

ONION PRODUCTION FROM TRANSPLANTS AND SETS

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Introduction

Increased interest in an earlier start for onion harvest has led to interest in transplanting onions. Our earlier research showed that when onions are grown from transplants they can be harvested in July (Shock et al. 2004, 2007, 2008, 2009, 2010, 2011). This trial evaluated the performance of six onion varieties grown from transplants produced in a greenhouse at the Malheur Experiment Station, in Ontario, Oregon.

Materials and Methods

Onions were grown in 2012 on an Owyhee silt loam with a pH of 7.7 and 1.7 percent organic matter, previously planted to wheat. In the fall of 2011, the wheat stubble was shredded and the field was irrigated. The field was then disked, moldboard plowed, and groundhogged. Based on a soil analysis, 100 lb of phosphorus/acre, 200 lbs of sulfur/acre, 1,000 lbs of gypsum/acre, and 1 lb of boron/acre were broadcast before plowing. On September 25, the field was fumigated with Vapam[®] at 15 gal/acre and bedded at 22 inches.

Transplants of six onion varieties were grown in a heated greenhouse (65°F day, 45°F night air temperatures) at Ontario, Oregon. Onion seed was planted in the greenhouse in flats with a vacuum seeder at 72 seeds/flat on January 27, 2012. The seed was sown on a 1-inch layer of Sunshine general purpose potting mix. The seed was then covered with 1 inch of potting mix. The flats were watered immediately after planting and were kept moist. Onion seedlings began emerging on February 6. Transplants were grown without supplemental light.

The field had drip tape laid at 4-inch depth between 2 onion beds before planting. The drip tape had emitters spaced 12 inches apart and emitter flow rate of 0.22 gal/min/100 ft (Toro Aqua-Traxx, Toro Co., El Cajon, CA). The distance between the tape and the center of each double row of onions was 11 inches.

The seedlings were transplanted on March 23. The seedlings were planted in 2 rows spaced 3 inches apart on the 22-inch beds. The spacing between plants in each row was 6 inches (every 3 inches in the double row), equivalent to 95,000 plants/acre. Plots of each variety were 20 ft long by 4 double rows wide arranged in a randomized complete block design with 5 replicates.

An observation trial of onion bulbs grown from sets with one plot of each of 7 varieties was planted on March 23. The sets were grown in a farm near Ontario, Oregon. The sets of each

variety were planted manually in double rows spaced 3 inches apart on 22-inch beds. The sets were approximately 0.4 to 0.7 inches in diameter and were planted in double rows at 2 sets/ft of single row (6-inch spacing between individual onion plants or 95,000 plants/acre). Plots of each variety were 20 ft long by 4 double rows wide.

The onions were managed to avoid yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. Poast[®] at 2 pt/acre was broadcast on April 3. Prowl[®] H₂O at 2 pt/acre was broadcast for weed control on April 25. Root tissue samples were taken on June 18, July 2, and July 18. Based on the tissue analyses, a total of 135 lb nitrogen/acre, 5 lb magnesium/acre, 5 lb calcium/acre, and 0.6 lb boron/acre were applied during the season. The nutrients were injected through the drip tape.

The field was irrigated as necessary to maintain soil water tension at 20 cb at 8-inch depth. Soil water tension was monitored by six granular matrix sensors (Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA). The field was irrigated until the last harvest on August 6.

On July 19, bolted onions in each plot were counted. On July 23, July 30, and August 6, 6.7 ft of the middle 2 rows in each plot were topped and bagged. Decomposing bulbs were not bagged. At each harvest, the onions in each plot were visually rated for the percentage of tops that were down and the percent leaf dryness. Following each harvest the onions were graded. Bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), bulbs infected with neck rot (*Botrytis allii*) in the neck or side, plate rot (*Fusarium oxysporum*), or black mold (*Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading.

Onion bulbs from all harvests were rated for single centers. Twenty-five onions ranging in diameter from 3½ to 4¼ inches from each plot were rated. The onions were cut equatorially through the bulb middle and separated into single-centered and multiple-centered bulbs. The multiple-centered bulbs had the the long axis of the inside diameter of the first single ring measured. These multiple-centered onions were ranked according to the diameter of the first single ring: small had diameters under 1½ inch, medium had diameters from 1½ to 2¼ inches, and large had diameters over 2¼ inches. Onions were considered “functionally single centered” for processing if they were single centered or had a small multiple center.

