ORGANIC VIDALIA ONION PRODUCTION: THE BASICS OF WHAT WORKS, WHAT YOU CAN DO AND WHAT YOU CAN'T

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The National Organic Program (NOP) was implemented in it's entirety in the fall of 2002. This voluntary program is administered by the USDA through a variety of certification agencies both public and private. In Georgia, a grower contemplating becoming certified organic would contact one of these certifying agents, which would administer inspection and certification. Adoption of these rules and use of the 'USDA ORGANIC' seal has helped accelerate the growth of organic production, which has seen consistent growth for the past 30 years.

Beginning in 2002 we began looking at producing onions organically. We had secured a site at the Vidalia Onion and Vegetable Research Center (Lyons, GA) that we had certified for organic production. A variety of experiments have been conducted worldwide on organic onion production including fertility, disease incidence, varietal effects, and weed control to name a few (Bourdôt et al., 2004; Khalil et al., 2002; Ozer et al., 2002; Piazza et al., 2003).

Onions in southeast Georgia are grown from transplants produced on-farm with September sowing in high density plantings. These onions are then lifted, 50% of their tops removed, and tranplanted to their final spacing in mid-winter. To produce the transplants requires 130 lbs/acre of N and to produce the dry bulb onions requires an additional 150 lbs/acre N. This amount of N fertilizer then represents a considerable challenge for organic onion production.

For organic onion production, the primary method of weed control for transplant production has been handweeding and then transplanting onto plastic mulch to control weeds in dry bulb production. Some organic growers, however, do not want to use plastic mulch because of the environmental impact and disposal problem. One of the objectives of these experiments was to evaluate natural mulches as an alternative to plastic mulch for weed control.

Other objectives of these studies were to evaluate organic fertilization practices for both transplants and dry bulb onions production.

Methods

Transplant Production

Variety Granex EM 90 was sown on 17 Sept. 2003 with a Monosem vacuum planter (Model 540, Lenexa, KS). Four rows were sown on beds formed 6-ft on centers at a rate of 60 seed/ft. Rows were 12 in. apart and each experimental unit

consisted of 20 ft. of planted bed. Treatments consisted of poultry litter from 0 to 10 tons/acre in 2 ton/acre increments. The poultry litter application was split in two with half applied on 22 Sept. 2003 and half on 23 Oct. 2003. Transplants were removed from the beds on 3 Dec. 2003 for evaluation. The experimental design was a randomized complete block design (RCBD). Five plants were chosen at random from each plot and the height was determined from the basal plate to the tip of the longest leaf. Width was measured at the widest point near the base of the plant. Twenty plants were selected at random and their weight was also determined.

In 2004, poultry litter at rates from 0-10 tons/acre in 2 ton/acre rates were evaluated again. A combination of seed from varieties XON-202Y, HSX-19406 F_1, HSX-61304 F_1, and HSX-18201 F_1 were used. We used a combination of varieties because we did not have sufficient untreated seed of a single variety to conduct this experiment. Seed were sown on 1 Oct. 2004 and half of each treatment was applied on the same day. The planting arrangement was identical to 2003 except we used a 10 ft. plot as the experimental unit. The second half of each treatment was applied on 1 Nov. 2004. Plants were removed from the plots on 13 Dec. 2004 and evaluated as in 2003.

In addition, in 2004 a 3x2 factorial experiment was set up to evaluate compost and an organic fertilizer with 4N-2P-3K (Perdue AgriRecycle, Horsham, PA) formulation on transplant production. The experiment consisted of 3 rates of compost at 0, 5, and 10 tons/acre and fertilizer at 0 and 130 lbs/acre N. The experiment was a RCBD with four replications. The experimental unit was a plot planted as described for the 2003 experiment that was 10 ft. long. The same seed used for the poultry litter experiment in 2004 was used in this experiment and was also planted on 1 Oct. 2004. All of the compost was applied preplant and the fertilizer was split in half with the first application 1 Oct. 2004 and the second application 1 Nov. 2004. Plants were removed from the plots on 13 Dec. 2004 and evaluated for wieght, height, and width as decribed in the 2003 experiment.

