2023 ONION VARIETY TRIALS

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Introduction

Onion variety development for eastern Oregon and western Idaho is a continual process. Annually, seed companies enter their emerging varieties into an annual onion variety trial held at the Malheur Experiment Station. Direct-seeded yellow, white, and red long-day onion varieties were evaluated in 2023 for yield, grade, bulb decomposition, disease, thrips damage, maturity, bolting, and bulb single centers. Growers and seed industry representatives had the opportunity to examine the varieties at the annual Onion Variety Day on 30 August and during a bulb evaluation out of storage on 9 January 2024. Onion varieties were evaluated objectively for bolting, yield, grade, single centers, and storability. Varieties were evaluated subjectively for maturity, thrips leaf damage, iris yellow spot virus (IYSV), bulb shape, bulb shape uniformity, flesh brightness, and skin color and retention.

Materials and Methods

The trial was grown on an Owyhee silt loam previously planted to wheat. A soil analysis taken in the fall of 2022 showed a pH of 8.3, 3.79% organic matter, 5 ppm nitrogen (N) as nitrate, 2 ppm N as ammonium, 72 ppm phosphorus (P), 755 ppm potassium (K), 37 ppm sulfur as sulfate (S), 3741 ppm calcium, 850 ppm magnesium, 309 ppm sodium, 2.2 ppm zinc (Zn), 8 ppm manganese (Mn), 2.1 ppm copper (Cu), 14 ppm iron, and 0.8 ppm boron (B). Based on the soil analysis, 50 lbs N/ac, 70 lbs P/acre, 15 lbs sulfate/acre, 250 lbs elemental sulfur/ac, 1 lb Mn/acre, 8 lbs Zn/acre, and 1 lb B/acre were broadcast after plowing. 10 t/acre of composted cattle feedlot manure was applied after plowing. The field was fumigated with K-Pam at 15 gal/acre, then marked out at 22 inches.

The varieties were planted in four adjacent trials based on bulb color and harvest date (yellow, white, red, early). The experimental design of each full-season trial and the early-maturing trial were randomized complete blocks with five replicates. A sixth, non-randomized replicate was planted for demonstrating onion variety performance to growers and seed company representatives at the Onion Variety Day (30 August, 2023). All trials were planted 12 April in plots 4 double-rows wide and 27 ft long. The early-maturing trial had 10 yellow varieties from four seed companies; the full-season yellow trial had 28 varieties from six seed companies; the full-season white trial had six varieties from three seed companies, and the full-season red trial had six varieties from four seed companies.

Seed was planted in double rows spaced three inches apart at nine seeds/ft of single row. Two double rows were planted on 44-inch beds, with the middle of the double rows 20 inches apart. Planting was done with customized John Deere Flex Planter units equipped with disc openers.

The field was drip irrigated. The automated irrigation system was started on 5 June, and irrigation ended on August 20.

Onion emergence started on 1 May. Postemergence, 4' alleys were cut between plots, leaving them 23 ft long. The seedlings were hand-thinned on May 27 and 29 to a target spacing of 4.25 inches between individual onion plants in each single row, or 134,174 plants/acre.

The onions were managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. For weed control, the following herbicides were broadcast: Roundup PowerMax (glyphosate) at 22 oz/acre, and Prowl H2O (pendimethalin) at 1.5 pints/acre on 28 April; GoalTender (oxyfluorfen) at 4 oz/acre, Brox 2EC (bromoxynil) at 16 oz/acre and Prowl H2O (pendimethalin) at 2 pints/acre on 10 June: Avatar (clethodim) at 16 oz/acre on 11 June.

For thrips control, the following insecticides were applied by ground: Aza-Direct (azadirachtin) at 12 oz/acre and M-Pede (potassium salts of fatty acids) at 5.6 pts/acre on 6 June; Movento HL (spirotetramat) at 2.5 oz/acre and Agri-Mek (abamectin) at 3.5 oz/acre on 13 June and again 20 June; Exirel (cyantraniliprole) at 20 oz/acre on 27 June and 4 July; Radiant (spinetoram) at 8 oz/acre on 11 July and July 18; Lanveer (methomyl) at 8 oz/ac on 25 July; and Radiant at 8 oz/acre on 1 August.

Starting on June 13, weekly root tissue and soil samples were taken from the check (Vaquero) and analyzed for nutrients by Western Laboratories, Inc., Parma, Idaho. Root tissue was analyzed for nutrient concentration, and soil samples were analyzed for concentrations of nutrients in the soil solution. Nutrients were applied only if both the root tissue and soil solution concentrations were simultaneously below the critical levels (Table 1).

Table 1. Nitrogen applied through the drip tape in 2023. Malheur Experiment Station, Oregon State University, Ontario, OR.

Date	N, lb/acre
30-May	25
15-Jun	25
28-Jun	25
10-Jul	25
total	100

Onions in the early-maturing trial were evaluated for maturity and bolting on 31 July. Onions in the red, yellow, and white variety trials were evaluated for maturity and bolting on 31 July, 15 August, and 31 August. Onions in each plot were evaluated subjectively for maturity by visually rating the percentage of onions with the tops down and percent dry leaves. Onions in the red, yellow and white variety trials were evaluated for IYSV severity on 7 August. For the IYSV evaluations, ten consecutive onions in one of the middle two rows in each plot were given a subjective rating on a scale of 0 to 5 for severity of IYSV symptoms. The rating was 0 if there were no symptoms, 1 if 1 to 25% of foliage was diseased, 2 if 26 to 50% of foliage was diseased, 3 if 51 to 75% of foliage was diseased, 4 if 76 to 99% of foliage was diseased, and 5 if 100% of foliage was diseased.

Onions from the middle two double rows in each plot of the early maturing varieties were topped by hand, bagged, and stored on 15 August. The early maturing onions were graded on 24 August.

For the full season harvest, onions from the middle two rows in each plot were topped, bagged and placed in storage on 20 September. The ambient-air storage shed was ventilated, and the temperature was slowly decreased to maintain air temperature as close to 34°F as possible.

At harvest, 25 consecutive bulbs from one of the border rows ranging in diameter from 3½ to 4¼ inches were rated for single centers. The onions were cut equatorially through the bulb middle and separated into single-centered (bullet) 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 inside diameter of the first entire single ring: small had diameters less than 1½ inches, medium had diameters from 1½ to 2¼ inches, and large had diameters greater than 2¼ inches. Onions were considered "functionally single centered" for processing if they were single centered (bullet) or had a small, multiple center.

Red and white onions were graded out of storage on 6 & 8 December respectively. Yellow onions were graded out of storage 11-14 December. During grading, bulbs were separated according to external quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), bulbs infected with the fungus *Botrytis allii* in the neck or side, bulbs infected with the fungus *Fusarium oxysporum* (plate rot), bulbs infected with the fungus *Aspergillus niger* (black mold), and bulbs infected with unidentified bacteria in the external scales. 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). Marketable yield consisted of No.1 bulbs larger than 2¼ inches.

