

# ONION PRODUCTION FROM TRANSPLANTS IN 2018

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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 local onions are available, which is important for onion processors and possibly for onion packing sheds. Onion varieties suitable for processing into onion rings must be single centered, produce large bulbs, and store well. Previous research at the OSU Malheur Experiment Station (MES) has shown that when onions are grown from transplants, they can be harvested starting in July (Shock et al. 2004, 2007-2009, and 2011-2018). The 2018 trial evaluated 10 onion varieties grown from transplants potentially suitable for processing or fresh market. Seven varieties were grown from transplants produced in a greenhouse at MES and three 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 ‘Jasmine’, 4062, and 4500 (Crookham Co., Caldwell, ID); SPCI-1 and SPCI-5 (Seminis Vegetable Seed, Payette, ID); and 903S and TAS027 (New Zealand Onion, Pukekohe, New Zealand) was planted in the greenhouse on January 29, 2018 in flats with a vacuum seeder at 72 seeds/flat. The seed was sown on a 1-inch layer of Salamander Soil potting mix (Fox Farm Soil and Fertilizer Co., Arcata, CA). 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 4. Transplants were grown without supplemental light. On February 19 and 26, Ridomil Gold® SL was watered into each flat to control damping off. Bare-rooted transplants of ‘Montero’ (Nunhems, Parma, ID), ‘Avenger’ (Crookham Co.), and KW-0106 (Seminis) were grown in Arizona during the winter of 2017-2018.

Onions were grown from the transplants on an Owyhee silt loam at MES previously planted to wheat. In the fall of 2017, 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 2017 showed a pH of 8.2, 3.4% organic matter, 7 ppm nitrogen (N) as nitrate, 3 ppm N as ammonium, 22 ppm phosphorus (P), 386 ppm potassium (K), 20 ppm sulfur (S), 3218 ppm calcium, 533 ppm magnesium, 138 ppm sodium, 4.1 ppm zinc (Zn), 3 ppm manganese (Mn), 2.2 ppm copper (Cu), 16 ppm iron, and 0.5 ppm boron (B). Based on the soil analysis, 78 lb of P/acre, 81 lb of K/acre, 162 lb of S/acre, 9 lb of Mn/acre, and 1 lb of B/acre were broadcast before plowing. In addition

to the chemical fertilizer, 10 ton/acre 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 Jasmine, 4062, 4500, SPCI-1, SPCI-5, 903S, and TAS027, grown in the greenhouse, were transplanted on March 28. Varieties Avenger, KW-0106, and Montero, grown in Arizona, were transplanted on April 4. The onions were transplanted 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 was a randomized complete block with five replicates.

The onion crop was managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. The herbicide Prowl® H<sub>2</sub>O at 2 pt/acre (0.95 lb ai/acre) was broadcast for weed control on April 6. The herbicides GoalTender® at 4 oz/acre (0.09 lb ai/acre), Brox® at 16 oz/acre (0.25 lb ai/acre), and Shadow® at 5.3 oz/acre (0.12 lb ai/acre) were broadcast on May 7 for weed control. Thrips were controlled by ground application using the following insecticides: Aza-Direct® at 12 oz/acre (0.00093 lb ai/acre) and Movento® at 5 oz/acre (0.008 lb ai/acre) on May 9 and 16, and Agri-Mek® SC at 3.5 oz/acre (0.02 lb ai/acre) on May 24.

A total of 60 lb N/acre was applied in 3 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 (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 13 and terminated on July 23.

On July 9, 16, and 23, bulbs from 6 ft of the middle 2 double rows in each plot were topped and bagged. Variety SPCI-5 started maturing earlier than the other varieties and harvest began 1 week earlier. Variety SPCI-5 had bulbs from 5 ft of the middle 2 double rows in each plot harvested on July 2, 9, 16, and 23. Bolted onions were counted in each plot on July 23. 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, bulbs from each harvest were stored in a shed at ambient temperature for 2 weeks. After 2 weeks the bulbs were evaluated for single centers and for the number of sprouted or decomposed bulbs.

