

# ONION PRODUCTION FROM TRANSPLANTS

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## Introduction

Interest in an earlier start for onion harvest and marketing has led to interest in transplanting onions. Previous Treasure Valley research showed that when onions are grown from transplants they can be harvested starting in July (Shock et al. 2004, 2007-2014). This trial evaluated five onion varieties in a replicated trial and six varieties for preliminary results in 2015. Ten of the varieties were grown from transplants produced in a greenhouse at the Malheur Experiment Station, in Ontario, Oregon and one variety was produced from transplants grown in Arizona.

## Materials and Methods

Onions were grown in 2015 on a Greenleaf silt loam previously planted to wheat. In the fall of 2014, the wheat stubble was shredded and the field was irrigated. The field was then disked, moldboard plowed, and groundhogged. A soil analysis taken in the fall of 2014 showed a pH of 7.4, 1.92% organic matter, 15 ppm nitrate, 5 ppm ammonium, 44 ppm phosphorus (P), 270 ppm potassium (K), 23 ppm sulfur (S), 3880 ppm calcium (Ca), 203 ppm magnesium (Mg), 128 ppm sodium, 3.0 ppm zinc, 5 ppm manganese (Mn), 1.5 ppm copper, 11 ppm iron, and 0.6 ppm boron (B). Based on the soil analysis, 75 lb of P/acre, 200 lb of K/acre, 230 lbs of S/acre, 20 lb Mg/acre, 7 lb of Mn/acre, and 1 lb of B/acre were broadcast before plowing. After plowing, the field was fumigated with K-pam<sup>®</sup> at 15 gal/acre and bedded at 22 inches.

Transplants were grown in a heated greenhouse (65°F day, 45°F night air temperatures) at the Malheur Experiment Station. Onion seed was planted in the greenhouse on January 20, 2015 in flats with a vacuum seeder at 72 seeds/flat. Varieties ‘Avalon’, ‘Scout’, (Crookham Seed Co., Caldwell, ID), SV2102NG, and SV9131NG (Seminis Seed Co., Payette, ID) each had 28 flats planted for the replicated trial. Varieties ‘Scimitar’, ‘Avenger’, ‘Vanguard’, ‘Salute’ (Crookham Seed Co.), 16000, and SV0106NG (Seminis Seed Co.) each had 6 flats planted for non-replicated observation plots. 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 trays were watered immediately after planting and were kept moist. Onion seedlings began emerging on February 2. Transplants were grown without supplemental light. Bare-rooted transplants of ‘Montero’ (Nunhems, Parma, ID) were grown in Arizona during the winter of 2014-2015.

The field had drip tape laid at 4-inch depth between pairs of onion beds before planting. The drip tape had emitters spaced 12 inches apart and an emitter flow rate of 0.22 gal/min/100 ft (T-Tape, Rivulis USA, San Diego, CA). The distance between the tape and the center of each double row of onions was 11 inches.

The onions were transplanted on March 26 and 27. The onions were planted on 4 22-inch beds in double rows 3 inches apart. The spacing between plants in each row was 4.8 inches, equivalent to 120,000 plants/acre. Plots of each variety were 20 ft long by 4 double rows wide. The experimental design for varieties Scout, Avalon, SV2102NG, SV9131NG, and Montero was a randomized complete block with five replicates. Varieties 16000, SV0106NG, Scimitar, Avenger, Vanguard, and Salute were planted in preliminary observation plots without replication.

The onion crop was managed to avoid yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. Prowl<sup>®</sup> H<sub>2</sub>O at 2 pt/acre and Poast<sup>®</sup> at 24 oz/acre were broadcast for weed control on April 23. On April 28, Goal<sup>®</sup> at 4 oz/acre, Buctril<sup>®</sup> at 16 oz/acre, and Poast at 16 oz/acre were broadcast for weed control. Thrips were controlled using the following insecticides: Movento<sup>®</sup> at 5 oz/acre on May 1, Movento at 5 oz/acre and Aza-Direct<sup>®</sup> at 2 pt/acre on May 13, Agri-Mek<sup>®</sup> SC at 3.5 oz/acre on May 28 and June 18, Radiant<sup>®</sup> at 10 oz/acre on July 4 and Lannate<sup>®</sup> at 3 pt/acre on July 15. A total of 100 lbs nitrogen (N)/acre was applied in 20-lb increments during the season as urea ammonium nitrate solution (URAN) injected through the drip tape.