During grading, fifty No. 1 bulbs from each plot were cut longitudinally and evaluated for the presence of incomplete scales, dry scales, internal bacterial rot, and internal rot caused by *Fusarium proliferatum* or other fungi. Incomplete scales were defined as scales that had more than 0.25 inch from the center of the neck missing or any part missing lower down on the scale. Dry scales were defined as scales that had more than 0.25 inch from the center of the neck dry or any part dry deeper in the scale.

On January 9, 2024, a sample of each variety was evaluated for bulb shape, uniformity, firmness, skin color, skin retention, and flesh brightness (Tables 5 and 6, Figure 1). The quality characteristics were evaluated by a group of people who did not know the variety identities. Evaluators included OSU personnel, seed company representatives, and other stakeholders.

The varieties from each of the early-maturity and full-season trials were compared for yield, grade, internal quality, and disease expression. Varietal differences were determined using analysis of variance. Means separation was determined using a protected Fisher's least significant difference test at the 5% probability level, LSD (0.05). The least significant difference values in each table should be considered when comparisons are made between varieties for significant differences in their performance characteristics. Differences between varieties equal to or greater than the LSD value for a characteristic should exist before any variety is considered different from any other variety in that characteristic. Because variety performance varies by year, growers are encouraged to review variety performance data over a number of years before choosing a variety to plant.

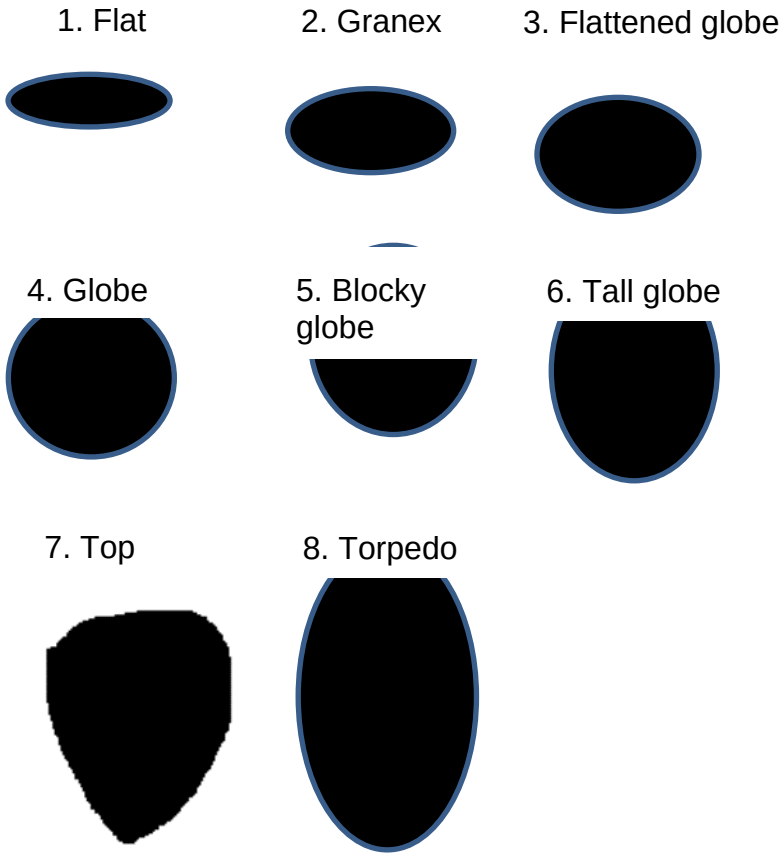

Figure 1. Onion bulb shape rating system. Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 2. Onion variety subjective quality evaluation rating system.

Characteristic	Scale	Description
Bulb shape	1-8	see Fig. 1
Skin color	1-5	1 = light, 5 = dark, white varieties: 1=dark, 5=white
Bulb shape uniformity	1-5	1 = nonuniform shape, 5 = uniform shape
Firmness	1-5	1 = soft, 5 = hard
Skin retention	1-5	1 = bald, 5 = no cracks
Flesh brightness	1-5	yellow varieties: 1 = yellow, 5 = white (5 = more desirable)
	1-5	red varieties: 1 = pale red, 5 = dark red (5 = more desirable)
	1-5	white varieties: 1 = less white, 5 = very white (5 = more desirable)

Results

In 2023, the trial planting date (12 April) was the latest since 1997 when these records were started due to cool, wet conditions. This was 20 days later than the average planting date (March 23) over the previous 26 years. The month of June was mostly average to cooler while July and August were amenable with good growing conditions (Table 3). Onion evapotranspiration curves at the Malheur Experiment Station showed reduced overall crop water use in 2023 when compared to the previous two years. (Figure 2). Growing degree unit accumulation in 2023 (3412) was similar to the 80-year avg (3257) (Figure 3).

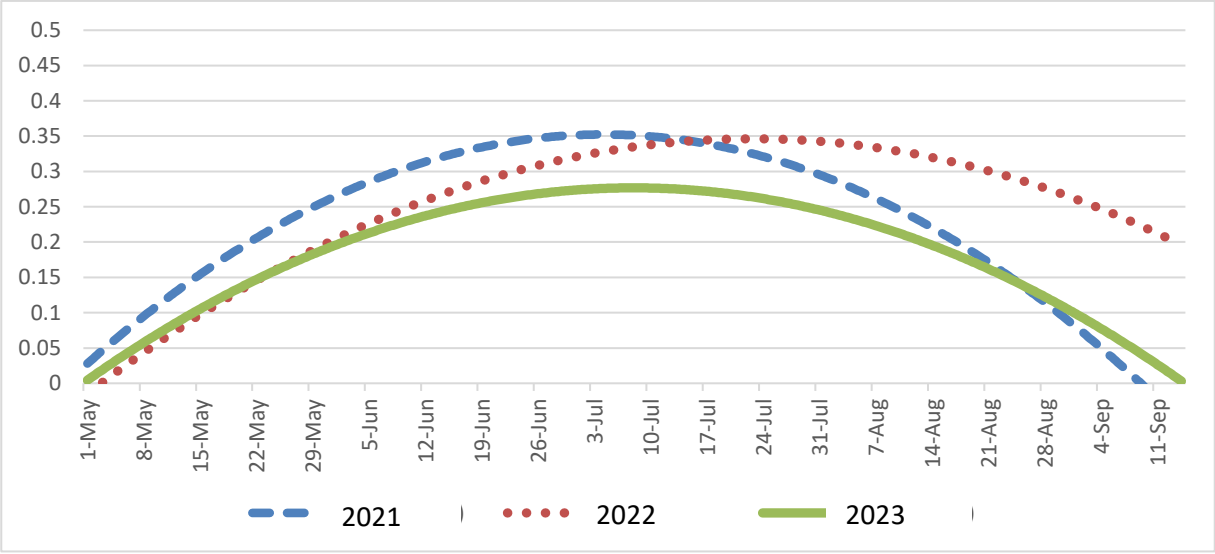

Figure 2. Onion evapotranspiration curves for 2021-2023 at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

