ONION PRODUCTION FROM TRANSPLANTS IN 2022

Stuart Reitz, Erik B. G. Feibert, Alicia Rivera, and Kyle D. Wieland, Malheur Experiment Station, Oregon State University, Ontario, OR

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 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 Oregon State University 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, 2011; Reitz et al. 2019). The 2022 trial evaluated four red onion varieties grown from transplants potentially suitable for processing or fresh market.

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 'TAS027', 'TAS-40', 'TAS-42', and '8229' (New Zealand Onion, Pukekohe, New Zealand) was planted in the greenhouse on January 12, 2022 in flats with a vacuum seeder at 72 seeds/flat. The seed was sown on a 1-inch layer of Sun Gro Horticulture professional growing mix (Sun Gro Horticulture, Agawam, MA). The seed was then covered with 1 inch of the potting mix. The flats were placed in metal trays in the greenhouse. Immediately after planting, the trays were filled with enough water to allow the flats to be kept moist. Onion seedlings began emerging on January 31. Transplants were grown without supplemental light.

Onions were grown from the transplants on an Owyhee silt loam at MES previously planted to wheat. After the wheat was harvested in 2021, the stubble was shredded, and the field was irrigated to sprout unharvested wheat kernels, and then the field was disked and plowed. A soil analysis taken in the fall of 2021 showed a pH of 7.4, 1.6% organic matter, 8 ppm nitrogen (N) as nitrate, 3 ppm N as ammonium, 27 ppm phosphorus (P), 348 ppm potassium (K), 13 ppm sulfur as sulfate (S), 2626 ppm calcium, 497 ppm magnesium, 216 ppm sodium, 3.3 ppm zinc (Zn), 2 ppm manganese (Mn), 1.5 ppm copper (Cu), 11 ppm iron, and 1 ppm boron (B). Based on the soil analysis, 77 lb P/acre, 153 lb K/acre, 100 lb S/acre, 13 lb Mn/acre, 3 lb Zn/acre, and 1 lb B/acre were broadcast after plowing. In addition to the chemical fertilizer, 10 tons/acre of composted cattle feedlot manure were broadcast after plowing. After plowing, the field was groundhogged, fumigated with K-Pam 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 8 inches apart and an emitter flow rate of 0.09 gal/hr (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 22 and March 23. The seedlings 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. Five plots of each variety were planted. Plots were 20 ft long by 4 double rows wide.

The onion crop was managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. The following herbicides were broadcast for weed control: Shadow 3EC (clethodim) at 10 oz/acre on April 7 and Prowl H2O (pendimethalin) at 2 pints/acre on April 15. Thrips were controlled by ground application using the following insecticides: Aza-Direct (azadirachtin) at 12 oz/acre and M-Pede (potassium salts of fatty acids) at 123 oz/acre on May 17, Aza-Direct at 12 oz/acre and Movento (spirotetramat) at 5 oz/acre on May 25 and June 3, Agri-Mek (abamectin) at 3.5 oz/acre on June 10 and June 16, and Radiant (spinetoram) at 8 oz/acre on June 24.

A total of 80 lb N/acre was applied in two 40-lb increments on May 26 and June 10 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 (Figure. 1, Shock et al. 2000). Soil water tension was measured with eight granular matrix sensors (GMS, Watermark soil moisture sensor model 200SS, Irrometer 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 (AM16/32, 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 May 23 and terminated on August 8.

Bulbs of each variety were harvested twice two weeks apart. Harvests for each variety were started when approximately 75% of the tops were down. At each harvest, bulbs from 10 ft of the middle two 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. 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 super colossal (>4¼ inches). Bulb counts per 50 lb of super colossal onions were calculated for each plot of every variety by weighing and counting all super colossal 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

In 2022, average maximum air temperatures were lower than average in April and May and higher than average in July (Table 1). In 2022, growing degree-days were lower than average in April, May, and June, but higher than average in July (Table 2).

Averaged over harvest dates, 'TAS-42' and 'TAS-27' had the highest total and marketable yields followed by '8229' with 'TAS-40' having the lowest total and marketable yields (Table 3). Averaged over varieties, there was a statistically significant total and marketable yield increase from the first to the second harvest. Bulb size also increased from the first to the second harvest, with yield of medium bulbs decreasing and yield of jumbo and colossal bulbs increasing.

Variety 'TAS027' was in the transplant trial in 2018, 2020, 2021, and 2022 (Table 4). Yield for 'TAS027' was highest in 2020. This could be related to the milder air temperatures in July of 2020 compared to the other years. July of 2020 had the fewest number of hours > 86°F of the four years (Table 2).

No bolting was observed for any of the varieties. No bulb decomposition or sprouting was observed for any of the varieties from the first harvest after 2 weeks of storage. For bulbs from the second harvest, only 'TAS-42' and '8229' showed some loss to rot, with 6.4% rot for 'TAS-42' and 0.8% rot for '8229' after 2 weeks of storage. Bulb single center data can be found in Table 5.