After grading, a sample of approximately 100 No. 1 jumbo bulbs of each early harvest variety was placed in crates and stored in a shed at ambient temperature for 2 weeks. After 2 weeks the samples were evaluated for the number of sprouted or decomposed bulbs.

Variety differences were compared using repeated measures analysis of variance. Means separation was determined using Fisher’s least significant difference test at the 5 percent probability level, LSD (0.05).

Results and Discussion

Transplants

July 23 Harvest

Marketable yield on July 23 averaged 772 cwt/acre and ranged from 676 cwt/acre for ‘Crocket’ to 815 cwt/acre for 7408. ‘Pulsar’ 7408, and ‘Hendrix’ were among the varieties with the highest marketable yield (Table 1). All varieties had more than 95 percent functionally single-centered bulbs (Table 2). All varieties had more than 10 percent tops down at harvest, except Crocket and ‘Gunnison’ (Table 3). Gunnison had the highest percentage of bolted bulbs (30.9 %), followed by Crocket (17.6 %) and others having significantly less bolting. The lines 7408, Hendrix, and 7406 had the least bolting at 0.8, 0.9, and 2.3 percent, respectively. All varieties had fewer than 10 percent sprouted or decomposed bulbs 2 weeks after harvest (Table 3).

July 30 Harvest

Marketable yield on July 30 averaged 844 cwt/acre and ranged from 787 cwt/acre for Crocket to 880 cwt/acre for 7406. Varieties 7406 and 7408 were among those with the highest marketable yield (Table 1). All varieties had more than 90 percent functionally single-centered bulbs (Table 2). All varieties had more than 70 percent tops down except Crocket (12%), and Gunnison (30.9%) (Table 3). All varieties had fewer than 10 percent sprouted or decomposed bulbs 2 weeks after harvest (Table 3).

August 6 Harvest

Yield of all varieties increased up to the last harvest. Marketable yield on August 6 averaged 963 cwt/acre and ranged from 933 cwt/acre for Gunnison to 1,000 cwt/acre for Pulsar. Crocket had the highest supercolossal yield (Table 1). All varieties had more than 90 percent functionally single-centered bulbs (Table 2). All varieties had fewer than 10 percent sprouted or decomposed bulbs 2 weeks after harvest (Table 3).

Overall

Onion yields varied over time between varieties ($p = 0.10$) suggesting that the rates of development and maturity differed between varieties. All of the varieties had less than 80 percent bullet single-centered bulbs on all harvest dates. However, all of the varieties had more than 80 percent functionally single-centered bulbs on all harvest dates. All of the varieties showed a decrease in the percentage of single-centered bulbs with the successive harvests.

Sets

The plots planted to sets were not replicated so none of the differences observed could be tested for statistical significance. NH 7202/03 had high marketable yield on August 6 (Table 4). For all varieties, total and marketable yield did not increase or increased only slightly from the second (July 30) to the third harvest (August 6, Table 4). By the second harvest (July 30), all varieties had 40 percent or more tops down and 30 percent or more leaf dryness. Bolting was less than 3 percent for all varieties except 'Talon' (Table 5), at 14.7 percent bolting. All varieties had fewer than 10 percent sprouted or decomposed bulbs 2 weeks after harvest (Table 5).