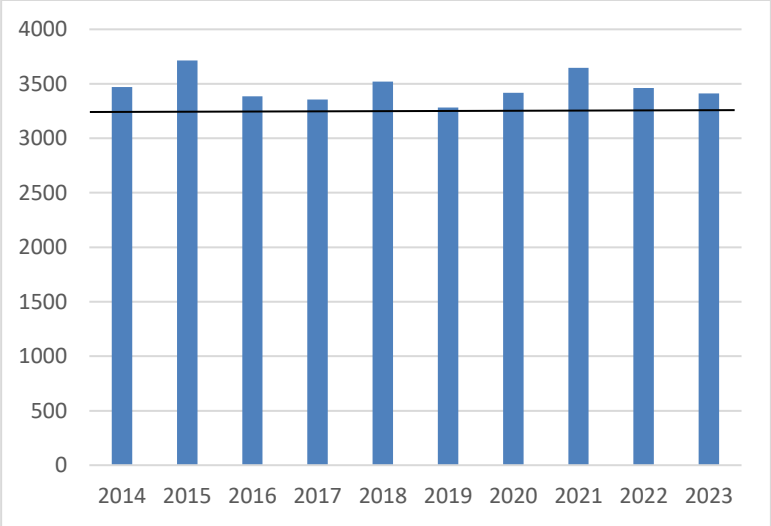

Figure 3. Growing degree units accumulated 2014-2023 with a bar denoting the 80-year average. Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

Table 3. Monthly average maximum and minimum air temperature (°F) in 2023 and the 80-year averages. Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		Apr	May	Jun	Jul	Aug
Maximum	2023	61.0	77.7	81.1	95.7	88.5
	Average	64.3	73.6	82.0	92.0	90.1
Minimum	2023	35.3	50.3	54.8	62.7	60.3
	Average	37.2	45.4	52.2	58.4	55.8

Early-maturing Trial

On 31 July, varieties Highlander, and Outlander had 70% or more tops down (Table 4). The average tops down including them was 26%. Frontier, Avalon, Scout, Ovation, Spanish Medallion and Yosemite were all less than 10% tops down.

The percentage of onions that were functionally single centered averaged 54.5% and ranged from 21.6% for Highlander to 92% for Avalon (Table 5). Total yield averaged 643 cwt/acre, ranging from 330 cwt/acre for Outlander to 975 cwt/acre for Scout (Table 6). The highest percent of Jumbo onions (>50%) 125 days after planting were for Switchback, Scout, Elsye, and Ovation (Table 6).

Full-season Trials

Yellow varieties. On 31 August, the percentage of tops down averaged 73% and ranged from 30% for Caliber to 100% for Traverse (Table 7).

The severity of thrips leaf damage, on a scale from 0 to 10 (0-none), averaged 2.0 and ranged from 1.0 for several varieties to 4.0 for Traverse (Table 7). Bolting was very low in 2023, with most varieties having no bolting (data not shown). The incidence of Iris Yellow Spot Virus (IYSV) averaged 15% of plants infected and ranged from 6% for Almanzoro, Campero, and

Hamilton to 36% for Glorioso. IYSV severity was low in this trial, with an average rating of 0.1 (0–10% of foliage diseased).

The percentage of functionally single-centered bulbs averaged 87% and ranged from 64% for Sedona and 37-126 to 99% for Oloroso (Table 8).

Total yield out of storage in December 2023 averaged 887 cwt/acre and ranged from 622 cwt/acre for Traverse to 1088 cwt/acre for Sedona (Table 9). Marketable yield out of storage averaged 871 cwt/acre and ranged from 604 cwt/acre for Thunderstone to 1075 cwt/acre for Sedona.

In December 2023, the percentage of bulbs with incomplete scales, regardless of dry scale or disease, averaged 25% and ranged from 5% for TTA 782 to 48% for Montero (Table 10). The percentage of bulbs with internal decomposition, regardless of incomplete or dry scales, averaged 8% and ranged from 0.4% for Yakama to 22% for Montero. In 2023, internal decomposition was mainly caused by Botrytis (4.0%) and *Fusarium proliferatum* (3.4%) (Table 11).

Results of the subjective evaluation can be found in table 12.

White varieties. The percentage of tops down averaged 19% on 15 August (Table 13).

The severity of thrips leaf damage, on a scale from 0 to 10, was low, averaging 1.0 (Table 13). IYSV severity was low in this trial, with all varieties showing low intensity of symptoms, with a rating of 1 (0–25% of foliage diseased) or less. Bolting was very low in 2023, not exceeding 0.1% of bulbs, with most varieties having no bolting. The percentage of functionally single-centered bulbs averaged 90% and ranged from 62% for White Cloud to 97% for Rhea (Table 14).

Total yield in December 2023 averaged 928 cwt/acre and ranged from 829 cwt/acre for White Cap to 1000 cwt/acre for 37-127 (Table 15). Marketable yield averaged 912 cwt/acre and ranged from 812 cwt/acre for White Cap to 983 cwt/acre for Rhea. Storage decomposition averaged 0.1% and ranged from 0% for Rhea, Brundage, White Cap, and Cometa to 0.5% for White Cloud.

In December 2023, the percentage of bulbs with incomplete scales, regardless of dry scale or disease, averaged 29% and ranged from 13% for White Cap to 45% for 37-127 (Table 16). The percentage of bulbs with internal decomposition, regardless of incomplete or dry scales, averaged 16% and ranged from 7% for White Cloud to 22% for Cometa. In 2023, the internal decomposition was mainly caused by *Fusarium proliferatum* (Table 17).

Results of the subjective evaluation can be found in table 18.

Red varieties. The percentage of tops down averaged 3% on 31 July, 26% on 15 August, and 87% on 31 August (Table 19).

The percentage of functionally single-centered bulbs averaged 76% and ranged from 38% for Barolo to 94% for Purple Haze (Table 20).

Total yield in December 2023 averaged 586 cwt/acre and ranged from 400 cwt/acre for 37-128 to 822 cwt/acre for Tannat (Table 21). Marketable yield averaged 528 cwt/acre and ranged from

255 cwt/acre for 37-128 to 805 cwt/acre for Tannat. Storage decomposition averaged 3.3% and ranged from 0% for Redwing and Red Beret to 17% for 37-128.

