	1.2	8	0.2
(% Increase or Decrease from 6/14/13)					
-93%	-92%	+70%	0%	-89%	-60%

Jerald Larson

Mechanical Subplot (2) Weed Counts and Weights (Totals for 3 sample sites for each date)

June 4, 2013

Common Bermuda		**Yellow Nutsedge**		**Others- Annual Broadleaf**	
Count	**Weight (oz)**	**Count**	**Weight (oz)**	**Count**	**Weight (oz)**
225	6.2	77	7.8	46	1.6

June 12, 2014

Common Bermuda		**Yellow Nutsedge**		**O-Annual Crabgrass & Broadleaf**	
Count	**Weight (oz)**	**Count**	**Weight (oz)**	**Count**	**Weight (oz)**
4	0.4	2	0.6	44	5.4

(%Increase or Decrease from 6/4/13)

-98%	-93%	-97%	-92%	-4%	+234%

October 28, 2014

Common Bermuda		**Yellow Nutsedge**		**O-Annual Crabgrass & Broadleaf**	
Count	**Weight (oz)**	**Count**	**Weight (oz)**	**Count**	**Weight (oz)**
4	**0.3**	**5**	**0.8**	**30**	**4.9**

(% Increase or Decrease from 6/4/13)

-98%	-95%	-94%	-90%	-35%	+206%

A summary of two years of weed response to biological and mechanical intervention:

1) The methods and resources used for both the biological and mechanical subplots, are described in the PowerPoint Report. At least twice as many man hours of hand labor were needed for maintenance of the mechanical verses the biological. The initial 3 tillages with the 2 row, crop cultivator gave inferior results, requiring more intensive hand labor for weed raking and removal.

2) During the summer and fall of 2014, the biological subplot had a buckewheat/millet/cowpea cover crop from mid July to mid November. The mechanical subplot had field cultivator tillage and hand raking of weeds in mid July and early September. With higher efficiency for the field cultivator, the total hand labor needed, was reduced by at least 30%.

3) The weed counts and weights taken on each of the 3 dates were based on 3 randomly chosen sites per subplot. At each site, a cubic foot of soil was dug and both weed roots and tops were studied.

4) On 6/4/13, near the project start, both subplots had comparable levels of common Bermudagrass, however, the mechanical subplot had considerably more yellow nutsedge. Annual broadleaf weeds were greater in the biological subplot.

5) Mechanical suppression of Bermudagrass reached a high level after the first season, while biological suppression required two growing seasons to achieve the same level.

6) At the same time that Bermudagrass was suppressed under biological management, nutsedge gained a significant advantage to increase.

7) Nutsedge was significantly suppressed for both seasons under mechanical management.

8) Other, annual weeds were reduced with the biological treatment, with the exception of the higher crabgrass weight on 6/12/14.

9) With good suppression of perennial weeds, the weights of the "other weeds-annuals", especially for crabgrass, showed high increases for the mechanical treatment, during both seasons.

Jerald Larson

Spring 2015 Sapelo/Candy Onion Yields
(Green onions - tops and bulbs in Pounds)

Biological Subplot (1) 4/16 - 6/5)			**Mechanical Subplot (2) (4/21 - 6/5)**		
Bed	1	56.8	Bed	1	38.6
	2	84.0		2	43.2
	3	38.0		3	31.7
	4	40.1		4	12.2
	5	43.3		5	25.4
	6	55.0		6	27.3
Total		317.2	Total		178.4
Average		52.9	Average		29.7

1) Onion yields in the biological subplot were 44% higher than in the mechanical subplot.

2) The marketable quality was excellent for both subplots: At a seasonal average market price/pound.

3) In the fall of 2014, all transplants were farm grown using quality worm compost.

4) Compost and organic fertilizers were applied based on soil test results.

5) Plant spacing was 5" in the row and 10" between each of 3 rows, to equal 234 plants per 100 sq.ft.bed.