The data from 2003 and 2004 was subjected to ANOVA and Fisher's Protected Least Significant Difference (LSD) at p=0.05 and a coefficient of variation (CV) was calculated for each parameter.

Natural mulches for weed control

Onion transplants with 50% of their tops removed were planted on 4-inch-high beds formed 6 ft on-centers with four rows per bed. Onion transplants were planted with 5.5-inch in-row and 12-inch between-row spacing. Plants were grown in accordance with the NOP rules as well as following cultural practices and maintaining fertility levels according to the University of Georgia Cooperative Extension Service recommendations for onions. The experiment was conducted in 2003-04 at the Vidalia Onion and Vegetable Research Center (VOVRC) in Lyons, Ga. The experiment was a RCBD with four replications. Each plot was 20 ft long and transplanted with variety Granex EM90 on 3 Dec. 2003. There were four treatments in this experiment consisting of hand weeding and mulches of pine needles, wheat straw, and bermudagrass hay. Treatment mulches were applied immediately after transplanting with additional treatment mulch applied as needed to help smother weeds. Hand weeding was also done as needed.

Plots were visually evaluated for weeds and for plant stand on 23 Feb. 2004. The weed rating scale was 0-10 with 0 indicating no weeds and 10 indicating many weeds (90-100% infestation). A rating was also used for plant stand with 1 indicating an excellent plant stand, while 5 indicated poor to non-existent plant stand.

Onions were pulled, soil shaken from the roots, and laid on top of the ground on 6 May 2004 and allowed to field dry until 11 May 2004. At that time, onion tops and roots were removed and total yield was recorded for each plot. Onions were then graded into jumbo and medium size classes with smaller sizes disposed of with the culls. Jumbo onions were ≥3 inches diameter and mediums were ≥2 inches and <3 inches.

Poultry litter for dry bulb production

In the 2004-05 season we evaluated poultry litter, compost, and a commercially available organic fertilizer. Transplants consisting of a mixture of varieties XON-202Y, HSX-19406, HSX-61304, and HSX-18201 were set on 31 Dec. 2004. Plots consisted of beds prepared 6-ft on-centers with four rows of onions planted with 12 in. between-rows and 5.5 in. in-row. Each experimental unit was 10 ft. long. The experiment was a RCBD with four replications. Onions were harvested on 31 May 2005 and total yield per plot was recorded. In addition, these onions were graded into jumbos (≥3 in.) and mediums (≥2 in. and <3 in.).

Results and Conclusions

Work at the University of Georgia on production of organic Vidalia onions began in 2002 with some preliminary work. This was followed up with certification of approximately 1 acre of land at the Vidalia Onion and Vegetable Research Center for organic production under the NOP. All subsequent work on organic onion production has occurred on certified ground either at the research farm or at on-farm locations that were certified or in the process of certification. Presented here are a series of experiments on transplant production, weed control, and dry bulb onion production.

Poultry litter from 0-10 tons/acre had a significant linear effect on transplant production (Table 1). Poultry litter at a rate of 10 tons/acre, however, was not significantly different from a 6 tons/acre rate on a plant weight basis by Fisher's LSD suggesting that 6-10 tons/acre should result in yields of good quality tranplants.

In a factorial experiment evaluating compost and organic fertilizer 4-2-3 effect on transplant production it was found that fertilizer at 130 lbs/acre N had a significant effect on plant length (Table 2). There were compost x fertilizer interactions when assessing these transplants by plant width or weight. Plant width was significantly greater with fertilizer and compost at 10 tons/acre. In addition, plant weight was significantly greater with fertilizer if either 5 or 10 tons/acre compost was used.

Evaluation of various natural mulches for weed control compared to hand weeding it was found the highest total yield was with handweeding, which was significantly greater than wheat straw or bermudagrass hay (Table 3). There were no differences for jumbo yields and medium yields were highest with hand weeding, which was significantly greater than pine needles, wheat straw, or bermudagrass hay.