Table 1. Yield and grade at three harvest dates for six onion varieties grown from transplants, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Company	Variety	Total yield	Marketable yield by grade						Small	Doubles	Bulb counts >4¼ in #/50 lb
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in				
July 23 harvest											
Bejo	Crocket	681.0	676.0	0.0	97.6	559.4	19.0	5.0			
	Gunnison	765.0	764.9	0.0	179.2	573.9	11.8	0.1			
Nunhems	7406	792.6	789.9	7.3	155.3	623.1	4.2	2.7		24.5	
	7408	814.9	814.9	0.0	181.3	630.9	2.7	0.0			
	Hendrix	776.4	776.3	0.0	145.1	629.8	1.4	0.0			
	Pulsar	808.5	808.2	0.0	162.5	645.1	0.6	0.3			
	Average	773.1	771.7	1.2	153.5	610.4	6.6	1.4		24.5	
July 30 harvest											
Bejo	Crocket	791.1	787.2	4.8	165.1	605.2	12.0	4.6		36.8	
	Gunnison	831.0	828.2	0.0	235.9	583.7	8.6	2.8			
Nunhems	7406	882.6	880.1	0.0	252.3	614.4	13.4	2.5			
	7408	878.5	875.8	4.8	225.5	640.6	4.8	2.7		36.8	
	Hendrix	844.3	841.1	0.0	167.2	662.0	11.9	3.1			
	Pulsar	853.7	853.0	0.0	247.4	603.7	1.9	0.8			
	Average	846.9	844.2	1.6	215.6	618.3	8.8	2.7		36.8	
August 6 harvest											
Bejo	Crocket	970.6	966.0	83.5	450.3	422.5	9.8	4.6	2.6	34.8	
	Gunnison	936.9	932.7	34.7	376.2	515.7	6.1	4.1	0.0	30.9	
Nunhems	7406	978.7	976.6	16.9	443.7	509.5	6.5	2.1	0.0	31.9	
	7408	967.5	963.2	21.5	411.3	527.3	3.1	4.3	0.0	34.9	
	Hendrix	940.9	937.4	17.6	314.9	595.3	9.6	3.5	0.0	31.4	
	Pulsar	1003.5	999.7	29.9	515.5	440.2	14.1	3.8	0.0	32.8	
	Average	966.3	962.6	34.0	418.6	501.8	8.2	3.7	0.4	32.8	
Average over harvest dates											
Bejo	Crocket	814.2	809.7	29.5	237.6	529.0	13.6	4.7	1.8	35.1	
	Gunnison	844.3	842.0	11.6	263.7	557.8	8.9	2.3	0.0	30.9	
Nunhems	7406	884.7	882.2	8.1	283.8	582.3	8.1	2.5	0.0	29.5	
	7408	887.0	884.7	8.8	272.7	599.6	3.6	2.3	0.0	35.5	
	Hendrix	853.8	851.6	5.9	209.1	629.0	7.6	2.2	0.0	31.4	
	Pulsar	888.6	886.9	10.0	308.4	563.0	5.5	1.6	0.0	32.8	
	LSD (0.05) Variety	NS	NS	13.6*	NS	62.1	5.7	NS	NS	NS	NS
LSD (0.05) Date	23.3	23.5	9.9	38.8	33.0	NS	NS	NS	NS	NS	
LSD (0.05) Variety X Date	47.6*	48.0*	24.2	NS	NS	9.1	NS	NS	NS	NS	

*LSD (0.10)

Table 2. Bulb single and multiple centers for three harvest dates for six onion varieties grown from transplants, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Company	Variety	Multiple center			Single center	
		Large	Medium	Small	Functional ^a	Single
		----- % -----				
July 23						
Bejo	Crocket	0.0	0.8	28.0	99.2	71.2
	Gunnison	0.8	0.8	43.2	98.4	55.2
Nunhems	7406	0.8	0.8	48.8	98.4	49.6
	7408	0.8	2.4	41.6	96.8	55.2
	Hendrix	0.0	4.0	48.8	96.0	47.2
	Pulsar	0.0	0.0	32.8	100.0	67.2
Average		0.4	1.8	43.0	97.8	54.8
July 30						
Bejo	Crocket	0.8	0.0	36.0	99.2	63.2
	Gunnison	1.6	3.2	47.2	95.2	48.0
Nunhems	7406	0.0	3.2	67.2	96.8	29.6
	7408	0.8	4.8	52.8	94.4	41.6
	Hendrix	0.8	7.1	48.4	92.1	43.7
	Pulsar	0.8	1.6	52.8	97.6	44.8
Average		0.8	3.3	50.7	95.9	45.2
August 6						
Bejo	Crocket	0.0	2.4	40.8	97.6	56.8
	Gunnison	0.0	2.4	64.2	97.6	33.4
Nunhems	7406	0.8	7.2	64.0	92.0	28.0
	7408	0.0	4.1	63.3	95.9	32.7
	Hendrix	1.6	10.4	46.0	88.0	42.0
	Pulsar	0.8	3.9	58.1	95.3	37.2
Average		0.5	5.1	56.1	94.4	38.3
Average over dates						
Bejo	Crocket	0.3	1.1	34.9	98.7	63.7
	Gunnison	0.8	2.1	51.5	97.1	45.5
Nunhems	7406	0.5	3.7	60.0	95.7	35.7
	7408	0.5	3.8	52.6	95.7	43.2
	Hendrix	0.8	7.2	47.7	92.0	44.3
	Pulsar	0.5	1.8	47.9	97.6	49.7
LSD (0.05) Variety		NS	2.3	9.6	2.9	10.2
LSD (0.05) Date		NS	NS	7.2	NS	7.0
LSD (0.05) Variety X Date		NS	NS	NS	NS	NS

^a single center plus small multiple center.