Acknowledgements

This project was funded by New Zealand Onion Company, Oregon State University, the Malheur County Service District, and supported by Formula Grant nos. 2022-31100-06041 and 2022-31200-06041 from the USDA National Institute of Food and Agriculture.

References

Shock, C.C., J. Barnum, and M. Seddigh. 1998. Calibration of Watermark soil moisture sensors for irrigation management. Irrigation Association. Proceedings of the International Irrigation Show. Pages 139-146. San Diego, CA.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2000. Irrigation criteria for drip-irrigated onions. HortScience 35:63-66.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2004. Onion production from transplants in the Treasure Valley. Oregon State University Agricultural Experiment Station Special Report 1055:47-52.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2007. Onion production from transplants. Oregon State University Agricultural Experiment Station Special Report 1075:45-50.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2008. Onion production from transplants grown in a low tunnel cold frame and in a greenhouse. Oregon State University Agricultural Experiment Station Special Report 1087:26-33.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2009. Onion production from transplants grown in a low tunnel cold frame and in a greenhouse. Oregon State University Agricultural Experiment Station Special Report 1094:32-40.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2011. Onion production from transplants. Malheur Experiment Station Annual Report 2010, Ext/CrS 132:42-51.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2012. Onion production from transplants. Malheur Experiment Station Annual Report 2011, Ext/CrS 141:24-31.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2013. Onion production from transplants and sets. Malheur Experiment Station Annual Report 2012, Ext/CrS 144:26-34.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2014. Onion production from transplants. Malheur Experiment Station Annual Report 2013, Ext/CrS 149:29-33.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2015. Onion production from transplants. Malheur Experiment Station Annual Report 2014, Ext/CrS 152:35-41.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and B. Simerly. 2016. Onion production from transplants. Malheur Experiment Station Annual Report 2015, Ext/CrS 156:28-37.

Shock, C.C., E.B.G. Feibert, A. Rivera, L.D. Saunders, and B. Simerly. 2017. Onion production from transplants. Malheur Experiment Station Annual Report 2016, Ext/CrS 157:32-42.

Shock, C.C., E.B.G. Feibert, A. Rivera, L.D. Saunders, and B. Simerly. 2018. Onion production from transplants. Malheur Experiment Station Annual Report 2017, Ext/CrS 159:32-41.

Shock, C.C., E.B.G. Feibert, A. Rivera, K. Wieland, and B. Simerly. 2019. Onion production from transplants. Malheur Experiment Station Annual Report 2018, Ext/CrS 161:34-45.

Reitz, S., E.B.G. Feibert, A. Rivera, and K. Wieland. 2020. Onion production from transplants. Malheur Experiment Station Annual Report 2019, Ext/CrS 163:50-62.

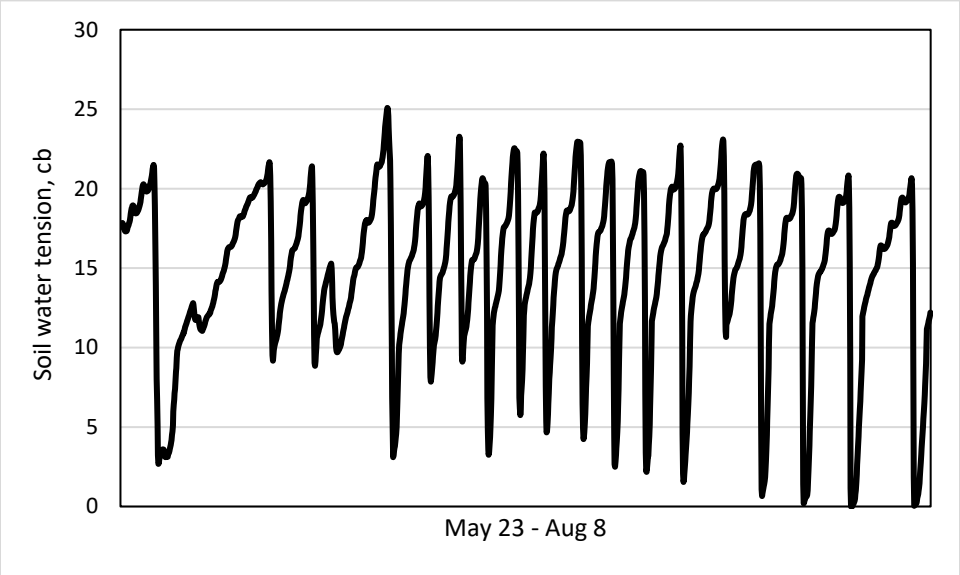

Figure 1. Soil water tension at 8-inch depth, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

Table 1. Monthly average air temperature (°F) for 2018, 2020-2022, and 1943-2021 average, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

	Year	April	May	June	July
Maximum	2018	65	78	82	96
	2020	66	73	79	90
	2021	67	74	91	99
	2022	60	69	80	96
	Average	64	74	82	92
Minimum	2018	38	51	53	62
	2020	37	47	54	59
	2021	35	47	59	65
	2022	31	43	52	64
	Average	37	45	52	58