Onions were irrigated automatically to maintain the soil water tension (SWT) in the onion root zone below 20 cb (Shock et al. 2000). Soil water tension was measured with eight granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co., Riverside, CA) installed at 8-inch depth in the center of the double row. Sensors had been calibrated to SWT (Shock et al. 1998). The GMS were connected to the datalogger via multiplexers (AM 16/32 multiplexer, Campbell Scientific, Logan, UT). The datalogger (CR1000, Campbell Scientific) read the sensors and recorded the SWT every hour. The datalogger automatically made irrigation decisions every 12 hours. The field was irrigated if the average SWT of the eight sensors was 20 cb or higher. The irrigations were controlled by the datalogger using a controller (SDM CD16AC controller, Campbell Scientific, Logan, UT) connected to a solenoid valve. Irrigation durations were 8 hours, 19 min to apply 0.48 inch of water. The water supply was well water maintained at a constant water pressure of 35 psi. The pressure in the drip lines was maintained at 10 psi by a pressure regulating valve. The automated irrigation system was started on May 19. Irrigations were terminated on July 28.

Bolted onions were counted in each plot on July 13. On July 14, 21, and 28, bulbs from 6 ft of the middle 2 double rows in each plot were topped and bagged. Decomposing bulbs were not bagged. At each harvest, onions in each plot were rated visually for the percentage of tops that were down and the percent dry leaves. 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 calculated for each plot of every variety by weighing and counting all supercolossal bulbs during grading.

After grading the onions were placed in burlap bags 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.

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 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 multiple-centered onions had diameters under 1½ inch, medium multiple-centered onions had diameters from 1½ to 2¼ inches, and large multiple-centered onions had diameters over 2¼ inches. Onions were considered “functionally single centered” for processing if they were single centered or had a small multiple center.

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

## Results and Discussion

### July 14 Harvest

Marketable yield on July 14 averaged 964 cwt/acre and ranged from 730 cwt/acre for Montero to 1122 cwt/acre for SV2102NG (Table 1). The percentage of functionally single-centered bulbs averaged 99.4% and ranged from 96.8% for SV2102NG to 100% for Scout, Avalon, SV9131NG, and Montero (Table 2). The percentage of tops down at harvest averaged 44% and ranged from 18% for Scout and Montero to 82% for SV2102NG (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 4.2% and ranged from 1.4% for Scout to 7.3% for Montero. Bolting averaged 1.4% and ranged from 0% for SV9131NG to 4.1% for Avalon (Table 1).

### July 21 Harvest

Marketable yield on July 21 averaged 1027 cwt/acre and ranged from 847 cwt/acre for Montero to 1168 cwt/acre for SV2102NG (Table 1). The percentage of functionally single-centered bulbs averaged 98.4% and ranged from 92.8% for SV2102NG to 100% for Scout, Avalon, and Montero (Table 2). The percentage of tops down at harvest averaged 63% and ranged from 52% for Avalon to 84% for SV2102NG (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 2.4% and ranged from 1.2% for SV2102NG to 4.3% for Avalon.

### July 28 Harvest

Marketable yield on July 28 averaged 1222 cwt/acre and ranged from 898 cwt/acre for Montero to 1443 cwt/acre for Avalon (Table 1). The percentage of functionally single-centered bulbs averaged 94.8% and ranged from 81.6% for SV2102NG to 100% for Montero and Avalon (Table 2). The percentage of tops down at harvest averaged 72% and ranged from 60% for Scout to 80% for SV2102NG and Montero (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 3% and ranged from 1.7% for Montero to 5.9% for SV2102NG.

### Overall

In 2015, the accumulated number of growing degree-days was substantially higher than average (Fig. 1). For comparison, varieties Avalon and Montero, which were in the transplant trial in 2014 and 2015, were substantially ahead in the percentage of tops down in 2015 compared to 2014 (Table 4, Shock et al. 2014). However, the percentage of dry leaves for the first two harvest dates in 2015 was behind the percentage of dry leaves in 2014. All varieties had yield

increases until the last harvest. Marketable yield for Avalon for the first two harvest dates was lower in 2015 than in 2014. Marketable yield for Montero on all harvest dates was lower in 2015 than 2014.

Performance of onions in the preliminary trial with unreplicated varieties can be found in Tables 5-7.