Plant stand with hand weeding was significantly better than pine needles, which was better than bermudagrass hay, which was better than wheat straw, or bermudagrass hay (Table 3).

There was a significant linerar increase in total onion yield based on increasing poultry litter rates from 0-10 tons/acre (Table 4). There was no effect on jumbo yields, but medium yields decreased in a linear fashion with increasing poultry litter application. Using Fisher's Protected LSD there was no difference in total yield (611 50-lb bags/acre) at 10 tons/acre compared to yields at 6 or 4 tons/acre suggesting that rates from 4-10 tons/acre should result in good total yields.

Fertilization of plantbeds can be accomplished with either locally available poultry litter or organic fertilizer. Poultry litter is made up of the wood shavings or other products placed in poultry houses to absorb bird droppings during production. It is removed from the houses after the birds have been harvested and it is often stored in 'stack' houses for later land application or may be applied immediately as an alternative inexpensive N source. The use of fresh manure such as this is restricted by NOP rules to 90 days before harvest for edible parts not in contact with the soil and 120 day for those vegetables with soil contact, such as onions. Overwintering onion production is such a long season propostion that this is not a problem. Poultry litter can be used throughout transplant production and still meet these rules.

Organic fertilizers have greater flexibility in that they can be used up until time of harvest. In general, organic fertilizers will not respond as a conventional fertilizer based on the package formulation. We have found that application rates as much as 50% higher may be required to get the desired effect. This is due to the fact that the majority of N-P-K is tied up in organic compounds, which must break down to a form that a crop can use unlike a conventional fertilizer where the material is immediately available.

Weed control is, however, the most important problem in organic onion production. Onions are relatively slow growing with an upright habit. This makes them poor competitors with weeds. In conventional production this is largely solved with modern herbicides. In organic onion production plastic mulch has been the primary means of weed control. Many organic growers are reasonably opposed to the use of plastic mulch because it is not biodegradable and presents an environmental and disposal problem.

We have attempted to address this with the use of various natural mulches to control weeds. Materials such as wheat straw and bermudagrass hay tended to lodge in the tops of closely spaced onion plants and at the same time appeared to have strong allelopathic effects on the onions with stand loss and reduced yield. Pine needle mulch also lodged in plant tops, but without the consequent stand loss although yields were reduced perhaps due to shading of plants. Weed free compost was also used (data not shown) and at the rates we used it did not prevent weed problems, however, one of our larger organic onion growers has adopted this method for weed control in plantbeds using a much heavier rate with a minimum of one inch of compost prior to seeding. This has been partially effective, but still requires some cultivation and/or hand weeding.

The use of poultry litter is more problematic on dry bulb production because of the waiting time. With an early harvest of April 1st the last poultry litter would

have to be put out almost at the time of transplanting. Early transplanting occurs the week before Thanksgiving, but will continue to the end of the year with some onions transplanted into January.

Growers who tranplant onto plastic will place all of their fertilizer as a preplant incorporated application, lay the plastic and drip line and then transplant their onions. Interestingly, although we have not tested it, it appeared that plastic conserves the fertility in the soil and helps prevent leaching of these nutrients. We had a few extra plants so we had one bed half covered with plastic and half bareground and the onions on the plastic appeared green and larger than those on the baregound, but again this was just an informal observation.

Compost in and of itself does not have enough fertility to produce either transplants or dry bulb onions, but it does have a synergistic effect on organic fertilizers. It is not clear why this is happening. Compost of course has many benefits beyond a source of fertility. We need more information about how compost mineralized under our conditions and if we can improve its use efficiency in terms of fertilty, affect on soil characteristics, and weed control potential.

In conclusion we are at the earliest stages of understanding and developing the protocols for organic Vidalia onion production. In several of these studies yields were no where near conventional onion production, but it should be pointed out that last year (2005-06 season) we averaged over 800 50-lb bags/acre in our organic onion research (data not shown). Commercial organic onion growers also reported excellent yields last year close to conventional production yields. At this juncture the greatest obstacle to organic onion production is weed control.