Table 3. Bolting and maturity at harvest, and bulb quality 2 weeks after harvest for six onion varieties grown from transplants harvested on three dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Company	Variety	Maturity at harvest			Bulb quality 2 weeks after harvest			
		Bolting	Tops down	Leaf dryness	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
----- % -----								
July 23								
Bejo	Crocket	17.6	0.0	0.0	2.5	0.8	0.0	3.4
	Gunnison	30.9	4.0	10.0	0.0	0.0	0.0	0.0
Nunhems	7406	2.3	26.0	14.0	0.0	0.0	0.0	0.0
	7408	0.8	78.0	14.0	0.0	0.7	0.0	0.7
	Hendrix	0.9	58.0	10.0	0.0	0.0	0.0	0.0
	Pulsar	5.1	64.0	8.0	0.0	0.0	0.0	0.0
Average		9.6	38.3	9.3	0.4	0.3	0.0	0.7
July 30								
Bejo	Crocket		12.0	10.0	0.8	4.0	0.0	4.8
	Gunnison		30.0	16.0	0.0	0.0	0.0	0.0
Nunhems	7406		78.0	28.0	0.0	0.0	0.0	0.0
	7408		90.0	26.0	0.7	0.0	0.0	0.7
	Hendrix		88.0	30.0	0.0	0.0	0.0	0.0
	Pulsar		88.0	20.0	0.0	0.0	0.0	0.0
Average			64.3	21.7	0.3	0.7	0.0	0.9
August 6								
Bejo	Crocket		24.0	18.0	0.0	6.0	0.0	6.0
	Gunnison		46.0	36.0	0.0	3.5	0.0	3.5
Nunhems	7406		92.0	50.0	0.0	0.5	0.0	0.5
	7408		98.0	42.0	0.0	0.0	0.0	0.0
	Hendrix		100.0	48.0	0.0	0.6	0.0	0.6
	Pulsar		92.0	38.0	0.0	1.2	0.0	1.2
Average			75.3	38.7	0.0	2.0	0.0	2.0
Average over dates								
Bejo	Crocket		12.0	9.3	1.1	3.6	0.0	4.7
	Gunnison		26.7	20.7	0.0	1.2	0.0	1.2
Nunhems	7406		65.3	30.7	0.0	0.2	0.0	0.2
	7408		88.7	27.3	0.2	0.2	0.0	0.5
	Hendrix		82.0	29.3	0.0	0.2	0.0	0.2
	Pulsar		81.3	22.0	0.0	0.4	0.0	0.4
LSD (0.05) Variety		2.5	7.6	3.1	na	na	na	na
LSD (0.05) Date			4.0	1.8	na	na	na	na
LSD (0.05) Var. X Date			9.8	6.3	na	na	na	na

