

ONION PRODUCTION FROM TRANSPLANTS IN 2017

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Introduction

Interest in an earlier start for onion harvest and marketing has led to interest in transplanting onions. In the Treasure Valley, onions are available out of the field from mid-August through October and then out of storage from October through March. An earlier harvest would extend the time when onions are available locally, which is important for onion processors. Onion varieties suitable for processing into onion rings must be highly single centered, produce large bulbs, and store well. Previous Treasure Valley research showed that when onions are grown from transplants, they can be harvested starting in July (Shock et al. 2004, 2007-2009, and 2011-2017). This trial evaluated eight onion varieties potentially suitable for processing grown from transplants in 2017. Six varieties were grown from transplants produced in a greenhouse at the Oregon State University Malheur Experiment Station (MES), in Ontario, Oregon and two varieties were grown from transplants produced in Arizona.

Materials and Methods

Transplants were grown at MES in a heated greenhouse with minimum air temperatures during the day of 65°F and 45°F at night. Onion seed of varieties ‘Salute’ (Crookham Co., Caldwell, ID), ‘Avalon’ (Crookham Co.), ‘Avenger’ (Crookham Co.), ‘Minister’ (Seminis, Payette, ID), ‘Chancellor’ (Seminis), and 903S (New Zealand Onion) was planted in the greenhouse on January 27, 2017 in flats with a vacuum seeder at 72 seeds/flat. The seed was sown on a 1-inch layer of Sunshine general purpose potting mix. The seed was then covered with 1 inch of the potting mix. The trays were watered immediately after planting and were kept moist. Onion seedlings began emerging on February 6. Transplants were grown without supplemental light. Bare-rooted transplants of ‘Montero’ (Nunhems, Parma, ID) and SV0106NG (Seminis) were grown in Arizona during the winter of 2016-2017.

Onions were grown at MES on an Owyhee silt loam previously planted to wheat. In the fall of 2016, 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 2016 showed a pH of 8.2, 3.7% organic matter, 4 ppm nitrogen (N) as nitrate, 3 ppm N as ammonium, 15 ppm phosphorus (P), 395 ppm potassium (K), 9 ppm sulfur (S), 3774 ppm calcium, 549 ppm magnesium, 208 ppm sodium, 0.6 ppm zinc (Zn), 17 ppm manganese (Mn), 0.4 ppm copper (Cu), 47 ppm iron, and 0.5 ppm boron (B). Based on the soil analysis, 55 lb of P/acre, 200 lb of S/acre, 1 lb Cu/acre, 9 lb Zn/acre, and 1 lb of B/acre were broadcast before plowing. In addition to the fertilizer, 10 tons of composted cattle feedlot manure was broadcast before plowing. Based on an analysis of the manure, 196 lb of N/acre, 156 lb of P/acre, and 342 lb of K/acre were

added from the manure. After plowing, the field was fumigated with Vapam[®] at 15 gal/acre and bedded at 22 inches.

Drip tape was 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 (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.

Varieties Salute, Avalon, Avenger, Minister, Chancellor and 903S were transplanted on April 5. Variety Montero was transplanted on April 17 and variety SV0106NG was transplanted on April 18. The onions were transplanted on four 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 was a randomized complete block with five replicates.

The onion crop was managed to avoid yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. Prowl[®] H₂O at 2 pt/acre and Poast[®] at 2 pt/acre were broadcast for weed control on April 25. Thrips were controlled by ground application using the following insecticides: Aza-Direct[®] at 12 oz/acre and Movento[®] at 5 oz/acre on May 11 and 23, Radiant[®] at 10 oz/acre on June 2. Thrips were controlled by aerial application using the following insecticides: Radiant at 10 oz/acre on July 1, 8, and 30, and Lannate[®] at 3 pt/acre on July 17 and 23.

A total of 90 lb N/acre was applied in 20-lb increments during the season as urea ammonium nitrate solution (URAN) injected through the drip tape. Five pounds of P/acre, 11 lb of K/acre, and 0.5 lb of Mn/acre were applied on May 23 through the drip tape based on root tissue and soil solution analyses.

Onions were irrigated automatically to maintain the soil water tension (SWT) in the onion root zone below 20 cb (Fig. 1, Shock et al. 2000). Soil water tension was measured with eight granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co. Inc., 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, 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, Campbell Scientific) 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 April 19 and terminated on August 3.

Bolted onions were counted in each plot on July 27. On July 20, 27, and August 3, bulbs from 6 ft of the middle 2 double rows in each plot were topped and bagged. Variety Avenger started maturing earlier than the other varieties and harvest began 1 week earlier. 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, a sample of approximately 100 No. 1 jumbo bulbs of each 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.