Citations

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Table 1. Effect of poultry litter rates on growth of onion transplants (2003-2004)

Poultry Litter Treatment (tons/acre)	Weight of 20 plts. (gms)	Plant Length (inches)	Plant Width (mm)
0	73.7	9.4	7.7
2	85.1	12.1	7.8
4	113.5	13.2	8.9
6	140.1	14.7	9.1
8	146.3	14.9	9.8
10	166.3	16.1	10.7
CV	21%	30%	31%
Fisher's Protected LSD (p=0.05)	46.3	6.0	4.2
Probabilities			
Treatment	0.004	0.000	0.002
Year	0.006	0.006	0.002
Treatment x year	0.822	0.704	0.470
Linear	0.000	0.000	0.000

Table 2. Evaluation of compost and organic fertilizer on growth of onion transplants.

	Fertilizer, lbs/acre N from 4-2-3 3% Ca					
	Plant Length (inches)		Plant Width (mm)		Weight/20 plants (gms)	
Compost, tons/acre	0	130	0	130	0	130
0	10.8	12.8	9.5	10.1	112.8	109.2
5	9.9	13.6	8.9	9.9	58.2	118.8
10	11.6	16.2	8.6	11.2	90.2	173.3
Probabilities						
Compost	0.389		0.797		0.054	
Fertilizer	0.023		0.062		0.003	
Compost X Fertilizer	0.181		0.013		0.046	
Compost with						
0 lbs/acre N			0.549		0.143	
130 lbs/acre N			0.445		0.098	
Fertilizer with						
0 tons/acre compost			0.159		0.843	
5 tons/acre compost			0.092		0.020	
10 tons/acre compost			0.047		0.006	

Table 3. Total and graded yield with plant stand and weed control ratings for hand weeded and different mulches in onions, 2003-04. Vidalia Onion & Vegetable Research Center, Lyons, Ga.

Treatment	Total yield (lb/acre)	Jumbos[z] (lb/acre)	Mediums[z] (lb/acre)	Plant stand (1-5 scale)[y]	Weed control rating (0-10 scale)[x]
Hand weeded	14,665	2,831	2,432	1.0	3.6
Pine needles	9,620	908	726	1.9	4.4
Wheat straw	2,977	0	73	3.9	6.4
Bermudagrass hay	7,078	1,162	508	3.2	4.4
CV	41%	59%	39%	17%	27%
Fishers Protected LSD ($P \leq 0.05$)	5,663	NS	1,416	0.2	NS

[z]Onion size classes: Jumbo≥3.0 inches, Medium>2 and <3 inches.

[z]Plant Stand Rating: 1-Excellent, 5-Poor to non-existent.

[y]Weed Rating: 0-Excellent control, 10-Poor control.

1 lb/acre = 1.1209 kg•ha^{-1}

Table 4. Evaluation of Poultry Litter Rates on Organic Onion Production (2004-05)

Treatments	Total Yield	Graded Yield	
		Jumbos	Mediums
(tons/acre)		(50-lb bags/acre)	
0	304	144	53
2	376	130	40
4	472	205	32
6	503	222	28
8	393	172	18
10	611	243	27
CV	18%	33%	32%
LSD (p=0.05)	145	NS	36
Linear Probability	0.000	-	0.000

Table 5. Effect of compost and organic fertilizer (3-2-4) on organic onion total, jumbo, and medium yields (2004-05).

	Fertilizer (3N-2P-4K) (lbs/acre N)					
		0			150	
Compost	Total	Jumbo	Medium	Total	Jumbo	Medium
(tons/acre)			(50-lb bags/acre)			
5	303	134	74	303	126	25
10	290	110	51	548	232	37

Probabilities	Total	Jumbo	Medium
Fertilizer	0.001	0.093	0.030
Compost	0.003	0.204	0.669
Fertilizer x compost	0.001	0.058	0.183
Compost 5 tons/acre			
Fertilizer	1.000		
Compost 10 tons/acre			
Fertilizer	0.003		