Table 4. Yield and grade at three harvest dates for seven onion varieties grown from sets, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Company	Variety	Total yield	Marketable yield by grade					Small	Bulb counts >4¼ in #/50 lb
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in		
----- cwt/acre -----									
July 23									
Nunhems	Arcero	405.9	402.0	0.0	0.0	321.1	80.9	3.9	
	Sabroso	398.6	377.1	0.0	0.0	254.5	122.6	21.4	
	Pulsar	562.6	562.4	0.0	0.0	519.3	43.1	0.2	
	NH 7202/03	447.3	438.0	0.0	0.0	421.3	16.8	9.3	
	NH7203/02	459.9	455.3	0.0	0.0	356.6	98.7	4.6	
	Gunnison	405.6	342.5	0.0	0.0	273.0	69.5	46.0	
Bejo	Talon	408.8	377.4	0.0	10.0	267.3	100.2	5.3	
Average		441.3	422.1	0.0	1.4	344.7	76.0	13.0	
July 30									
Nunhems	Arcero	509.3	416.6	0.0	20.0	367.5	29.2	18.5	
	Sabroso	527.8	513.9	0.0	0.0	435.5	78.4	13.9	
	Pulsar	598.8	573.5	0.0	59.5	468.7	45.3	16.0	
	NH 7202/03	629.8	599.5	0.0	149.3	425.9	24.2	10.0	
	NH7203/02	596.3	571.7	0.0	0.0	500.0	71.6	24.6	
	Gunnison	546.4	489.7	0.0	44.6	348.6	96.6	22.1	
Bejo	Talon	428.8	377.8	0.0	0.0	300.8	77.0	18.2	
Average		548.2	506.1	0.0	39.1	406.7	60.3	17.6	
August 6									
Nunhems	Arcero	496.8	296.5	0.0	0.0	261.7	34.8	7.4	
	Sabroso	450.2	420.9	0.0	0.0	342.7	78.2	23.1	
	Pulsar	546.7	388.8	0.0	13.9	342.5	32.4	10.0	
	NH 7202/03	670.8	665.1	0.0	173.0	444.8	47.3	5.6	
	NH7203/02	541.0	448.3	0.0	85.5	308.3	54.5	25.3	
	Gunnison	608.2	564.3	31.0	74.3	345.5	113.4	23.6	29.8
Bejo	Talon	452.0	414.5	0.0	0.0	341.6	72.9	37.5	
Average		537.9	456.9	4.4	49.5	341.0	61.9	18.9	29.8
Average over dates									
Nunhems	Arcero	470.7	371.7	0.0	6.7	316.8	48.3	10.0	
	Sabroso	458.9	437.3	0.0	0.0	344.2	93.1	19.5	
	Pulsar	569.3	508.2	0.0	24.5	443.5	40.3	8.7	
	NH 7202/03	582.6	567.5	0.0	107.5	430.7	29.4	8.3	
	NH7203/02	532.4	491.8	0.0	28.5	388.3	75.0	18.2	
	Gunnison	520.1	465.5	10.3	39.6	322.4	93.2	30.6	
Bejo	Talon	429.8	389.9	0.0	3.3	303.2	83.3	20.3	

Table 5. Bolting and maturity at harvest, and bulb quality 2 weeks after harvest for seven onion varieties grown from sets harvested on three dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Company	Variety	Maturity		Bulb quality 2 weeks after harvest				
		Bolting	Tops down	Leaf dryness	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
----- % -----								
July 23								
Nunhems	Arcero	2.2	30	10	0.0	0.0	0.0	0.0
	Sabroso	1.6	10	20	0.0	0.0	0.0	0.0
	Pulsar	1.6	20	10	0.0	0.5	0.0	0.5
	NH 7202/03	0.9	60	20	0.0	0.0	0.0	0.0
	NH7203/02	0.3	80	20	0.0	0.5	0.0	0.5
	Gunnison	0.6	80	30	0.0	0.0	0.0	0.0
Bejo	Talon	14.7	90	30	0.0	0.4	0.0	0.4
Average		3.1	52.9	20.0	0.0	0.2	0.0	0.2
July 30								
Nunhems	Arcero		50	50	1.1	0.7	0.0	1.8
	Sabroso		50	40	1.0	1.0	0.0	1.9
	Pulsar		40	30	1.8	1.8	0.0	3.5
	NH 7202/03		80	30	0.5	2.7	0.0	3.2
	NH7203/02		90	40	1.1	2.1	0.0	3.2
	Gunnison		90	50	0.0	1.3	0.0	1.3
Bejo	Talon		90	50	0.0	0.7	0.0	0.7
Average			70.0	41.4	0.8	1.5	0.0	2.2
August 6								
Nunhems	Arcero		80	50	0.0	0.4	0.0	0.4
	Sabroso		100	50	0.0	0.4	0.0	0.4
	Pulsar		70	40	0.0	1.6	0.0	1.6
	NH 7202/03		90	40	0.0	0.4	0.0	0.4
	NH7203/02		100	70	0.0	0.4	0.0	0.4
	Gunnison		100	60	0.0	0.5	0.5	0.9
Bejo	Talon		100	60	0.0	0.3	0.0	0.3
Average			91.4	52.9	0.0	0.6	0.1	0.6
Average over dates								
Nunhems	Arcero		53.3	36.7	0.4	0.4	0.0	0.7
	Sabroso		53.3	36.7	0.3	0.5	0.0	0.8
	Pulsar		43.3	26.7	0.6	1.3	0.0	1.9
	NH 7202/03		76.7	30.0	0.2	1.0	0.0	1.2
	NH7203/02		90.0	43.3	0.4	1.0	0.0	1.3
	Gunnison		90.0	46.7	0.0	0.6	0.2	0.7
Bejo	Talon		93.3	46.7	0.0	0.5	0.0	0.5