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 13 Harvest - Avenger

Marketable yield on July 13 for variety Avenger averaged 1076 cwt/acre (Table 1). The percentage of functionally single-centered bulbs averaged 86.4% (Table 2). The percentage of tops down at harvest averaged 99% and bulb decomposition or sprouting after 2 weeks of storage averaged 2% (Table 3).

July 20 Harvest

Marketable yield on July 20 averaged 975 cwt/acre and ranged from 537 cwt/acre for 903S to 1172 cwt/acre for Minister (Table 1). The percentage of functionally single-centered bulbs averaged 73.5% and ranged from 46% for 903S to 98.4% for Avalon (Table 2). The percentage of tops down at harvest averaged 57% and ranged from 22% for Montero to 100% for Avenger (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 5% and ranged from 1.3% for 903S to 7.5% for Chancellor. Bolting averaged 1% and ranged from 0% for Avenger and Minister to 4.3% for Avalon (Table 1).

July 27 Harvest

Marketable yield on July 27 averaged 1090 cwt/acre and ranged from 615 cwt/acre for 903S to 1314 cwt/acre for Minister (Table 1). The percentage of functionally single-centered bulbs averaged 70.9% and ranged from 44% for 903S to 94% for Avalon (Table 2). The percentage of tops down at harvest averaged 79% and ranged from 64% for Salute to 100% for Avenger (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 3% and ranged from 0.3% for 903S to 15% for Avalon.

August 3 Harvest

Marketable yield on August 3 averaged 1161 cwt/acre and ranged from 593 cwt/acre for 903S to 1385 cwt/acre for Minister (Table 1). The percentage of functionally single-centered bulbs averaged 61% and ranged from 35% for SV0106NG to 93% for Avalon (Table 2). The percentage of tops down at harvest averaged 85% and ranged from 74% for Chancellor to 98% for Minister (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 1.1% and ranged from 0% for Minister and 903S to 3% for Salute.

Overall

In 2017, the accumulated number of growing degree-days was higher than the 24-year average, but was the lowest of the years 2014-2017 (Table 4). For comparison, performance data for varieties Avalon and Montero, which were in the transplant trials in 2014-2017 is presented in Table 5.

Acknowledgements

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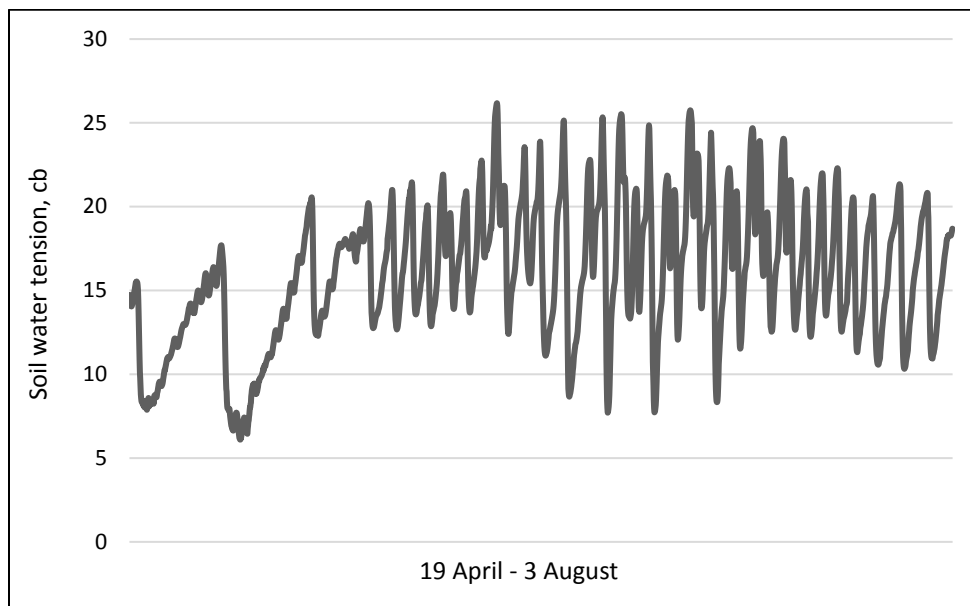


Figure 1. Soil water tension at 8-inch depth. Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Table 1. Bulb yield and grade for seven yellow onion varieties and one red variety (903S) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017. Continued on next page.

