ONION SPACING AND MULCH TYPE TO IMPROVE QUALITY AND PROFITABILITY OF FRESH MARKET ONIONS

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INTRODUCTION: Small-scale diversified fresh market vegetable growers who grow onions intensively are constantly challenged by yield losses due to bacterial bulb rots, which greatly compromise the profitability of the crop. If bacterial diseases cannot be managed, the profitability of this industry will not be sustained or expanded.

Bacterial diseases of onions: Onions are plagued by a number of bacterial diseases that cause both bulb and leaf decay. In PA, the most frequently isolated bacterial pathogens include: soft rot pathogens, *Pseudomonas marginalis* and *Pectobacterium caratovora*; and center rot pathogens, *Pantoea ananatis* and *P. agglomerans*; *Xanthomonas axonopodis* and *Pseudomonas viridiflava*. In NY, sour skin caused by *Burholderia cepacia*, is the most common cause of bacterial bulb rot, but *Pantoea ananatis* has also been identified. Bacterial diseases first appear as leaf blight symptoms on the center leaves of the plant, resulting in yellowing or bleaching and wilting of these leaves. The infection progresses down the leaves and the neck, and eventually into the bulb. Affected bulb scales eventually become soft and yellowish-brown in appearance. At harvest, the foliage often tears away from the bulb when pulled causing in-field losses. Additional losses can occur during storage when outwardly asymptomatic bulbs at harvest continue to breakdown. In PA and NY it is not uncommon for growers to harvest 2 to 3 weeks early and sacrifice bulb size in attempt to prevent the bacteria from moving into the bulb and causing rots and additional storage losses.

Chemical tactics have failed to control bacterial diseases: Attempts have been made by several growers to control bacterial diseases in onions with copper bactericides and other chemicals such as Oxidate. However, it has been reported in PA that weekly sprays of various bactericides starting as early as the second week in May when onion plants have just 5 leaves and continuing until the pre-harvest entry interval of the bactericide still resulted in unacceptably high incidence of bacterial disease (i.e. >30%). In order for bactericides to work, they need to be part of an IPM program that incorporates various cultural tactics.

Using cultural practices to reduce incidence of bacterial rots: In this project, increased planting densities and alternative mulch types including silver reflective, black biodegradable and bare-ground, were evaluated in three on-farm replicated small-plot research trials in PA with sweet onions and in NY with yellow cooking onions. An economic analysis was also conducted.

RESULTS:

Higher planting density reduced bacterial diseases of onions: In 2009, Hoepting *et al.* evaluated different planting configurations on the incidence of bacterial diseases of onions grown on plastic mulch in NY (Table 1) and PA. In NY, the grower's standard planting configuration (4 rows per 3-foot bed with 8" plant spacing = 48 $inch^2$ per bulb) resulted in 37% incidence of bacterial bulb rot at harvest compared to the higher density plantings, 4 rows and 3 rows per bed with 4" plant spacing, which had 13% and 14% disease incidence, respectively. Consequently, these higher density configurations also had significantly higher marketable yields and economic return despite higher input costs, as a result of more marketable jumbo and colossal sized bulbs. The cost of transplants in the higher planting densities was 1.5 to 2 times more than for the standard planting configuration (Table 1). Despite this, the net economic return was 1.4 and 1.5 times more than the standard

($276.75 per 100 ft bed) for the 4 inch plant spacing configurations with 3 and 4 rows per bed, respectively. In PA, unusually cool weather conditions resulted in very low incidence of bacterial disease negating any treatment differences (data not shown). However, when we analyzed the NY yield data using PA sweet onion pricing, where larger bulb sizes obtain higher prices, the net economic return was again 1.4 times higher in the higher density plantings with 4 inch plant spacing compared to the standard (Table 2).

We hypothesize that bacterial disease incidence is reduced in higher density planting configurations, because these conditions hasten maturity and produce plants with thinner necks and fewer leaves thus creating a less favorable environment for the pathogen(s); a trend that was observed in our trials in NY and PA. In the PA trial, at harvest, the highest planting density (4" plant spacing & 4 rows/bed) had significantly fewer leaves per plant, thinner necks and half as many plants lodged compared to the standard (Table 3).

Table 3. Evaluation of planting configurations on small-scale fresh market sweet onions (cv. Candy) for plant size and lodging at maturity, New Holland, PA, July 16, 2009 (Hoepting, 2009).

Planting Configuration					***Plant Size***[4]		***Maturity***
Planting Density (inch^2/bulb)	**Number Rows per Bed**[1]	**Row Spacing (inch)**	**Plant Spacing (inch)**	**No. plants per 100 ft bed**[1]	**Number Leaves per Plant**	**Neck Diameter (inch)**	**% Lodging**[3]
24 inch^2	4	6	4	1200	7.86 b[2]	0.66 d	86.4 a
32 inch^2	3	8	4	900	8.16 b	0.69 cd	68.3 ab
36 inch^2 Standard	4	6	6	800	8.83 a	0.74 bc	44.3 b
60 inch^2	4	6	10	480	9.16 a	0.78 ab	7.5 c
80 inch^2	3	8		360	9.18 a	0.81 a	7.0 c
				P value:	***0.0001***	***0.0001***	***0.0004***

[1]bed width = 3 ft. [2]numbers in a column followed by the same letter are not significantly different, Fisher's Protected LSD test, $p > 0.05$. [3]percent lodging was estimated visually. [4]number of leaves per plant and neck diameter were counted and measured, respectively from 10 randomly selected plants per replicate.