In December 2023, the percentage of bulbs with incomplete scales, regardless of dry scale or disease, averaged 29% and ranged from 14% for Barolo to 44% for Tannat (Table 22). The percentage of bulbs with internal decomposition, regardless of incomplete or dry scales, averaged 7% and ranged from 0.4% for Barolo to 13% for Red Beret. In 2023, the internal decomposition was mainly caused by *Fusarium proliferatum* (Table 23).

Results of the subjective evaluation can be found in Table 24.

Acknowledgements

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Table 4. Maturity ratings for early maturing onion varieties harvested in August 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	31-July	
		Tops down	Leaf dryness
		---------- %	----------
A. Takii	Frontier	3	13
	Highlander	72	16
	Outlander	90	23
	Switchback	48	15
Crookham	Avalon	0	0
	Scout	6	0
Enza Zaden	Elsye	31	5
Sakata	Ovation	2	0
	Spanish Medallion	4	1
	Yosemite	7	0
Average		26	7
LSD (0.05)		10	4

Table 5. Single and multiple-center bulb ratings for early maturing onion varieties harvested in August 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	Multiple center			Single center	
		large	medium	small	functional[a]	bullet
		---------- % ----------				
A. Takii	Frontier	9.0	39.0	42.0	52.0	10.0
	Highlander	42.4	36.0	16.8	21.6	4.8
	Outlander	28.0	44.0	22.4	28.0	5.6
	Switchback	14.4	49.6	27.2	36.0	8.8
Crookham	Avalon	0.8	7.2	39.2	92.0	52.8
	Scout	8.8	16.0	20.8	75.2	54.4
Enza Zaden	Elsye	16.8	25.6	36.0	57.6	21.6
Sakata	Ovation	7.2	24.0	33.6	68.8	35.2
	Yosemite	31.2	32.0	24.8	36.8	12.0
	Spanish Medallion	6.0	17.0	29.0	77.0	48.0
	Average	16.5	29.0	29.2	54.5	25.3
	LSD (0.05)	12.3	16.7	11.4	11.3	11.1

[a]Functional single-centered bulbs are the small multiple-centered bulbs plus the bullet-centered onions.

Table 6. Yield and grade performance of early-maturing onion varieties harvested in August 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

			Marketable yield by grade							Size distribution			
Company	Variety	Total yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	No. 2s	>4¼ in	4-4¼ in	3-4 in	2¼-3 in
		cwt/acre								%			
A. Takii	Frontier	405.5	351.2	0.0	0.0	65.5	285.7	54.1	0.2	0.0	0.0	16.0	70.0
	Highlander	380.1	312.6	0.0	3.8	121.8	187.0	59.9	7.6	0.0	1.0	32.0	49.0
	Outlander	330.4	234.2	0.0	0.0	22.7	211.5	95.3	0.8	0.0	0.0	6.6	63.9
	Switchback	370.1	297.8	0.0	0.0	70.8	227.0	72.2	0.0	7.1	25.3	59.8	6.0
Crookham	Avalon	863.5	848.2	61.4	220.5	514.8	51.5	14.2	1.1	8.9	36.2	49.3	4.1
	Scout	974.7	961.5	87.9	350.0	484.1	39.5	9.3	3.9	2.6	15.3	62.1	15.0
Enza Zaden	Elsye	742.1	705.9	20.4	116.2	459.3	110.0	25.6	10.6	9.1	27.4	53.1	7.1
Sakata	Ovation	749.5	724.7	66.4	204.0	400.9	53.4	8.7	16.1	3.5	17.5	61.4	11.3
	Yosemite	769.8	722.2	27.6	134.3	474.3	86.0	19.1	28.5	16.8	32.4	42.3	4.4
	Spanish Medallion	845.8	811.2	138.9	278.3	358.5	35.5	13.1	21.5	0.0	0.0	19.0	61.2
	Average	643.1	597.0	40.3	130.7	297.3	128.7	37.1	9.0	4.8	15.5	40.2	29.2
	LSD (0.05)	81.6	86.3	36.4	64.6	87.9	41.7	18.5	13.2	5.2	7.7	10.5	6.2

Table 7. Maturity, IYSV ratings, thrips leaf damage on 31 August, and number of leaves per plant of full-season yellow onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

							Number of leaves	
Company	Variety	Tops down	Leaf dryness	IYSV severity[a]	IYSV incidence[b]	Thrips damage[c]	23-Jun	3-Aug
		-------- % ---------		0 - 5	%	0-10		
A. Takii	Traverse	100	53	0.3	26	4	7.7	10.0
	TTA-782	88	18	0.1	14	2	0.4	11.9
Bejo	Colt	79	14	0.2	18	1	6.8	11.5
	Hamilton	54	18	0.1	6	2	6.7	11.5
	Yakama	92	25	0.1	12	1	7.1	10.5
	Sedona	71	15	0.2	16	2	6.6	11.9
	EXP 375	99	34	0.2	16	3	7.1	10.8
Crookham	Trident	80	26	0.2	16	3	6.7	10.9
	Caldwell	84	21	0.1	14	2	7.0	11.4
	Caliber	30	14	0.2	18	1	6.5	12.4
	Epic	88	23	0.1	8	2	6.3	10.0
	Defender	64	19	0.1	8	2	6.6	10.8
Hazera	Thunderstone	77	27	0.1	14	3	7.1	11.3
	37-126	68	21	0.1	10	2	7.0	11.4
Nunhems	Anillo	74	22	0.2	20	2	7.0	11.1
	Arcero	62	27	0.2	18	2	6.9	10.9
	Campero	76	18	0.1	6	1	6.4	11.0
	Glorioso	88	25	0.4	36	2	6.5	10.8
	Granero	90	19	0.2	18	2	7.1	11.3
	Joaquin	58	12	0.1	12	1	7.1	12.1
	Montero	95	34	0.2	16	3	7.0	11.0
	Oloroso	42	26	0.1	8	2	6.7	11.1
	Pandero	44	18	0.1	8	1	6.6	12.2
	Vaquero	47	21	0.2	18	2	7.0	12.0
Seminis	Crusher	90	17	0.1	12	2	6.8	11.5
	Tucannon	80	17	0.1	6	2	6.8	11.5
	Almanzoro	79	16	0.2	18	1	6.5	11.6
	Hatchet	44	20	0.1	14	2	7.0	12.0
	Average	73	22	0.1	15	2	6.6	11.3
	LSD (0.05)	12	5	NS	NS	1	0.5	0.75

[a] IYSV severity: 0 = no disease, 5 = 100% of foliage diseased

[b] IYSV Incidence: percentage of the 10 plants evaluated having at least one lesion

[c] Thrips leaf damage: 0 = no damage, 10 = most damage.