Company	Variety	Total yield	Marketable yield by grade							Total rot	Plate rot %	Slime rot	Bulb counts >4¼ in #/50 lb
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	Doubles				
			----- cwt/acre -----							----- % -----			
July 13 harvest													
Crookham	Avenger ^a	1079	1076	73.3	357.0	626.9	18.6	3.3	0.0	0.0	0.0	0.0	30.0
July 20 harvest													
Crookham	Avenger	1150	1139	87.1	464.2	579.0	8.2	1.9	0.0	0.9	0.0	0.9	33.3
	Salute	1130	1128	151.0	498.8	468.3	10.2	0.3	0.0	0.2	0.0	0.2	31.3
	Avalon	928	919	40.7	282.2	580.6	15.2	5.3	0.0	0.4	0.0	0.4	34.1
Nunhems	Montero	778	768	0.0	69.9	656.1	41.7	10.3	0.0	0.0	0.0	0.0	
Seminis	Minister (2102)	1172	1163	128.9	565.0	465.1	4.3	1.6	0.0	0.6	0.0	0.6	34.1
	Chancellor (9131)	953	949	25.2	276.8	637.6	9.2	0.6	1.7	0.2	0.0	0.2	34.6
	SV0106NG	1151	1148	84.6	454.4	594.6	13.9	2.5	1.0	0.0	0.0	0.0	33.9
N. Zealand Onion	903S	537	516	0.0	5.1	367.4	143.1	21.6	0.0	0.0	0.0	0.0	
	Average	950	941	61.5	307.5	538.5	33.9	6.0	0.4	0.2	0.0	0.2	33.6
July 27 harvest													
Crookham	Avenger	1233	1202	260.1	495.2	441.2	5.7	1.8	0.0	2.3	0.6	1.7	31.8
	Salute	1287	1249	178.3	615.3	451.4	3.5	2.8	0.0	2.8	0.0	2.8	30.1
	Avalon	1138	1111	46.7	528.5	523.7	11.9	4.8	0.0	1.8	0.0	1.8	33.1
Nunhems	Montero	857	841	0.0	109.8	707.5	24.1	9.7	0.0	0.7	0.0	0.7	
Seminis	Minister (2102)	1314	1309	140.9	577.1	587.1	3.7	0.0	0.0	0.4	0.0	0.4	30.4
	Chancellor (9131)	1094	1087	34.3	351.6	694.0	7.3	4.8	0.0	0.2	0.0	0.2	31.5
	SV0106NG	1184	1176	86.1	496.7	577.9	15.8	3.0	0.0	0.5	0.0	0.5	31.6
N. Zealand Onion	903S	615	602	0.0	1.5	450.4	149.9	11.9	0.0	0.2	0.0	0.2	
	Average	1070	1054	69.5	382.9	570.3	30.9	5.3	0.0	0.9	0.0	0.9	31.4
August 3 harvest													
Crookham	Salute	1347	1330	412.0	560.1	354.8	3.5	0.0	0.0	1.2	0.1	1.1	30.2
	Avalon	1291	1278	375.8	568.2	320.1	13.4	8.5	0.0	0.4	0.2	0.2	30.9
Nunhems	Montero	964	947	37.4	239.2	646.3	24.6	12.5	0.0	0.5	0.5	0.0	32.6
Seminis	Minister (2102)	1385	1352	357.8	565.8	424.6	3.7	0.0	0.0	1.8	0.0	1.8	30.4
	Chancellor (9131)	1197	1178	112.1	476.9	578.5	10.4	4.2	0.0	0.6	0.0	0.6	31.1
	SV0106NG	1352	1340	317.4	575.8	437.5	8.9	5.3	0.0	0.2	0.0	0.2	30.4
N. Zealand Onion	903S	593	572	0.0	0.0	447.3	124.5	21.0	0.0	0.0	0.0	0.0	
	Average	1161	1142	230.3	426.6	458.4	27.0	7.4	0.0	0.7	0.1	0.6	30.9

^a Data for Avenger were not included in the statistical analysis.