Twenty-five onions ranging in diameter from 3½ to 4¼ inches from each plot from each harvest were rated for single centers. 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 2 Harvest – SPCI-5

Marketable yield for variety SPCI-5 was 912 cwt/acre on July 13 (Table 1). The percentage of functionally single-centered bulbs was 93% (Table 2). The percentage of tops down at harvest was 40% and bulb decomposition or sprouting after 2 weeks of storage was 0% (Table 3).

### July 9 Harvest

Marketable yield on July 9 ranged from 442 cwt/acre for TAS027 to 1078 cwt/acre for KW-0106 (Table 1). The marketable yield of the yellow varieties averaged 989 cwt/acre and the reds averaged 460 cwt/acre. The percentage of functionally single-centered bulbs averaged 84.8% and ranged from 54.4% for KW-0106 to 98.7% for SPCI-1 (Table 2). The percentage of tops down at harvest averaged 52% and ranged from 18% for SPCI-1 to 91% for Avenger (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 1.3% and ranged from 0% for SPCI-5, 903S, and TAS027 to 3.2% for Montero.

### July 16 Harvest

Marketable yield on July 16 ranged from 468 cwt/acre for TAS027 to 1127 cwt/acre for SPCI-1 (Table 1). The marketable yield of the yellow varieties averaged 988 cwt/acre and the reds averaged 475 cwt/acre. The percentage of functionally single-centered bulbs averaged 79% and ranged from 50% for KW-0106 to 98% for Jasmine (Table 2). The percentage of tops down at harvest averaged 70% and ranged from 54% for SPCI-1 to 91% for Jasmine and SPCI-5 (Table

3). Bulb decomposition or sprouting after 2 weeks of storage averaged 0.6% and ranged from 0% for several varieties to 1.6% for Avenger and KW-0106.

### **July 23 Harvest**

Marketable yield on July 23 ranged from 549 cwt/acre for 903S to 1366 cwt/acre for SPCI-1 (Table 1). The marketable yield of the yellow varieties averaged 1177 cwt/acre and the reds averaged 564 cwt/acre. The percentage of functionally single-centered bulbs averaged 69% and ranged from 31% for KW-0106 to 94% for Jasmine (Table 2). The percentage of tops down at harvest averaged 88% and ranged from 78% for 4062 to 94% for Jasmine (Table 3). Bulb decomposition or sprouting after 2 weeks of storage averaged 1% and ranged from 0% for SPCI-1, SPCI-5, and TAS027 to 3% for Jasmine (Table 3).

### **Overall**

Bulb yields were high in 2018. May of 2018 had the highest number of growing degree-days since 2014. In 2018, the accumulated number of growing degree-days from April through July was higher than the 25-year average (Table 4). For comparison, performance data for variety Montero, which was in the transplant trials in 2014-2018 is presented in Table 5. Compared with recent years, Montero matured earlier in 2018, having 36% tops down on July 9.