Table 8. Single- and multiple-center ratings for full-season yellow onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		Multiple center			Single center	
Company	Variety	large	medium	small	functional[a]	bullet
		---------- % ----------				
A. Takii	Traverse	0.0	16.8	45.6	83.2	37.6
	TTA-782	7.2	17.6	48.0	75.2	27.2
Bejo	Colt	0.8	6.4	32.8	92.8	60.0
	Hamilton	6.4	16.0	33.6	77.6	44.0
	Legend	0.0	3.2	32.0	96.8	64.8
	Sedona	14.4	21.6	40.0	64.0	24.0
	EXP 375	7.2	17.6	42.4	75.2	32.8
Crookham	Trident	0.0	2.4	14.4	97.6	83.2
	Caldwell	0.0	1.6	12.0	98.4	86.4
	Caliber	0.8	3.2	11.2	96.0	84.8
	Epic	0.0	8.8	20.8	91.2	70.4
	Defender	1.6	4.8	16.0	93.6	77.6
Hazera	Thunderstone	3.2	23.2	30.4	73.6	43.2
	37-126	7.2	28.8	31.2	64.0	32.8
Nunhems	Anillo	0.0	1.6	8.8	98.4	89.6
	Arcero	0.8	4.0	17.6	95.2	77.6
	Campero	5.6	35.2	37.6	59.2	21.6
	Glorioso	0.8	4.8	30.4	94.4	64.0
	Granero	2.4	6.4	27.2	91.2	64.0
	Joaquin	2.4	4.0	19.2	93.6	74.4
	Montero	0.8	2.4	32.8	96.8	64.0
	Oloroso	0.0	0.8	11.2	99.2	88.0
	Pandero	0.8	8.0	33.6	91.2	57.6
	Vaquero	6.4	9.6	35.2	84.0	48.8
Seminis	Crusher	1.6	2.4	19.2	96.0	76.8
	Tucannon	0.0	5.6	16.8	94.4	77.6
	Almanzoro	3.2	14.4	39.2	82.4	43.2
	Hatchet	4.0	5.6	31.2	90.4	59.2
	Average	2.8	9.9	27.5	87.3	59.8
	LSD (0.05)	4.1	7.7	12.9	9.3	12.8

[a] Functional single-centered bulbs are the small multiple-centered bulbs plus the bullet-centered onions.

Table 9. Yield and grade of full-season experimental and commercial yellow onion varieties graded out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

			Marketable yield by grade										
Company	Variety	Total yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	No. 2s	Total rot	Neck rot	Plate rot	Black mold
		---------- cwt/acre ----------								---------- % of total yield ----------			
A. Takii	Traverse	622	610	2	9	470	129	12	0	0.1	0.0	0.1	0.0
	TTA782	942	923	74	343	476	30	8	7	0.2	0.0	0.2	0.0
Bejo	Colt	1030	1016	58	308	602	48	9	5	0.1	0.0	0.1	0.0
	Hamilton	908	881	6	126	684	65	11	15	0.0	0.0	0.0	0.0
	Yakama	1088	1075	74	339	628	33	10	1	0.2	0.0	0.0	0.0
	Sedona	994	947	17	227	645	58	9	38	0.0	0.0	0.0	0.0
	EXP 375	802	774	4	88	591	90	15	13	0.1	0.0	0.1	0.0
Crookham	Trident	763	747	11	71	557	107	16	0	0.1	0.0	0.1	0.0
	Caldwell	925	914	61	246	562	45	10	0	0.1	0.0	0.1	0.0
	Caliber	933	920	169	345	376	30	11	0	0.1	0.0	0.1	0.0
	Epic	852	839	20	154	580	85	13	0	0.0	0.0	0.0	0.0
	Defender	843	832	48	174	543	67	10	0	0.1	0.0	0.1	0.0
Hazera	Thunderstone	631	604	13	124	399	68	17	9	0.1	0.0	0.1	0.0
	37-126	863	854	50	241	532	31	7	2	0.1	0.0	0.1	0.0
Nunhems	Anillo	923	913	47	233	581	51	9	1	0.0	0.0	0.0	0.0
	Arcero	904	893	47	256	543	47	11	0	0.0	0.0	0.0	0.0
	Campero	893	880	53	198	582	47	7	5	0.1	0.0	0.1	0.0
	Glorioso	757	734	0	49	581	105	23	0	0.0	0.0	0.0	0.0
	Granero	980	972	69	337	530	37	6	1	0.0	0.0	0.0	0.0
	Joaquin	1003	995	182	378	398	36	9	0	0.0	0.0	0.0	0.0
	Montero	900	887	31	215	579	62	9	3	0.0	0.0	0.0	0.0
	Oloroso	729	720	13	157	509	41	7	1	0.1	0.0	0.1	0.0
	Pandero	870	857	140	281	414	22	7	5	0.0	0.0	0.0	0.0
	Vaquero	854	841	31	216	552	42	7	4	0.2	0.0	0.2	0.0
Seminis	Crusher	1049	1027	125	349	516	37	9	1	1.2	0.0	1.2	0.0
	Tucannon	912	901	82	254	512	54	9	1	0.1	0.0	0.0	0.0
	Almanzoro	870	847	45	241	507	54	12	8	0.2	0.0	0.2	0.0
	Hatchet	1007	987	128	383	445	31	8	7	0.2	0.0	0.2	0.0
	Average	887	871	57	226	532	55	10	5	0.10		0.10	
	LSD (0.05)	95	98	44	73	102	24	6	10	NS		NS	

Table 10. Internal defects of full-season experimental and commercial yellow onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