## Acknowledgements

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Table 1. Bulb yield and grade for five onion varieties grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Total yield	Marketable yield by grade						Total rot %	Bulb counts	
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small		>4¼ in #/50 lb	Bolters* %
----- cwt/acre -----											
July 14 harvest											
Crookham	Scout	943.2	943.2	11.7	309.2	611.9	10.3	0.0	0.0	32.2	2.7
	Avalon	1058.2	1048.7	70.7	371.2	597.4	9.3	1.2	1.0	31.6	4.1
Seminis	SV2102NG	1121.5	1121.5	50.6	506.3	545.7	19.0	0.0	0.0	31.9	0.1
	SV9131NG	967.3	937.1	26.0	303.0	587.1	21.1	1.5	3.5	28.3	0.0
Nunhems	Montero	730.1	720.8	6.1	194.9	495.4	24.4	6.5	0.6	29.8	0.1
	Average	964.1	954.3	33.0	336.9	567.5	16.8	1.8	1.0	30.8	1.4
July 21 harvest											
Crookham	Scout	1072.7	1061.8	36.9	503.3	515.0	6.6	5.0	0.5	32.2	
	Avalon	1124.4	1117.9	83.9	581.2	433.6	19.3	3.0	0.4	33.9	
Seminis	SV2102NG	1167.9	1166.0	50.3	460.0	643.7	12.0	1.9	0.0	32.6	
	SV9131NG	922.7	881.1	90.0	349.2	415.2	26.8	4.3	3.8	33.9	
Nunhems	Montero	846.8	841.0	7.2	279.4	535.0	19.4	5.7	0.0	28.7	
	Average	1026.9	1013.6	53.7	434.6	508.5	16.8	4.0	0.9	36.2	
July 28 harvest											
Crookham	Scout	1312.6	1304.7	340.8	630.3	329.6	4.0	3.6	0.3	29.0	
	Avalon	1443.4	1439.6	462.9	670.9	298.9	6.8	1.2	0.2	29.9	
Seminis	SV2102NG	1288.2	1281.7	175.0	597.3	498.8	10.7	1.1	0.4	29.3	
	SV9131NG	1169.1	1137.0	177.0	441.2	505.6	13.1	5.3	2.3	28.7	
Nunhems	Montero	897.6	892.2	94.2	378.0	407.4	12.6	5.4	0.0	29.6	
	Average	1222.2	1211.0	250.0	543.5	408.1	9.4	3.3	0.6	29.3	
Average over harvest dates											
Crookham	Scout	1109.5	1103.2	129.8	480.9	485.5	7.0	2.9	0.3	31.0	
	Avalon	1208.6	1202.1	205.8	541.1	443.3	11.8	1.8	0.5	31.8	
Seminis	SV2102NG	1192.6	1189.8	92.0	521.2	562.7	13.9	1.0	0.1	31.2	
	SV9131NG	1019.7	985.1	97.7	364.5	502.6	20.3	3.7	3.2	30.6	
Nunhems	Montero	824.8	818.0	35.8	284.1	479.3	18.8	5.9	0.2	29.4	
LSD (0.05) Variety		115.4	119.7	45.9	94.7	NS	NS	NS	NS	NS	
LSD (0.05) Date		68.8	69.2	30.3	47.1	91.4	5.6	NS	NS	NS	
LSD (0.05) Variety X Date		NS	NS	67.7	105.3	NS	NS	NS	NS	NS	1.4

\*Bolted onions were counted in each plot on July 13.

Table 2. Single and multiple bulb centers for five onion varieties grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Multiple center			Single center	
		Large	Medium	Small	Functional <sup>a</sup>	Bullet
----- % -----						
July 14 harvest						
Crookham	Scout	0.0	0.0	5.6	100.0	94.4
	Avalon	0.0	0.0	2.4	100.0	97.6
Seminis	SV2102NG	0.8	2.4	59.2	96.8	37.6
	SV9131NG	0.0	0.0	8.0	100.0	92.0
Nunhems	Montero	0.0	0.0	2.4	100.0	97.6
	Average	0.2	0.5	15.5	99.4	83.8
July 21 harvest						
Crookham	Scout	0.0	0.0	16.8	100.0	83.2
	Avalon	0.0	0.0	14.4	100.0	85.6
Seminis	SV2102NG	0.8	6.4	58.4	92.8	34.4
	SV9131NG	0.0	0.8	25.6	99.2	73.6
Nunhems	Montero	0.0	0.0	8.8	100.0	91.2
	Average	0.2	1.4	24.8	98.4	73.6
July 28 harvest						
Crookham	Scout	5.3	0.0	30.6	94.7	64.1
	Avalon	0.0	0.0	30.4	100.0	69.6
Seminis	SV2102NG	2.4	16.0	64.8	81.6	16.8
	SV9131NG	0.8	1.6	44.8	97.6	52.8
Nunhems	Montero	0.0	0.0	12.0	100.0	88.0
	Average	1.7	3.5	36.5	94.8	58.3
Average over harvest dates						
Crookham	Scout	1.8	0.0	17.7	98.2	80.6
	Avalon	0.0	0.0	15.7	100.0	84.3
Seminis	SV2102NG	1.3	8.3	60.8	90.4	29.6
	SV9131NG	0.3	0.8	26.1	98.9	72.8
Nunhems	Montero	0.0	0.0	7.7	100.0	92.3
LSD (0.05) Variety		1.2	1.6	9.6	2.1	9.5
LSD (0.05) Date		1.0	1.8	6.5	2.0	7.0
LSD (0.05) Variety X Date		2.3	4.0	NS	4.5	NS