6) Micro sprinkler irrigation and hand weeding were practiced.

7) A comparison of onion yields from 2014 and 2015 showed a 54% increase in the biological, and a 28% increase in the mechanical subplot for the 2015 crop.

Spring 2015 Camarosa Strawberry Yields (Weighed in Pounds)

Biological Subplot (1) (4/7 - 6/5)			**Mechanical Subplot (2) (4/7 - 6/5)**		
Bed	1	2.0	Bed	1	2.1
	2	3.0		2	2.4
	3	1.7		3	1.4
	4	0.8		4	2.3
	5	1.6		5	2.9
	6	0.9		6	1.9
Total		10.0	Total		17.2
Average		1.7	Average		2.9

1) The strawberry yields this far into the season were 42% higher in mechanical subplot. With a later ripening season this year.

2) The marketable quality was good for both subplots.

3) During the summer and fall of 2014, the plants were grown in propagation beds at the farm.

4) Compost and organic fertilizers were applied based on soil test results.

5) Plant spacing was 12" in the row and 18" between the 2 rows, to equal 66 plants per 100 sq.ft.bed.

6) Micro sprinkler irrigation, hand weeding, row cover frost protection, and ½" mesh, poly, bird netting were used.

7) After final weeding in April, an inch of pine straw mulch was placed under and around each plant.

Jerald Larson

Recommendations based on two years of weed and vegetable responses, to biological and mechanical intervention.

1) The biological management over two growing seasons gave higher onion and kale yields, however, was slower to suppress Bermudagrass and allowed nutsedge to increase.
2) By contast, the mechanical management suppressed both of these perennial weeds effectively and much quicker. The negative responses were poor suppression of annual weeds and lower vegetable yields.
3) To take advantage of the strengths of both of these management systems, a further two year trial on a similar site could be proposed. Use field cultivator tillage and hand raking every two weeks from mid May to mid July for five tillages. This should be followed by strategic cover crop management the remainder of that season as well as the next, full summer/fall season.
4) Another approach would be to continue a third summer/fall of cover crop management for Subplot 1, by changing the species and/or mix to one that is more aggressive against nutsedge.
5) Both of the two above approaches, (3 and 4), would promote growing winter/spring cash crops, however, would forego summer cash crops until perennial weeds are sufficiently under control.
6) During the summer and fall of 2014, a 7' wide border was "field cultivator" tilled, raked, and planted to iron clay cowpeas, to reduce Bermudagrass invasion into the subplots. This should become a standard practice for the future.
7) The field cultivator (chisel plow) became our machine of choice for combing the soil 6-8" deep to uniformly loosen and lift the extensive root systems of Bermudagrass. Changing the direction of tillage from north to south and west to east was also accomplished. By contrast, the 2 row, crop cultivator with 6" and 12" wide sweeps, tended to snag and clump up with thick roots and soil. For our light, sandy soil the field cultivator is one of the best implements to use. A single spading machine tillage, followed by raking may also be effective. For heavier or compacted soils, plowing to a 6"depth may need to be done before tillage. The disk harrow should be avoided, since it cuts Bermudagrass roots into many smaller pieces, increasing its vegetative multiplication, and making removal even more difficult.
8) Perhaps at least 50% of the highly demanding labor for hand raking and removing weed residues, could be done by tractor with either the old, hay dump rake or a contemporary landscaping rake.
9) Not having hogs, for feeding our weed residues, they were dried and burned.
10) Special attention and training should be given to the uniform distribution of cover crop seeds, light incorporation in the soil, and adequate watering for good germination.
11) Soil testing for both cover and cash crops is always well rewarded.
12) A good quality worm compost, by itself, was an excellent growing medium for our kale and onion transplants.

13) Due to a lack of organically grown wheat straw, we used pine straw, instead, to mulch under the strawberries. It worked well to reduce fruit rot and keep it free of sand. We had organic certified pine straw from our pine trees.