		All bulbs						Diseased bulbs						
		Complete scales			Incomplete scales			Complete scales			Incomplete scales			Total
Company	Variety	no dry scale	dry scale	total	no dry scale	dry scale	total	no dry scale	dry scale	total	no dry scale	dry scale	total	
		---------- % ----------												
A. Takii	Traverse	64.9	0.4	65.3	20.9	13.8	34.7	0.0	0.4	0.4	0.4	3.0	3.4	3.8
	TTA782	94.8	0.4	95.2	3.2	1.6	4.8	0.4	0.0	0.4	0.0	1.2	1.2	1.6
Bejo	Colt	80.8	0.0	80.8	10.0	9.2	19.2	0.0	0.0	0.0	0.0	0.8	0.8	0.8
	Hamilton	77.6	0.4	78.0	10.0	12.0	22.0	2.0	0.0	2.0	0.8	3.6	4.4	6.4
	Yakama	86.4	0.4	86.8	5.2	8.0	13.2	0.0	0.0	0.0	0.0	0.4	0.4	0.4
	Sedona	79.6	0.0	79.6	7.2	13.2	20.4	0.4	0.0	0.4	1.2	4.4	5.6	6.0
	EXP 375	74.8	0.0	74.8	19.6	5.6	25.2	0.4	0.0	0.4	1.6	1.6	3.2	3.6
Crookham	Trident	70.0	0.0	70.0	13.6	16.4	30.0	2.0	0.0	2.0	1.6	6.0	7.6	9.6
	Caldwell	86.8	0.0	86.8	9.6	3.6	13.2	1.2	0.0	1.2	0.0	0.0	0.0	1.2
	Caliber	78.4	0.8	79.2	12.8	8.0	20.8	3.6	0.0	3.6	1.2	4.4	5.6	9.2
	Epic	70.4	0.0	70.4	10.8	18.8	29.6	1.2	0.0	1.2	0.8	4.4	5.2	6.4
	Defender	80.0	0.4	80.4	13.2	6.4	19.6	1.2	0.0	1.2	0.8	1.6	2.4	3.6
Hazera	Thunderstone	58.0	0.4	58.4	15.2	26.4	41.6	1.6	0.0	1.6	1.2	5.2	6.4	8.0
	37-126	73.8	0.4	74.2	10.9	15.0	25.9	1.2	0.0	1.2	1.2	5.7	6.9	8.1
Nunhems	Anillo	68.8	0.8	69.6	5.6	24.8	30.4	6.4	0.8	7.2	0.0	11.6	11.6	18.8
	Arcero	70.4	0.4	70.8	12.0	17.2	29.2	0.4	0.0	0.4	2.0	6.0	8.0	8.4
	Campero	84.8	0.8	85.6	4.0	10.4	14.4	2.4	0.4	2.8	0.4	3.6	4.4	6.8
	Glorioso	80.8	0.8	81.6	6.0	12.4	18.4	5.6	0.0	5.6	0.8	5.6	6.4	12.0
	Granero	74.8	0.0	74.8	7.6	17.6	25.2	2.0	0.0	2.0	1.6	4.8	6.4	8.4
	Joaquin	78.4	0.4	78.8	9.6	11.6	21.2	2.4	0.0	2.4	1.2	4.8	6.0	8.4
	Montero	52.0	0.0	52.0	11.6	36.4	48.0	1.2	0.0	1.2	2.4	18.4	20.8	22.0
	Oloroso	58.4	1.6	60.0	9.8	30.3	40.0	2.0	0.4	2.4	3.6	13.6	17.2	19.5
	Pandero	75.6	0.4	76.0	10.4	13.6	24.0	1.6	0.4	2.0	0.8	4.0	4.8	6.8
	Vaquero	68.7	1.2	69.8	12.3	17.9	30.2	4.0	0.0	4.0	1.6	10.7	12.3	16.3
Seminis	Crusher	82.8	2.4	85.2	4.0	10.8	14.8	4.4	0.0	4.4	0.0	3.2	3.2	7.6
	Tucannon	76.4	1.6	78.0	5.6	16.4	22.0	2.4	0.8	3.2	1.2	3.2	4.4	7.6
	Almanzoro	89.2	2.8	92.0	2.0	6.0	8.0	1.6	0.0	1.6	0.8	1.6	2.4	4.0
	Hatchet	52.4	1.2	53.6	16.0	30.4	46.4	0.4	0.4	0.8	0.8	4.4	5.2	6.0
	Average	74.6	0.6	75.3	10.0	14.8	24.7	1.9	0.1	2.0	1.0	4.9	5.9	7.9
	LSD (0.05)	9.7	NS	10.1	7.1	8.5	10.1	2.8	NS	2.8	NS	4.8	4.5	4.9

Table 11. Internal decomposition by disease type of full-season experimental and commercial yellow onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	Bacterial Rot	*Fusarium proliferatum*	Neck Rot	Black Mold
			---------- % ----------		
A. Takii	Traverse	0.0	0.3	0.4	3.1
	TTA782	0.0	1.6	0.0	0.0
Bejo	Colt	0.0	0.8	0.0	0.0
	Hamilton	0.4	5.2	0.8	0.0
	Yakama	0.0	0.4	0.0	0.0
	Sedona	0.0	4.4	1.2	0.4
	EXP 375	0.0	0.4	1.2	2.0
Crookham	Trident	0.0	2.8	6.8	0.0
	Caldwell	0.0	0.4	0.8	0.0
	Caliber	0.0	2.4	6.8	0.0
	Epic	0.0	1.6	4.0	0.8
	Defender	0.4	0.8	2.4	0.0
Hazera	Thunderstone	0.0	3.2	4.4	0.4
	37-126	0.0	4.0	3.7	0.4
Nunhems	Anillo	2.4	6.0	10.4	0.0
	Arcero	0.4	4.4	3.6	0.0
	Campero	0.4	2.4	3.6	0.4
	Glorioso	0.4	4.8	6.8	0.0
	Granero	0.0	4.0	4.4	0.0
	Joaquin	1.2	4.8	2.4	0.0
	Montero	0.8	10.8	10.0	0.4
	Oloroso	0.0	10.9	8.6	0.0
	Pandero	0.0	3.6	3.2	0.0
	Vaquero	0.4	7.9	7.9	0.0
Seminis	Crusher	0.0	1.2	6.4	0.0
	Tucannon	0.4	2.4	4.8	0.0
	Almanzoro	0.0	0.0	4.0	0.0
	Hatchet	0.0	2.4	3.6	0.0
	Average	0.3	3.4	4.0	0.3
	LSD (0.05)	0.97	3.49	3.76	0.68

Table 12. Subjective evaluation of bulb characteristics for yellow onion varieties. Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

Company	Variety	Bulb shape[a]	Bulb shape uniformity[b]	Firmness[b]	Scale retention[b]	Skin color[b]	Flesh brightness[b]
				1 - 5			
A. Takii	Traverse	4.0	4.0	3.5	2.5	3.5	4.5
	TTA782	4.0	4.0	4.0	5.0	4.5	3.0
Bejo	Colt	3.5	3.0	4.0	5.0	4.0	3.5
	Hamilton	4.0	4.0	4.5	5.0	4.5	3.0
	Yakama	3.0	2.5	3.5	3.0	3.0	4.0
	Sedona	4.0	3.5	4.0	4.0	3.5	3.5
	EXP 375	3.0	2.0	4.0	3.0	3.5	3.5
Crookham	Trident	4.0	2.0	3.0	3.0	3.0	3.0
	Caldwell	4.0	4.0	3.5	3.5	3.0	5.0
	Caliber	3.0	3.0	3.5	3.5	3.5	4.0
	Epic	5.0	3.0	3.5	3.5	3.5	4.0
	Defender	4.0	3.0	4.0	3.5	4.0	4.0
Hazera	Thunderstone	4.0	4.0	3.5	3.0	3.5	4.0
	37-126	5.0	4.0	4.0	4.5	4.0	3.5
Nunhems	Anillo	4.0	4.5	3.5	5.0	4.0	4.5
	Arcero	4.0	4.0	4.0	4.5	4.5	5.0
	Campero	4.0	3.5	3.5	4.0	4.5	3.0
	Glorioso	5.0	4.5	4.5	5.0	5.0	4.0
	Granero	3.0	3.5	3.5	4.0	4.0	3.0
	Joaquin	4.0	3.5	4.0	4.0	4.0	4.5
	Montero	3.0	2.0	3.0	3.5	3.0	3.5
	Oloroso	4.0	4.0	4.5	4.0	4.0	4.0
	Pandero	5.0	4.0	3.5	4.5	4.0	3.0
	Vaquero	4.0	3.0	4.5	4.5	4.0	3.5
Seminis	Crusher	6.0	4.5	3.5	4.5	4.0	4.0
	Tucannon	4.0	4.5	4.0	5.0	4.0	3.5
	Almanzoro	6.0	3.0	3.5	4.0	3.5	4.0
	Hatchet	4.0	4.0	3.5	3.5	4.0	4.0
	Average	4.1	3.5	3.8	4.0	3.8	3.8