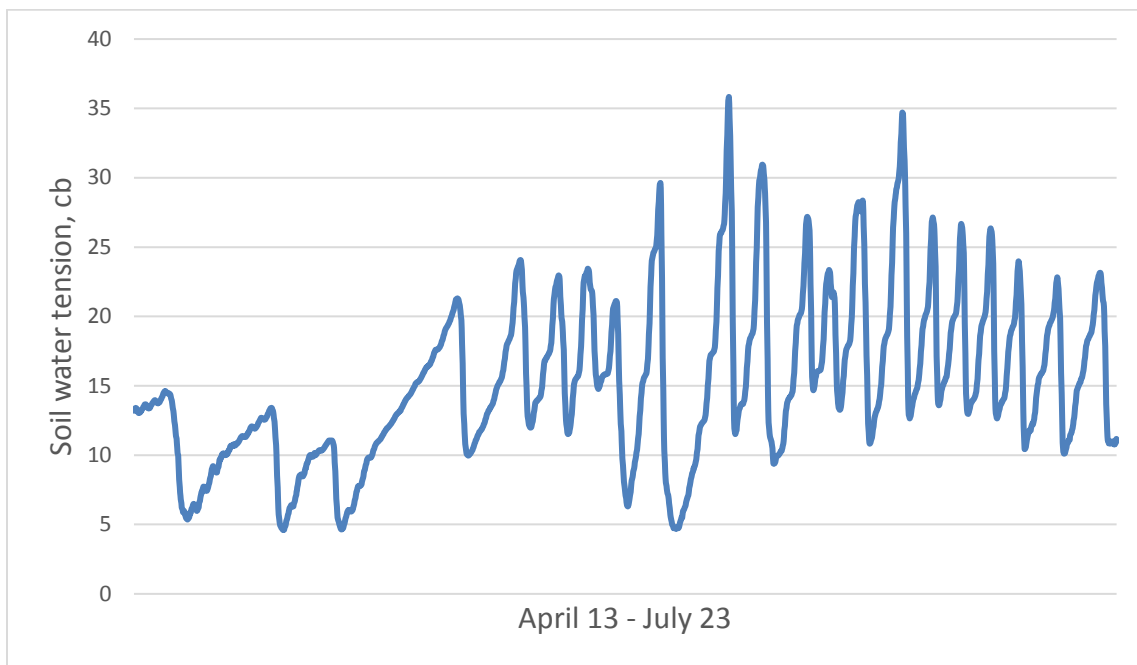
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*Figure 1. Soil water tension at 8-inch depth. Malheur Experiment Station, Oregon State University, Ontario, OR, 2018.*

Table 1. Bulb yield and grade for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018. Continued on next page.

Bulb color	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	Sunscald	rot	Plate rot %	Slime rot		
				cwt/acre								%			
<b>July 2 harvest</b>															
	Seminis	SPCI-5 <sup>a</sup>	925	912	52.9	350.5	493.9	14.6	13.7	0.0	0.0	0.0	0.0	0.0	35.7
<b>July 9 harvest</b>															
yellow	Nunhems	Montero	947.3	933.5	12.9	194.7	705.8	20.0	6.3	0.0	0.0	0.8	0.2	0.6	30.9
yellow	Crookham	Avenger	950.3	928.6	0.0	283.7	620.6	24.3	6.4	0.0	0.0	1.6	0.2	1.4	
yellow		Jasmine	999.6	985.6	106.5	361.4	480.0	37.7	12.4	0.0	0.0	0.2	0.0	0.2	33.6
yellow		4062	944.5	926.5	49.6	347.5	502.4	26.9	6.4	0.0	0.0	1.2	0.0	1.2	36.2
yellow		4500	990.3	984.6	75.5	327.3	555.6	26.1	5.7	0.0	0.0	0.0	0.0	0.0	36.5
yellow	Seminis	KW-0106	1090.0	1077.9	68.6	470.2	519.6	19.6	3.2	0.0	0.0	0.8	0.0	1.0	35.0
yellow		SPCI-1	1066.0	1052.3	192.6	436.9	402.9	19.9	7.8	0.0	0.0	0.5	0.0	0.5	33.8
yellow		SPCI-5	1064.3	1022.4	296.8	372.8	332.4	20.4	15.8	0.0	0.0	2.5	0.0	2.5	33.1
yellow		average		1006.6	988.9	100.3	349.3	514.9	24.4	8.0	0.0	0.0	0.9	0.0	0.9
red	N. Zealand Onion	903S	506.0	477.3	0.0	6.1	345.7	125.5	28.6	0.0	0.0	0.0	0.0	0.0	
red		TAS027	483.1	442.3	0.0	0.0	361.7	80.6	40.8	0.0	0.0	0.0	0.0	0.0	
red		average		494.5	459.8	0.0	3.0	353.7	103.1	34.7	0.0	0.0	0.0	0.0	0.0
Average			904.2	883.1	80.2	280.1	482.7	40.1	13.4	0.0	0.0	0.8	0.0	0.7	34.2
<b>July 16 harvest</b>															
yellow	Nunhems	Montero	999.9	974.7	0.0	233.5	727.7	13.5	3.7	0.0	7.6	1.4	0.0	1.4	
yellow	Crookham	Avenger	1015.0	964.8	28.8	233.9	690.0	12.0	10.8	3.4	9.2	2.7	0.0	2.7	34.4
yellow		Jasmine	1055.9	929.1	127.5	397.6	382.9	21.1	8.9	8.9	21.0	8.2	0.0	8.2	32.8
yellow		4062	972.4	928.9	106.4	384.6	426.2	11.7	8.8	0.0	30.9	0.4	0.0	0.4	34.2
yellow		4500	1005.6	968.1	52.4	435.0	464.9	15.8	6.3	0.0	24.2	0.9	0.3	0.6	34.0
yellow	Seminis	KW-0106	1056.6	979.5	135.2	365.3	466.1	12.9	7.1	8.4	26.3	3.5	0.0	3.5	32.0
yellow		SPCI-1	1194.5	1126.6	143.6	550.8	420.2	12.1	7.1	0.0	60.8	0.0	0.0	0.0	34.3
yellow		SPCI-5	1079.7	1035.8	361.5	424.8	228.3	21.2	13.0	0.0	24.7	0.6	0.0	0.6	31.6
yellow		average		1047.5	988.4	119.4	378.2	475.8	15.0	8.2	2.6	25.6	2.2	0.0	2.2
red	N. Zealand Onion	903S	525.1	478.0	0.0	32.1	363.9	82.0	36.2	7.3	0.0	0.7	0.0	0.7	
red		TAS027	500.3	467.5	0.0	18.8	372.2	76.4	28.7	4.2	0.0	0.0	0.0	0.0	
red		average		512.7	472.7	0.0	25.4	368.1	79.2	32.5	5.7	0.0	0.3	0.0	0.3
Average			940.5	885.3	95.5	307.7	454.2	27.9	13.1	3.2	20.5	1.8	0.0	1.8	33.3