Effect of mulch type on bacterial bulb rot: Our only trial was in PA, where unusually cool weather conditions resulted in very low incidence of bacterial disease negating any treatment differences (data not shown). Black plastic absorbs sunlight thus increasing soil temperature, which in turn, promotes early crop development of onions. However, we suspect that during June and July, the warmer soil temperatures provided by the black plastic may actually create a more favorable environment for bacteria. In 2007, in NY we demonstrated that the daily high soil line temperature during July was approximately 10 ˚F cooler under reflective silver mulch than it was under black plastic. This could be the difference between optimum and below optimum temperatures for bacterial growth. Growing onions without mulch on bare soil may be another option, provided weeds can be economically controlled and not have a negative effect on yield. Biodegradable black plastic represents a compromise between black plastic and bare ground with the black plastic giving a push to early season growth and then giving way to cooler soil temperatures as it degrades.

STAY TUNED! More work is planned (funding is pending) for 2010 and 2011 to continue this work in NY and PA.

Table 1. Evaluation of planting configurations of small-scale pungent yellow fresh market onions (cv. Nebula) on marketable yield and grade, quality and economic return, Interlaken, NY 2009 (Hoepting 2009).

Planting Density (inch²/bulb)	Planting Configuration: No. rows /bed[1]	Planting Configuration: Row spacing (inch)	Planting Configuration: Plant spacing (inch)	No. plants per 100 ft bed[1]	Total Marketable yield (lb per 100 ft bed[1])	Onion Grade (lb per 100 ft bed): Small <2.5”	Onion Grade: Medium 2.5-3”	Onion Grade: Jumbo 3-4”	Onion Grade: Colossal >4”	Bacterial Bulb Rot: lb per 100 ft bed[1]	Bacterial Bulb Rot: % by weight	Economic Return ($ per 100 ft bed): GROSS[3]	Economic Return: Cost of transplants[4]	Economic Return: NET[5]
24 inch²	4	6	4	1200	510 a[2]	10.0 a	36.0 a	330 a	130 b	70	13.3 b	$459	$40.50	$418.50
32 inch²	3	8	4	900	460 a	2.00 b	10.0 b	190 b	270 a	70	13.8 b	$414	$30.38	$383.62
48 inch² standard	4	6	8	600	330 b	0.00 b	6.00 bc	50.0 c	270 a	180	37.3 a	$297	$20.25	$276.75
60 inch²	4	6	10	480	220 bc	1.00 b	0.00 c	20.0 c	200 ab	170	41.5 a	$198	$16.20	$181.80
80 inch²	3	8	10	360	160 c	0.00 b	1.00 c	10.0 c	130 b	190	53.6 a	$144	$12.15	$131.85
P Value:					***0.0001***	***0.0046***	***0.0000***	***0.0000***	***0.0352***	***NS[6]***	***0.0064***			

[1]Bed width = 3 ft. [2]numbers in a column followed by the same letter are not significantly different, Fisher’s Protected LSD test, p > 0.05. [3]GROSS = marketable yield x $0.90 per pound. [4]cost of transplants = $1.35 per 40 plants (=$0.03375 per plant). [5]NET = GROSS minus cost of transplants, all other expenses equal. [6]NS = not significant.

Table 2. Evaluation of planting configurations of small-scale pungent yellow fresh market onions (cv. Nebula) on economic return, using PA sweet onion pricing, 2009 (Hoepting 2009).

Planting Density (inch²/bulb)	Planting Configuration: No. rows /bed[1]	Planting Configuration: Row spacing (inch)	Planting Configuration: Jumbo 3-4”	No. plants per 100 ft bed[1]	$ per size class (per 100 ft bed[1])[2]: Small $0.20/lb	Medium $0.40/lb	Jumbo $0.50/lb	Colossal $0.55/lb	Economic Return ($ per 100 ft bed): GROSS[3]	Cost of transplants[4]	NET[5]
24 inch²	4	6	4	1200	$2.00	$14.40	$165.00	$71.50	$252.90	$24.00	$228.90
32 inch²	3	8	4	900	$0.40	$4.00	$95.00	$148.50	$247.90	$18.00	$229.90
48 inch² standard	4	6	8	600	$0.00	$2.40	$25.00	$148.50	$175.90	$12.00	$163.90
60 inch²	4	6	10	480	$0.20	$0.00	$10.00	$110.00	$120.20	$9.60	$110.60
80 inch²	3	8	10	360	$0.00	$0.40	$5.00	$71.50	$76.90	$7.20	$69.70

[1]Bed width = 3 ft. [2]size class distribution from Table 1. [3]GROSS = sum of $ per size. [4]cost of transplants = $0.02 per plant. [5]NET = GROSS minus cost of transplants, all other costs equal.