

2011 ONION VARIETY TRIALS

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Introduction

The objectives of the onion variety trials were to evaluate yellow, white, and red onion varieties for disease, maturity, bolting, single centers, and bulb yield and grade out of storage. Three early-season yellow varieties were planted in March and were harvested and graded in early September. Forty-seven full-season varieties (34 yellow, 6 red, and 7 white) were planted in March, harvested in September 2011, and graded out of storage in January 2012. Each year, growers and seed industry representatives have the opportunity to examine the varieties at our annual Onion Variety Field Day in late August and during onion grading in early January. Varieties are evaluated for yield, grade, internal quality, and storability.

Methods

In 2011, onions were grown on an Owyhee silt loam previously planted to wheat. In the fall of 2010 the wheat stubble was shredded and the field was irrigated and disked. Based on a soil analysis, 150 lb phosphate (P₂O₅)/acre, 80 lb sulfur/acre, 7 lb manganese/acre, and 1 lb boron/acre were broadcast in the fall of 2010. The field was then ripped, moldboard-plowed, and groundhogged. The field was fumigated with Vapam[®] (metham sodium) at 50 gal/acre applied through a solid set sprinkler system on March 1, 2011. On March 22, the field was roller harrowed and bedded into 22-inch rows.

Both the full-season trial and the early-maturing trial were planted on April 12, adjacent to each other, and in plots 4 double rows wide and 27 ft long. The planting date was later than normal due to snow, rain, and wet soil. The early-maturing trial had 3 varieties from 3 seed companies (Table 3) and the full-season trial had 47 varieties from 9 seed companies (Table 4). The experimental designs for both trials were randomized complete blocks with five replicates. A sixth nonrandomized replicate was planted for demonstrating onion variety performance to growers and seed company representatives.

Seed was planted in double rows spaced 3 inches apart at 9 seeds/ft of single row. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onions received a narrow band of Lorsban 15G[®] at 3.7 oz/1,000 ft of row (0.82 lb ai/acre), and the soil surface was rolled. Onion emergence started on May 2. On June 8, alleys 4 ft wide were cut between plots, leaving plots 23 ft long. On June 9 and 10, the seedlings were hand thinned to a plant population of 2 plants/ft of single row (6-inch spacing between individual onion plants, or 95,000 plants/acre).

The onions were managed to minimize yield reductions from weeds, pests, diseases, water stress, and nutrient deficiencies. On May 13, Prowl H₂O[®] at 0.95 lb ai/acre was applied for weed control. On May 31, Goal[®] at 0.16 lb ai/acre, Buctril[®] at 0.19 lb ai/acre, and Volunteer[®] at 0.25 lb ai/acre were applied for weed control. On July 12, Prowl H₂O[®] at 0.45 lb ai/acre and Poast[®]

at 1 pint/acre were applied for weed control. On June 13 and June 28, Movento[®] at 5 oz/acre was applied for thrips control. On July 12, Radiant[®] at 10 oz/acre was applied for thrips control. The field received one aerial application of Radiant[®] at 10 oz/acre on July 23 and one aerial application of Lannate[®] at 0.9 lb ai/acre on July 31 for thrips control.

Based on analyses of root tissue samples taken on June 21, July 8, and July 22, a total of 220 lb nitrogen/acre, 40 lb potassium/acre, and 0.4 lb boron/acre were applied during the season.

The trial was furrow irrigated when the soil water tension at 8-inch depth reached 25 cb (1 cb = 1 kPa) (Shock et al. 2005). Starting in early June, soil water tension was monitored by six granular matrix sensors (GMS, Watermark Soil Moisture Sensors Model 200SS, Irrrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with an AM-400 meter (Mike Hansen Co., East Wenatchee, WA). The last irrigation was on September 2.

The early-maturing trial was evaluated for maturity on September 6 and the full-season trial was evaluated for maturity on September 6 and September 12. Onions in each plot were evaluated subjectively for maturity by visually rating the percentage of onions with the tops down and the percent dryness of the foliage. The number of bolted onion plants was counted in each plot.

Onions in each plot of the full-season trial were evaluated subjectively for severity of symptoms of iris yellow spot virus (IYSV) on September 6. Each plot was given a rating on a scale of 0 to 5 of increasing severity of symptoms. The rating was 0 if there were no symptoms, 1 if 1-25 percent of foliage was diseased, 2 if 26-50 percent of foliage was diseased, 3 if 51-75 percent of foliage was diseased, 4 if 76-99 percent of foliage was diseased, and 5 if 100 percent of foliage was diseased. On September 12, plots were also rated for subjective symptoms of powdery mildew (*Leveillula taurica*) using the same system as for IYSV.

At harvest, bulbs from one of the border rows in each plot of both trials were rated for single centers. Twenty-five consecutive onions ranging in diameter from 3½ to 4¼ inches 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 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 or had a small multiple center.

Onions from the middle two double rows in each plot in the early maturity trial were topped by hand, bagged, and graded on September 6.

The onions in the full-season trial were lifted on September 13 to field cure. Onions from the middle two rows in each plot of the full-season trial were topped by hand and bagged on September 19. The bags were put in storage on October 3. The storage shed was ventilated and the temperature was slowly decreased to maintain air temperature as close to 34°F as possible. Onions from the full-season trial were graded out of storage on January 9 and 10, 2012.