<sup>a</sup> Data for the July 2 harvest for SPCI-5 were not included in the statistical analysis.

Table 1. (Continued.) Bulb yield and grade for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018.

Bulb color	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	Sunscald	rot	Plate rot %		Slime rot
----- cwt/acre ----- % -----															
<b>July 23 harvest</b>															
yellow	Nunhems	Montero	1111.1	1085.6	113.0	428.0	530.9	13.7	3.3	2.3	2.1	1.6	0.0	1.6	30.2
yellow	Crookham	Avenger	1052.2	1008.3	124.7	308.2	555.4	20.0	10.9	17.0	4.3	1.2	0.0	1.2	29.1
yellow		Jasmine	1335.9	1187.1	443.8	460.0	269.1	14.2	4.9	7.7	42.5	7.1	0.4	6.7	29.8
yellow		4062	1083.9	1070.7	286.2	437.8	338.4	8.2	7.0	0.0	3.5	0.2	0.0	0.2	28.3
yellow		4500	1248.8	1229.9	307.3	550.0	365.0	7.6	4.2	0.0	8.3	0.6	0.0	0.6	29.7
yellow	Seminis	KW-0106	1249.6	1196.5	265.0	542.0	377.8	11.6	8.2	7.1	3.0	2.9	0.0	2.9	30.4
yellow		SPCI-1	1455.7	1366.4	623.8	489.7	239.4	13.5	1.0	0.0	28.4	4.2	0.0	4.2	30.1
yellow		SPCI-5	1426.8	1275.5	587.7	374.4	267.2	46.1	18.5	12.6	30.6	6.4	0.0	6.4	26.6
yellow		average	1245.5	1177.5	343.9	448.8	367.9	16.9	7.2	5.8	15.3	3.0	0.1	3.0	29.3
red	N. Zealand Onion	903S	581.3	549.4	0.0	0.0	428.4	121.0	32.0	0.0	0.0	0.0	0.0	0.0	
red		TAS027	620.5	578.2	0.0	26.8	500.1	51.3	29.3	0.0	0.0	2.2	1.9	0.4	
red		average	600.9	563.8	0.0	13.4	464.2	86.2	30.6	0.0	0.0	1.1	0.9	0.2	
	Average		1116.6	1054.7	275.2	361.7	387.2	30.7	11.9	4.7	12.3	2.6	0.2	2.4	29.3
<b>Average over harvest dates</b>															
yellow	Nunhems	Montero	1019.4	997.9	42.0	285.4	654.8	15.8	4.4	0.8	4.9	1.2	0.1	1.2	30.4
yellow	Crookham	Avenger	1005.8	967.2	51.2	275.3	622.0	18.7	9.4	6.8	6.7	1.8	0.1	1.8	30.8
yellow		Jasmine	1115.8	1023.0	210.4	402.5	385.0	25.0	9.0	5.4	30.5	5.0	0.1	4.9	32.2
yellow		4062	1000.3	975.3	147.4	390.0	422.3	15.6	7.4	0.0	17.2	0.6	0.0	0.6	32.4
yellow		4500	1081.6	1060.9	145.1	437.4	461.8	16.5	5.4	0.0	16.2	0.5	0.1	0.4	33.4
yellow	Seminis	KW-0106	1123.7	1076.7	148.5	453.3	460.0	14.9	6.0	5.0	15.9	2.4	0.0	2.6	32.6
yellow		SPCI-1	1214.1	1163.3	301.8	484.5	361.1	15.9	5.7	0.0	44.6	1.4	0.0	1.4	32.9
yellow		SPCI-5	1105.6	1047.9	303.3	377.9	342.2	24.4	15.2	3.4	27.7	2.2	0.0	2.2	31.9