<sup>a</sup>Functional single centers are the small multiple centers plus the bullet single centers.

Table 3. Maturity at harvest and bulb quality 2 weeks after harvest for five onion varieties grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Maturity at harvest		Bulb quality 2 weeks after harvest			
		Tops down	Dry leaves	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
----- % -----							
July 14							
Crookham	Scout	18.0	0.0	0.0	1.4	0.0	1.4
	Avalon	36.0	0.0	1.7	3.3	2.3	7.3
Seminis	SV2102NG	82.0	0.0	0.0	1.6	0.0	1.6
	SV9131NG	66.0	0.0	1.4	1.9	0.6	4.0
Nunhems	Montero	18.0	0.0	0.0	6.8	0.0	6.8
	Average	44.0	0.0	0.6	3.0	0.6	4.2
July 21							
Crookham	Scout	46.0	10.0	0.0	1.5	0.0	1.5
	Avalon	52.0	10.0	0.0	4.3	0.0	4.3
Seminis	SV2102NG	84.0	26.0	0.0	1.2	0.0	1.2
	SV9131NG	78.0	20.0	0.0	1.3	0.0	1.3
Nunhems	Montero	54.0	20.0	0.0	3.8	0.0	3.8
	Average	62.8	17.2	0.0	2.4	0.0	2.4
July 28							
Crookham	Scout	60.0	24.0	0.5	1.6	0.0	2.1
	Avalon	68.0	20.0	0.0	2.4	0.0	2.4
Seminis	SV2102NG	80.0	30.0	0.0	5.9	0.0	5.9
	SV9131NG	74.0	24.0	0.0	2.8	0.0	2.8
Nunhems	Montero	80.0	32.0	0.0	1.7	0.0	1.7
	Average	72.4	26.0	0.1	2.9	0.0	3.0
Average over dates							
Crookham	Scout	41.3	11.3	0.2	1.5	0.0	1.6
	Avalon	52.0	10.0	0.6	3.3	0.8	4.6
Seminis	SV2102NG	82.0	18.7	0.0	2.9	0.0	2.9
	SV9131NG	72.7	14.7	0.5	2.0	0.2	2.7
Nunhems	Montero	50.7	17.3	0.0	4.1	0.0	4.1
LSD (0.05) Variety		12.5	2.3	NS	NS	NS	NS
LSD (0.05) Date		4.0	1.6	NS	NS	NS	NS
LSD (0.05) Var. X Date		9.0	3.5	NS	NS	NS	NS

\*LSD (0.10)