Table 1. (Continued). Bulb yield and grade for seven yellow onion varieties and one red variety (903S) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Company	Variety	Total yield	Marketable yield by grade							Total			Bulb counts >4¼ in #/50 lb
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	Doubles	rot	Plate rot	Slime rot	
			----- cwt/acre -----							----- % -----			
Average over harvest dates													
Crookham	Avenger ^a	1154	1139	140.2	438.8	549.1	10.8	2.4	0.0	1.1	0.5	0.6	30.7
	Salute	1255	1236	247.1	558.1	424.8	5.7	1.0	0.0	1.4	0.1	1.3	31.2
	Avalon	1119	1102	154.4	459.6	474.8	13.5	6.2	0.0	0.8	0.2	0.7	32.1
Nunhems	Montero	867	852	12.5	139.6	670.0	30.1	10.9	0.0	0.4	0.2	0.2	32.6
Seminis	Minister (2102)	1296	1275	209.2	569.3	492.3	3.9	0.5	0.0	0.9	0.2	0.7	30.8
	Chancellor (9131)	1081	1071	57.2	368.4	636.7	9.0	3.2	1.7	0.3	0.1	0.3	32.2
	SV0106NG	1229	1221	162.7	509.0	536.6	12.9	3.6	1.0	0.2	0.0	0.2	31.6
N. Zealand Onion	903S	582	563	0.0	2.2	421.7	139.2	18.2	0.0	0.1	0.0	0.1	
LSD (0.05) Variety		89.6	93.9	83.4	66.8	79.2	13.4	5.5	NS	NS	NS	NS	NS
LSD (0.05) Date		34.5	34.3	26.5	44.9	38.7	NS	NS	NS	NS	NS	NS	NS
LSD (0.05) Variety x date		91.1	90.9	70.0	118.7	59.1	NS	NS	NS	NS	NS	NS	NS

^aData for Avenger were not included in the statistical analysis.

Table 2. Single and multiple bulb centers, and bolting for seven yellow onion varieties and one red variety (903S) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Company	Variety	Multiple center			Single center		Bolters
		large	medium	small	functional ^a	bullet	
		----- % -----					
July 13 harvest							
Crookham	Avenger	0.0	13.6	45.6	86.4	40.8	
July 20 harvest							
Crookham	Avenger	0.0	17.8	54.5	82.2	27.7	
	Salute	8.8	37.6	44.0	53.6	9.6	
	Avalon	0.8	0.8	12.0	98.4	86.4	
Nunhems	Montero	0.8	5.6	20.0	93.6	73.6	
Seminis	Minister	3.2	33.6	57.6	63.2	5.6	
	Chancellor	0.0	8.0	38.0	92.0	54.1	
	SV0106NG	0.8	31.2	62.4	68.0	5.6	
N. Zealand Onion	903S	2.0	52.0	46.0	46.0	0.0	
	Average	2.3	24.1	40.0	73.5	33.6	
July 27 harvest							
Crookham	Avenger	2.4	15.2	53.6	82.4	28.8	0.0
	Salute	10.4	39.2	37.6	50.4	12.8	1.7
	Avalon	0.8	4.8	8.0	94.4	86.4	4.3
Nunhems	Montero	0.8	8.8	15.2	90.4	75.2	0.6
Seminis	Minister	2.9	28.7	54.0	68.4	14.4	0.0
	Chancellor	0.0	17.6	43.2	82.4	39.2	1.1
	SV0106NG	2.4	31.2	52.8	66.4	13.6	0.1
N. Zealand Onion	903S	8.0	48.0	40.0	44.0	4.0	0.1
	Average	3.6	25.5	35.8	70.9	35.1	1.1
August 3 harvest							
Crookham	Salute	24.0	36.0	25.6	40.0	14.4	
	Avalon	2.4	4.8	17.3	92.8	75.5	
Nunhems	Montero	0.8	8.8	26.4	90.4	64.0	
Seminis	Minister	12.8	45.6	38.4	41.6	3.2	
	Chancellor	3.2	19.2	36.8	77.6	40.8	
	SV0106NG	8.8	56.0	35.2	35.2	0.0	
N. Zealand Onion	903S	6.4	48.0	41.6	45.6	4.0	
	Average	8.3	31.2	31.6	60.5	28.8	
Average over harvest dates							
Crookham	Avenger	0.8	15.5	51.2	83.7	32.4	
	Salute	14.4	37.6	35.7	48.0	12.3	
	Avalon	1.3	3.5	12.4	95.2	82.8	
Nunhems	Montero	0.8	7.7	20.5	91.5	70.9	
Seminis	Minister	6.3	36.0	50.0	57.7	7.7	
	Chancellor	1.1	14.9	39.3	84.0	44.7	
	SV0106NG	4.0	39.5	50.1	56.5	6.4	
N. Zealand Onion	903S	5.7	49.1	42.3	45.1	2.9	
LSD (0.05) Variety		4.3	7.6	6.5	7.7	6.6	2.0
LSD (0.05) Date		2.2	NS	5.3	4.9	4.1	
LSD (0.05) Variety X Date		5.8	13.0	14.0	13.1	NS	

^aFunctional single centers are the small multiple centers plus the bullet single centers.