yellow		average	1083.3	1039.0	168.7	388.3	463.7	18.4	7.8	2.7	20.5	1.9	0.0	1.9	32.1
red	N. Zealand Onion	903S	533.0	498.1	0.0	11.8	374.5	111.8	31.8	2.1	0.0	0.2	0.0	0.2	
red		TAS027	534.6	496.0	0.0	15.2	411.4	69.4	32.9	1.0	0.0	0.7	0.6	0.1	
red		average	533.8	497.0	0.0	13.5	392.9	90.6	32.4	1.6	0.0	0.5	0.3	0.2	
	LSD (0.05) Variety		81.7	88.8	47.1	68.6	64.6	10.2	5.5	NS	10.2	1.9	NS	1.9	NS
	LSD (0.05) Date		39.6	41.9	31.8	NS	69.8	6.0	NS	NS	NS	NS	NS	NS	1.2
	LSD (0.05) Variety x date		NS	NS	100.4	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 2. Single- and multiple-centered bulbs, and bolting for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018. Continued on next page.

Company	Variety	Multiple center			Single center		Bolters <sup>c</sup>
		Large	Medium	Small	Functional <sup>a</sup>	Bullet <sup>b</sup>	
		----- % -----					
<b>July 2 harvest</b>							
Seminis	SPCI-5	0.0	6.8	37.8	93.2	55.4	
<b>July 9 harvest</b>							
Nunhems	Montero	2.4	4.8	14.4	92.8	78.4	
Crookham	Avenger	0.0	2.0	31.0	98.0	67.0	
	Jasmine	0.0	2.4	21.6	97.6	76.0	
	4062	2.4	2.4	19.2	95.2	76.0	
	4500	0.0	14.0	32.0	86.0	54.0	
Seminis	KW-0106	6.4	39.2	36.0	54.4	18.4	
	SPCI-1	0.0	1.3	38.7	98.7	60.0	
	SPCI-5	1.0	17.3	45.5	81.8	36.3	
N. Zealand Onion	903S	2.0	26.0	38.0	72.0	34.0	
	TAS027	12.0	16.0	68.0	72.0	4.0	
Average		2.6	12.5	34.4	84.8	50.4	
<b>July 16 harvest</b>							
Nunhems	Montero	3.0	9.0	18.0	88.0	70.0	
Crookham	Avenger	4.0	9.6	35.2	86.4	51.2	
	Jasmine	0.0	2.4	35.7	97.6	62.0	
	4062	2.4	13.5	32.2	84.1	51.9	
	4500	1.0	29.0	37.0	70.0	33.0	
Seminis	KW-0106	22.5	27.2	33.3	50.3	17.0	
	SPCI-1	0.0	4.0	34.0	96.0	62.0	
	SPCI-5	2.6	35.6	36.7	61.8	25.1	
N. Zealand Onion	903S	6.0	20.0	52.0	74.0	22.0	
	TAS027	6.0	12.0	70.0	82.0	12.0	
Average		4.7	16.2	38.4	79.0	40.6	
<b>July 23 harvest</b>							
Nunhems	Montero	2.4	8.0	11.2	89.6	78.4	0.7
Crookham	Avenger	3.0	10.0	34.0	87.0	53.0	0.3
	Jasmine	1.0	5.0	18.0	94.0	76.0	1.0
	4062	8.8	19.2	17.6	72.0	54.4	3.1
	4500	8.0	27.0	30.0	65.0	35.0	0.0
Seminis	KW-0106	25.2	44.3	20.3	30.5	10.2	0.1
	SPCI-1	2.2	10.9	42.1	87.0	44.9	0.3
	SPCI-5	10.7	22.7	32.0	66.7	34.7	0.0
N. Zealand Onion	903S	14.0	34.0	30.0	52.0	22.0	0.0
	TAS027	17.0	38.7	28.8	44.4	15.6	0.0
Average		9.2	22.0	26.4	68.8	42.4	0.5