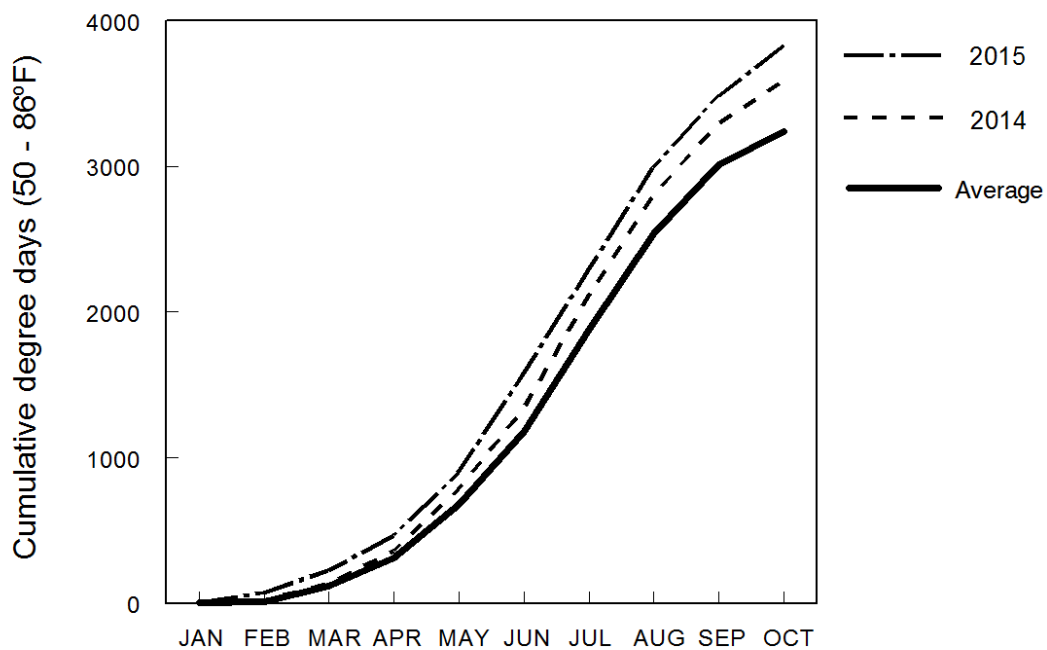


Figure 1. Cumulative growing degree-days (50 to 86°F) for 2014, 2015, and the 22-year average at the Malheur Experiment Station, Ontario, OR.

Table 4. Percentage of tops down, leaf dryness, and marketable yield at three harvest dates for onion varieties Avalon and Montero grown from transplants in 2014 and 2015.

	Year	Avalon				Montero			
		Date				Date			
		Jul 14	Jul 21	Jul 28	Aug 4	Jul 14	Jul 21	Jul 28	Aug 4
% tops down	2014	–	16	30	64	–	12	40	76
	2015	36	46	68	–	18	54	80	–
% dry leaves	2014	–	14	20	76	–	16	28	32
	2015	18	10	20	–	0	20	32	–
Marketable yield cwt/acre	2014	–	1,287	1,387	1,488	–	826	911	1,024
	2015	1,058	1,124	1,443	–	730	847	898	–



Table 5. Non-replicated bulb yield and grade for six onion varieties grown from transplants and harvested on August 5, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Total yield	Marketable yield by grade						Total rot %	Bulb counts	
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small		>4¼ in #/50 lb	Bolters %
----- cwt/acre -----											
Seminis	16000	948.6	938.3	209.7	427.3	294.4	6.9	0.0	1.1	32.0	0.0
	SV0106NG	1224.5	1223.2	466.4	542.8	208.1	5.9	1.3	0.0	27.7	0.2
Crookham	Scimitar	1199.2	1199.1	338.3	527.1	332.7	1.0	0.1	0.0	29.8	0.2
	Avenger	1066.4	1066.4	161.7	549.0	354.8	0.9	0.0	0.0	31.9	0.0
	Vanguard	1228.2	1211.2	398.7	569.8	242.1	0.6	0.9	1.3	29.8	0.0
	Salute	1154.3	1146.6	332.1	532.6	281.6	0.3	0.0	0.7	28.8	0.0
Average		1136.9	1130.8	317.8	524.7	285.6	2.6	0.4	0.5	30.0	0.1

Table 6. Non-replicated data for single and multiple bulb centers for six onion varieties grown from transplants and harvested on August 5, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Multiple center			Single center	
		Large	Medium	Small	Functional <sup>a</sup>	Single
----- % -----						
Seminis	16000	0.0	8.0	4.0	92.0	88.0
	SV0106NG	4.0	28.0	64.0	68.0	4.0
Crookham	Scimitar	8.0	12.0	28.0	80.0	52.0
	Avenger	0.0	16.0	52.0	84.0	32.0
	Vanguard	4.0	20.0	24.0	76.0	52.0
	Salute	16.0	56.0	24.0	28.0	4.0
Average		5.3	23.3	32.7	71.3	38.7

<sup>a</sup>Single center plus small multiple center.

Table 7. Non-replicated maturity at harvest and bulb quality 2 weeks after harvest for six onion varieties grown from transplants and harvested on August 5, Malheur Experiment Station, Oregon State University, Ontario, OR, 2015.

Company	Variety	Maturity at harvest		Bulb quality 2 weeks after harvest			
		Tops down	Dry leaves	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
		----- % -----					
Seminis	16000	80	20	0.0	1.7	0.0	1.7
	SV0106NG	90	30	0.0	4.7	0.0	4.7
Crookham	Scimitar	90	30	0.0	5.7	0.0	5.7
	Avenger	90	30	0.0	5.7	0.0	5.7
	Vanguard	90	30	0.6	13.9	0.6	15.0
	Salute	90	30	0.0	7.0	0.0	7.0
Average		88	28	0.1	6.4	0.1	6.6