^bBolted onions were counted in each plot on July 27.

Table 3. Maturity at harvest and bulb quality 2 weeks after harvest for seven yellow onion varieties and one red variety (903S) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017.

Company	Variety	Maturity at harvest		Bulb quality 2 weeks after harvest			
		tops down	leaf dryness	sprouted	decomposed	sprouted and decomposed	total sprouted or decomposed
----- % -----							
July 13 harvest							
Crookham	Avenger	99	16	0.7	1.3	0.0	2.1
July 20 harvest							
Crookham	Avenger	100	28	0.0	7.0	0.0	7.0
	Salute	46	10	3.4	3.3	0.0	6.7
	Avalon	30	8	0.0	7.2	0.0	7.2
Nunhems	Montero	22	12	1.8	0.7	0.0	2.5
Seminis	Minister	84	22	0.0	1.4	0.0	1.4
	Chancellor	38	10	4.2	3.3	0.0	7.5
	SV0106NG	78	10	0.6	5.3	0.0	5.9
N. Zealand Onion	903S	58	32	0.5	0.9	0.0	1.3
	Average	51	15	1.5	3.2	0.0	4.7
July 27 harvest							
Crookham	Avenger	100	32	0.0	2.3	0.0	2.3
	Salute	64	22	1.3	0.0	0.0	1.3
	Avalon	66	14	8.6	6.5	0.0	15.1
Nunhems	Montero	70	24	0.6	3.5	0.0	4.1
Seminis	Minister	90	24	0.0	1.3	0.0	1.3
	Chancellor	68	18	0.0	0.6	0.0	0.6
	SV0106NG	88	24	0.0	0.6	0.0	0.6
N. Zealand Onion	903S	84	38	0.0	0.3	0.0	0.3
	Average	76	23	1.5	1.8	0.0	3.4
August 3 harvest							
Crookham	Salute	80	24	0.8	2.2	0.0	3.0
	Avalon	78	16	1.5	0.8	0.0	2.3
Nunhems	Montero	80	30	0.0	1.1	0.0	1.1
Seminis	Minister	98	28	0.0	0.0	0.0	0.0
	Chancellor	74	24	0.0	0.7	0.0	0.7
	SV0106NG	93	26	0.0	0.7	0.0	0.7
N. Zealand Onion	903S	92	42	0.0	0.0	0.0	0.0
	Average	85	27	0.3	0.8	0.0	1.1
Average over harvest dates							
Crookham	Avenger	100	25	0.2	3.5	0.0	3.8
	Salute	63	19	1.8	1.9	0.0	3.7
Crookham	Avalon	58	13	3.4	4.8	0.0	8.2
Nunhems	Montero	57	22	0.8	1.7	0.0	2.6
Seminis	Minister	91	25	0.0	0.9	0.0	0.9
	Chancellor	60	17	1.4	1.6	0.0	2.9
	SV0106NG	86	20	0.2	2.2	0.0	2.4
N. Zealand Onion	903S	78	37	0.1	0.4	0.0	0.5
LSD (0.05) Variety		8	5	NS	NS	NS	3.8
LSD (0.05) Date		4	2	NS	NS	NS	NS
LSD (0.05) Variety X Date		10	5	NS	NS	NS	NS

Table 4. Monthly growing degree-days (50-86°F) in 2014-2017, and the 24-year average, Malheur Experiment Station, Oregon State University, Ontario, OR.

Year					Total
	April	May	June	July	April-July
2014	227	424	544	779	1974
2015	241	427	674	716	2059
2016	305	405	576	680	1967
2017	169	380	533	766	1848
Avg 1993-2016	200	371	511	702	1785

Table 5. Percentage of tops down, leaf dryness, and marketable yield at three harvest dates for onion varieties Avalon and Montero grown from transplants in 2014, 2015, 2016, and 2017. Malheur Experiment Station, Oregon State University, Ontario, OR.

	Year	Avalon				Montero			
		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	–
	2016	0	8	28		0	16	58	
	2017		30	66	78		22	70	80
% dry leaves	2014	–	14	20	76	–	16	28	32
	2015	18	10	20	–	0	20	32	–
	2016	0	3	16		0	12	20	
	2017		8	14	16		12	24	30
Marketable yield cwt/acre	2014	–	1287	1387	1488	–	826	911	1024
	2015	1058	1124	1443	–	730	847	898	–
	2016	692	870	1115		731	931	1154	
	2017		919	1111	1278		768	841	947