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

<sup>b</sup>bullet: single center. <sup>c</sup>Bolted onions were counted in each plot on July 23.



Table 2. (Continued.) Single- and multiple-centered bulbs, and bolting for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants averaged over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018.

Company	Variety	Multiple center			Single center	
		Large	Medium	Small	Functional <sup>a</sup>	Bullet <sup>b</sup>
		----- % -----				
<b>Average over harvest dates</b>						
Nunhems	Montero	2.6	7.1	14.3	90.3	76.0
Crookham	Avenger	2.5	7.4	33.5	90.2	56.6
	Jasmine	0.3	3.1	25.6	96.6	71.0
	4062	4.5	11.7	23.0	83.8	60.8
	4500	3.0	23.3	33.0	73.7	40.7
Seminis	KW-0106	17.5	36.4	30.5	46.1	15.5
	SPCI-1	0.6	4.8	38.3	94.6	56.2
	SPCI-5	3.4	20.3	38.6	76.3	37.7
N. Zealand Onion	903S	7.3	26.7	40.0	66.0	26.0
	TAS027	11.6	23.5	53.1	64.9	11.8
LSD (0.05) Variety		2.9	4.6	NS	4.7	8.1
LSD (0.05) Date		3.0	5.2	6.2	5.5	5.9
LSD (0.05) Variety x date		NS	NS	NS	NS	NS

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

<sup>b</sup>bullet: single center.

Table 3. Maturity at harvest and bulb quality 2 weeks after harvest for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018. Continued on next page.