[a] Bulb shape: see Fig. 1.
[b] Subjective ratings are described in Table 4: 1 = worst, 5 = best.

Table 13. Maturity, thrips leaf damage, and IYSV ratings of full-season white onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		August 15					Number of leaves	
Company	Variety	Tops down	Leaf dryness	Thrips leaf damage[a]	IYSV severity[b]	IYSV Incidence[c]	23-Jun	3-Aug
		-------- % --------		0 - 10	0 - 5	%		
Crookham	Brundage	21	7	1.2	0.3	24	6.9	11.3
	White Cap	17	7	1.6	0.2	22	6.5	11.9
	White Cloud	19	8	1.0	0.1	12	6.3	11.1
Hazera	37-127	5	5	1.0	0.2	22	7.4	12.2
Nunhems	Cometa	28	5	1.6	0.1	10	6.8	11.7
	Rhea	21	4	1.0	0.2	16	6.7	11.7
	Average	19	6	1	0.2	18	6.8	11.7
	LSD (0.05)	9	3	0.5	NS	NS	0.4	NS

[a] Thrips leaf damage: 0 = no damage, 10 = most damage.

[b] IYSV severity: 0 = no disease, 5 = 100% of foliage diseased

[c] IYSV Incidence: percentage of the 10 plants evaluated having at least one lesion

Table 14. Single- and multiple-center ratings for full-season white onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		Multiple center			Single center	
Company	Variety	large	medium	small	functional[a]	bullet
			---------- % ----------			
Crookham	Brundage	0.8	4.0	13.6	95.2	81.6
	White Cap	0.0	5.6	13.6	94.4	80.8
	White Cloud	11.2	27.2	26.4	61.6	35.2
Hazera	37-127	2.4	4.8	20.0	92.8	72.8
Nunhems	Cometa	0.8	2.4	12.8	96.8	84.0
	Rhea	0.0	3.0	10.1	97.0	87.0
	Average	2.5	7.8	16.1	89.6	73.6
	LSD (0.05)	4.1	6.8	9.1	8.7	11.8

[a] Functional single-centered bulbs are the small multiple-centered bulbs plus the bullet-centered onions.

Table 15. Yield and grade of full-season experimental and commercial white onion varieties graded out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

			Marketable yield by grade									
Company	Variety	Total yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	No. 2s	Total rot	Neck rot	Plate rot
			---------- cwt/acre ----------							--- % of total yield ---		
Crookham	Brundage	874	858	63	252	488	55	11	1	0.0	0.00	0.00
	White Cap	829	812	62	242	450	58	13	3	0.0	0.04	0.00
	White Cloud	942	912	71	283	498	60	12	10	0.5	0.04	0.07
Hazera	37-127	1000	983	142	422	401	19	6	6	0.1	0.02	0.06
Nunhems	Cometa	962	953	103	333	483	34	9	0	0.0	0.00	0.00
	Rhea	960	951	59	309	542	41	9	0	0.0	0.00	0.00
	Average	928	912	83	307	477	45	10	3	0.1	0.02	0.02
	LSD (0.05)	66	65	40	76	NS	21	NS	NS	NS	NS	NS

Table 16. Internal defects of full-season experimental and commercial white onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

		All bulbs						Diseased bulbs						
		Complete scales			Incomplete scales			Complete scales			Incomplete scales			Total
Company	Variety	no dry scale	dry scale	total	no dry scale	dry scale	total	no dry scale	dry scale	total	no dry scale	dry scale	total	
		---------- % ----------												
Crookham	Brundage	71.2	0.0	71.2	7.2	21.6	28.8	0.8	0.0	0.8	1.6	16.8	18.4	19.2
	White Cap	85.6	1.2	86.8	2.0	11.2	13.2	1.6	0.4	2.0	0.0	5.6	5.6	7.6
	White Cloud	82.8	0.4	83.2	4.4	12.4	16.8	1.2	0.0	1.2	0.4	5.6	6.0	7.2
Hazera	37-127	55.0	0.0	55.0	20.5	24.5	45.0	0.4	0.0	0.4	4.4	15.7	20.1	20.5
Nunhems	Cometa	72.4	0.4	72.8	2.4	24.8	27.2	2.8	0.0	2.8	0.0	19.2	19.2	22.0
	Rhea	57.2	0.8	58.0	17.2	24.8	42.0	0.4	0.0	0.4	2.0	16.0	18.0	18.4
	Average	70.7	0.5	71.2	8.9	19.9	28.8	1.2	0.1	1.3	1.4	13.1	14.5	15.8
	LSD (0.05)	12.2	NS	12.2	11.2	NS	12.2	NS	NS	NS	NS	NS	NS	NS

Table 17. Internal decomposition by disease type of full-season experimental and commercial white onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	Bacterial Rot	*Fusarium proliferatum*	Neck Rot	Black Mold
			---------- % ----------		
Crookham	Brundage	0.4	14.8	4.0	0.0
	White Cap	0.0	6.0	1.6	0.0
	White Cloud	0.0	4.8	2.4	0.0
Hazera	37-127	0.4	17.6	2.4	0.0
Nunhems	Cometa	2.0	4.8	6.8	0.0
	Rhea	1.6	14.0	2.8	0.0
	Average	0.7	10.3	3.3	
	LSD (0.05)	NS	NS	NS	

Table 18. Subjective evaluation of bulb characteristics for white onion varieties. Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

Company	Variety	Bulb shape[a]	Bulb shape uniformity[b]	Firmness[b]	Scale retention[b]	Skin color[b]	Flesh brightness[b]
			---------- 1 - 5 ----------				
Crookham	Brundage	4.0	3.5	4.0	4.0	3.0	3.0
	White Cap	6.0	3.5	3.0	4.0	4.0	4.0
	White Cloud	4.0	3.0	3.5	3.5	2.5	3.0
Hazera	37-127	3.5	4.0	4.0	4.0	3.5	3.5
Nunhems	Cometa	5.0	4.0	4.0	4.0	3.5	3.5
	Rhea	4.0	3.0	4.0	4.0	3.0	3.5
	Average	4.4	3.5	3.6	3.9	3.3	3.4

[a] Bulb shape: see Fig. 1.
[b] Subjective ratings are described in Table 4: 1 = worst, 5 = best.