Table 2. Monthly growing degree-days (50-86°F) and number of hours with air temperature >86°F in 2018, 2020-2022, and 1943-2021 average, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

Year	March	April	May	June	July	No. of hours >86°F in July*
2018	101	225	471	516	733	238
2020	121	249	386	542	670	165
2021	120	259	372	648	806	291
2022	144	151	302	489	773	266
Average	110	204	376	519	707	194

*1993-2022 average

Table 3. Bulb yield, grade, and maturity over two harvest dates for four onion varieties grown from transplants, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

			Marketable yield by grade							
Variety	Harvest date	Total yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	Tops down	Leaf dryness
		cwt/acre							%	
TAS-27	20-Jul	572.9	536.5			410.0	126.5	36.4	89	10
	3-Aug	664.3	647.3		16.1	531.5	99.7	17.0	100	80
	average	618.6	591.9		16.1	470.8	113.1	26.7		
TAS-40	26-Jul	469.8	427.3			275.9	151.3	42.5	69	10
	9-Aug	500.2	467.6		0.0	357.2	110.4	32.6	90	50
	average	485.0	447.4		0.0	316.6	130.9	37.6		
TAS-42	20-Jul	585.0	553.4			446.5	106.9	31.6	89	10
	3-Aug	662.5	639.5		13.9	509.4	116.1	23.0	100	60
	average	623.8	596.4		13.9	478.0	111.5	27.3		
8229	20-Jul	503.7	466.7			290.1	176.6	37.0	73	10
	3-Aug	589.6	555.9		0.0	427.3	128.5	33.7	90	50
	average	546.6	511.3		0.0	358.7	152.6	35.3		
	1	532.8	496.0		0.0	355.6	140.3	36.9	72.5	10.0
	2	604.1	577.6		7.5	456.4	113.7	26.6	95.0	60.0
LSD (0.05)										
Variety		50.9	54.1		6.0	47.0	NS	NS	7.6	NS
Date		19.5	18.8		4.3	20.5	11.8	NS	5.3	NS
Var X Date		NS	NS		8.5	NS	23.6	NS	10.7	NS

Table 4. Yield, grade, and maturity of variety TAS027 in 2018, and 2020-2022, and TAS042 in 2021 and 2022.

			Total	Marketable yield by grade						Tops	Leaf
Variety	Year	Date	yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	down	dryness
			cwt/acre							%	
TAS027	2018	9-Jul	483.1	442.3			361.7	80.6	40.8	40	18
		16-Jul	500.3	467.5		18.8	372.2	76.4	28.7	60	29
		23-Jul	620.5	578.2		26.8	500.1	51.3	29.3	90	40
	2020	16-Jul	730.1	721.7	0	60	634.5	27.2	8.5	30	10
		30-Jul	928.2	916.6	29.9	324.4	552.2	10.1	6.9	80	30
	2021	13-Jul	577.2	548.3		37.1	460.4	78.6	28.9	86.3	15.0
		27-Jul	630.7	607.2		34.7	501.7	93.9	23.5	100.0	63.3
	2022	20-Jul	572.9	536.5			410.0	126.5	36.4	89	10
		3-Aug	664.3	647.3		16.1	531.5	99.7	17.0	100	80
TAS-42	2021	13-Jul	506.0	467.9			366.9	98.3	38.1	70.0	16.0
		27-Jul	604.9	576.2		21.4	468.4	94.9	28.8	99.0	64.0
	2022	20-Jul	585.0	553.4			446.5	106.9	31.6	89	10
		3-Aug	662.5	639.5		13.9	509.4	116.1	23.0	100	60

Table 5. Single- and multiple-centered bulbs over two harvest dates for four onion varieties grown from transplants, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

		Multiple center			Single center	
Variety	Harvest date	Large	Medium	Small	Functional[a]	Bullet[b]
		---------- % ----------				
TAS-27	20-Jul	9.6	31.7	29.8	58.8	29.0
	3-Aug	3.2	41.6	37.6	55.2	17.6
	average	6.4	36.6	33.7	57.0	23.3
TAS-40	26-Jul	5.6	37.6	34.4	56.8	22.4
	9-Aug	4.0	40.0	37.6	56.0	18.4
	average	4.8	38.8	36.0	56.4	20.4
TAS-42	20-Jul	3.2	44.0	33.6	52.8	19.2
	3-Aug	8.8	50.4	18.4	40.8	22.4
	average	6.0	47.2	26.0	46.8	20.8
8229	20-Jul	8.0	50.4	24.8	41.6	16.8
	3-Aug	11.2	41.6	37.6	47.2	9.6
	average	9.6	46.0	31.2	44.4	13.2
Harvest date	1	6.6	40.9	30.6	52.5	21.9
	2	6.8	43.4	32.8	49.8	17.0
LSD (0.05)						
Variety		NS	NS	NS	NS	NS
Date		NS	NS	NS	NS	NS
Var X Date		5.9	8.5	13.7	10.1	NS

[a]Functional single centers are the small multiple centers plus the bullet single centers.
[b]Bullet: single center.