Company	Variety	Maturity at harvest		Bulb quality 2 weeks after harvest			
		Tops down	Leaf dryness	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
		----- % -----					
<b>July 2 harvest</b>							
Seminis	SPCI-5	40.0	7.5	0.0	0.0	0.0	0.0
<b>July 9 harvest</b>							
Nunhems	Montero	36.0	6.0	2.4	0.8	0.0	3.2
Crookham	Avenger	91.3	13.8	0.8	0.8	0.0	1.6
	Jasmine	88.0	15.0	0.8	0.0	0.0	0.8
	4062	20.0	4.0	2.4	0.0	0.0	2.4
	4500	26.3	5.0	1.6	0.0	0.0	1.6
Seminis	KW-0106	78.0	15.0	0.8	0.0	0.0	0.8
	SPCI-1	18.3	1.7	2.4	0.0	0.0	2.4
	SPCI-5	90.0	22.5	0.0	0.0	0.0	0.0
N. Zealand Onion	903S	30.0	20.0	0.0	0.0	0.0	0.0
	TAS027	40.0	17.5	0.0	0.0	0.0	0.0
Average		51.8	12.0	1.1	0.2	0.0	1.3
<b>July 16 harvest</b>							
Nunhems	Montero	58.0	20.0	0.0	0.0	0.0	0.0
Crookham	Avenger	90.0	25.6	0.8	0.8	0.0	1.6
	Jasmine	88.8	25.5	0.0	0.8	0.0	0.8
	4062	50.0	11.0	0.8	0.0	0.0	0.8
	4500	55.0	12.5	0.0	0.8	0.0	0.8
Seminis	KW-0106	79.0	25.5	1.6	0.0	0.0	1.6
	SPCI-1	56.7	7.5	0.0	0.0	0.0	0.0
	SPCI-5	91.3	28.8	0.0	0.0	0.0	0.0
N. Zealand Onion	903S	56.7	30.0	0.0	0.0	0.0	0.0
	TAS027	60.0	28.8	0.0	0.0	0.0	0.0
Average		68.5	21.5		0.2	0.0	0.6
<b>July 23 harvest</b>							
Nunhems	Montero	88.0	34.0	0.8	0.0	0.0	0.8
Crookham	Avenger	90.0	37.5	2.4	0.0	0.0	2.4
	Jasmine	94.0	36.0	0.0	3.2	0.0	3.2
	4062	78.0	18.0	0.8	0.0	0.0	0.8
	4500	87.5	20.0	0.8	0.8	0.0	1.6
Seminis	KW-0106	84.0	36.0	0.8	0.0	0.0	0.8
	SPCI-1	90.0	13.3	0.0	0.0	0.0	0.0
	SPCI-5	92.5	35.0	0.0	0.0	0.0	0.0
N. Zealand Onion	903S	90.0	46.7	0.0	0.8	0.0	0.8
	TAS027	90.0	40.0	0.0	0.0	0.0	0.0
Average		88.4	31.7	0.6	0.5	0.0	1.0

Table 3. (Continued). Maturity at harvest and bulb quality 2 weeks after harvest for eight yellow onion varieties and two red varieties (903S and TAS027) grown from transplants averaged over three harvest dates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018.

Company	Variety	Maturity at harvest		Bulb quality 2 weeks after harvest			
		Tops down	Leaf dryness	Sprouted	Decomposed	Sprouted and decomposed	Total sprouted or decomposed
----- % -----							
<b>Average over harvest dates</b>							
Nunhems	Montero	60.7	20.0	1.1	0.3	0.0	1.3
Crookham	Avenger	90.4	25.6	1.3	0.5	0.0	1.9
	Jasmine	90.4	25.5	0.3	1.3	0.0	1.6
	4062	49.3	11.0	1.3	0.0	0.0	1.3
	4500	56.3	12.5	0.8	0.5	0.0	1.3
Seminis	KW-0106	80.3	25.5	1.1	0.0	0.0	1.1
	SPCI-1	55.0	7.5	0.8	0.0	0.0	0.8
	SPCI-5	78.4	23.4	0.0	0.0	0.0	0.0
N. Zealand Onion	903S	62.5	33.8	0.0	0.3	0.0	0.3
	TAS027	63.3	28.8	0.0	0.0	0.0	0.0
LSD (0.05) Variety		7.6	3.2	NS	NS	NS	NS
LSD (0.05) Date		3.4	1.6	NS	NS	NS	NS
LSD (0.05) Variety x date		10.8	NS	NS	NS	NS	NS

Table 4. Monthly growing degree-days (50-86°F) in 2014-2018 and the 25-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
2018	225	471	516	733	1945
Avg. 1993-2017	199	372	512	704	1787

Table 5. The average percentage of tops down, leaf dryness, and marketable yield at three harvest dates for onion variety 'Montero' grown from transplants in 2014, 2015, 2016, 2017, and 2018. Malheur Experiment Station, Oregon State University, Ontario, OR.

	Year	9-Jul	14-Jul	16-Jul	21-Jul	23-Jul	28-Jul	4-Aug
% tops down	2014				12		40	76
	2015		18		54		80	
	2016		0		16		58	
	2017				22		70	80
	2018	36		62		88		
% dry leaves	2014				16		28	32
	2015		0		20		32	
	2016		0		12		20	
	2017				12		24	30
	2018	6		20		34		
Marketable yield cwt/acre	2014				826		911	1024
	2015		730		847		898	
	2016		731		931		1154	
	2017				768		841	947
	2018	934		975		1086		