Table 19. Maturity ratings and number of leaves per plant of full-season red onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		July 31		August 15		August 31		Number of leaves	
Company	Variety	Tops down	Leaf dryness	Tops down	Leaf dryness	Tops down	Leaf dryness	23-Jun	3-Aug
		---------- % ----------							
Bejo	Redwing	0	5	6	17	77	44	6.8	9.7
Crookham	Purple Haze	2	1	15	15	77	50	6.5	10.1
	Red Beret	4	4	32	18	82	50	6.3	10.6
Enza Zaden	Barolo	8	3	66	16	100	43	6.7	8.5
	Tannat	1	0	23	5	93	20	6.9	11.7
Hazera	37-128	3	7	11	25	92	80	6.2	10.7
	Average	3	3	26	16	87	48	6.6	10.2
	LSD (0.05)	3	4	15	6	12	17	0.38	0.83

Table 20. Single- and multiple-center ratings for full-season red onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

		Multiple center			Single center	
Company	Variety	large	medium	small	functional[a]	bullet
			---------- % ----------			
Bejo	Redwing	0.0	8.0	22.4	92.0	69.6
Crookham	Purple Haze	0.8	5.6	14.4	93.6	79.2
	Red Beret	3.2	4.8	16.8	92.0	75.2
Enza Zaden	Barolo	21.6	40.0	29.6	38.4	8.8
	Tannat	3.2	19.9	34.9	76.9	42.0
Hazera	37-128	11.5	25.6	39.6	62.9	23.3
	Average	6.7	17.3	26.3	76.0	49.7
	LSD (0.05)	10.9	9.7	15.5	15.3	11.7

[a] Functional single-centered bulbs are the small multiple-centered bulbs plus bullet-centered onions.

Table 21. Yield and grade of full-season experimental and commercial red onion varieties graded out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	Total yield	Marketable yield by grade					Small	No. 2s	Total rot	Neck rot	Plate rot	Black mold
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in						
			cwt/acre								% of total yield		
Bejo	Redwing	590	535	0.0	18.0	376.7	140.4	55.0	0.0	0.0	0.0	0.0	0.0
Crookham	Purple Haze	562	513	0.0	9.8	306.0	197.4	46.2	1.2	1.4	0.0	1.4	0.0
	Red Beret	536	494	0.0	16.4	304.1	173.5	40.1	1.9	0.0	0.0	0.0	0.0
Enza Zaden	Barolo	608	565	0.0	8.4	360.1	196.9	34.4	7.2	0.7	0.0	0.7	0.0
	Tannat	822	805	3.0	76.0	635.4	90.6	14.4	2.3	0.5	0.0	0.5	0.0
Hazera	37-128	400	255	0.0	0.7	64.0	190.1	84.8	43.7	17.0	0.0	17.0	0.0
	Average	586	528	0.5	21.5	341	164.8	45.8	9.4	3.3		3.3	
	LSD (0.05)	79	78	2.2	16.2	64.2	35.1	12.3	13.9	NS		NS	

Table 22. Internal defects of full-season experimental and commercial red onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	All bulbs							Diseased bulbs						
		Complete scales			Incomplete scales			I	Complete scales			Incomplete scales			Total
		no dry scale	dry scale	total	no dry scale	dry scale	total		no dry scale	dry scale	total	no dry scale	dry scale	total	
		%													
Bejo	Redwing	72.5	5.0	77.5	13.2	9.3	22.5		0.0	0.0	0.0	0.4	3.6	4.0	4.0
Crookham	Purple Haze	66.3	0.4	66.7	13.7	19.7	33.3		1.2	0.0	1.2	0.4	4.0	4.4	5.6
	Red Beret	66.8	0.4	67.2	16.8	16.0	32.8		5.2	0.0	5.2	1.6	6.0	7.6	12.8
Enza Zaden	Barolo	86.4	0.0	86.4	11.2	2.4	13.6		0.0	0.0	0.0	0.4	0.0	0.4	0.4
	Tannat	55.2	0.4	55.6	20.9	23.5	44.4		1.2	0.0	1.2	0.8	7.7	8.5	9.7
Hazera	37-128	72.9	0.0	72.9	12.8	14.3	27.1		2.8	0.0	2.8	0.0	5.7	5.7	8.5
	Average	70.0	1.0	71.0	14.2	14.2	29.0		1.7		1.7	0.6	4.5	5.1	6.8
	LSD (0.05)	NS	NS	NS	NS	NS	NS		NS		NS	NS	NS	NS	6.9

Table 23. Internal decomposition by disease type of full-season experimental and commercial red onion varieties evaluated out of storage in December 2023, Malheur Experiment Station, Oregon State University, Ontario, OR.

Seed company	Variety	Bacterial Rot	*Fusarium proliferatum*	Neck Rot	Black Mold
			---------- % ----------		
Bejo	Redwing	0.4	3.6	0.0	0.0
Crookham	Purple Haze	1.6	4.0	0.0	0.0
	Red Beret	6.8	6.0	0.0	0.0
Enza Zaden	Barolo	0.0	0.4	0.0	0.0
	Tannat	1.2	8.5	0.0	0.0
Hazera	37-128	4.9	3.6	0.0	0.0
	Average	2.5	4.3		
	LSD (0.05)	4.3	NS		

Table 24. Subjective evaluation of bulb characteristics for red onion varieties. Malheur Experiment Station, Oregon State University, Ontario, OR, 2023.

Company	Variety	Bulb shape[a]	Bulb shape uniformity[b]	Firmness[b]	Scale retention[b]	Skin color[b]	Flesh brightness[b]
				---------- 1 - 5 ----------			
Bejo	Redwing	4.0	3.5	4.0	3.5	3.0	3.0
Crookham	Purple Haze	3.0	3.0	3.0	3.0	3.0	3.0
	Red Beret	3.0	2.0	2.5	2.0	3.0	3.0
Enza Zaden	Barolo	4.0	3.0	3.0	1.0	4.5	4.0
	Tannat	3.0	3.0	3.5	4.0	4.5	4.5
Hazera	37-128	4.0	2.5	4.0	4.0	4.0	4.0
	Average	3.5	2.8	3.3	2.9	3.7	3.6

[a] Bulb shape: see Fig. 1.

[b] Subjective ratings are described in Table 4: 1 = worst, 5 = best.