During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1s), split bulbs (No. 2s), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *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 determined for each plot of every variety by weighing and counting all super colossal bulbs during grading. Marketable yield consists of No.1 bulbs larger than 2¼ inches.

After grading, one sample of each variety consisting of a combination of two replicates was evaluated for subjective quality characteristics on January 20, 2012 (Fig. 1, Table 1). The quality characteristics were evaluated by 10 people including Brian Bair, Keithly-Williams Seed; Casey Crookham, Scott Seed; Clint Shock and Erik Feibert, Malheur Experiment Station; Danny Gabiola, Champion Seed; Deron Beck, Seminis Seed; Diane Crookham; James Pierce, Seminis Seed; Jim Klauzer, Clearwater Supply; and Lyndon Johnson, Nunhems. The characteristics evaluated were: bulb shape, skin color, bulb shape uniformity, firmness, scale retention, and flesh brightness (Fig. 1, Table 1).

Objective varietal differences were compared using analysis of variance. Means separation was determined using Fisher's least significant difference test at the 5 percent probability level, LSD (0.05). The varieties from each of the early maturity and full-season trials were compared for yield, grade, internal quality, and disease expression. Results are listed in Tables 1-4 in alphabetical order by company. The least significant difference LSD (0.05) values in each table should be considered when comparisons are made between varieties for significant differences in 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. Variety performance will vary by year. Growers are encouraged to review performance over a number of years before choosing a variety to plant.

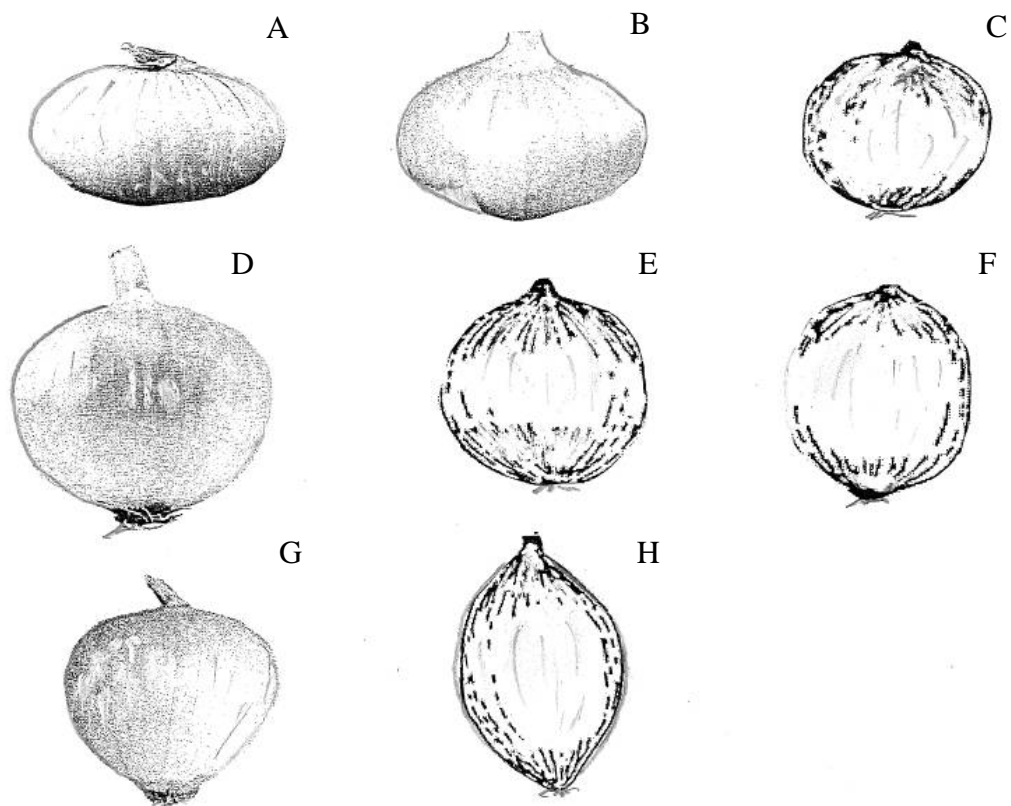


Figure 1. Onion bulb shape rating system. Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 1. Onion variety subjective quality evaluation rating system.

Characteristic	Scale	description
Bulb shape	A - H	see Fig. 1
Skin color	1 - 5	1 = light, 5 = dark
Bulb shape uniformity	1 - 5	1 = disuniform bulb shape, 5 = uniform bulb shape
Firmness	1 - 5	1 = soft, 5 = hard
Scale retention	1 - 5	1 = bald, 5 = no cracks
Flesh brightness	1 - 5	yellow varieties: 1 = yellow, 5 = white red varieties: 1 = dark red, 5 = pale red white varieties: 1 = less white, 5 = very white

Results

Planting was delayed until April due to excessively wet soil from winter snow and higher than normal precipitation in March. The 2011 season was cool, with lower heat units than normal, particularly during March, April, and May (Fig. 2). The crop developed slowly.

Early-maturing Trial

The percentage of single-centered bulbs averaged 54.7 percent and ranged from 39.2 percent for 'Ovation' to 78.4 percent for 'Montero' (Table 2). The percentage of onions that were functionally single centered averaged 59.5 percent and ranged from 47.2 percent for 'DPID1472' to 82.4 percent for Montero.

Total yield averaged 806.1 cwt/acre and ranged from 669.7 cwt/acre for DPID1472 to 905.9 cwt/acre for Ovation (Table 3).

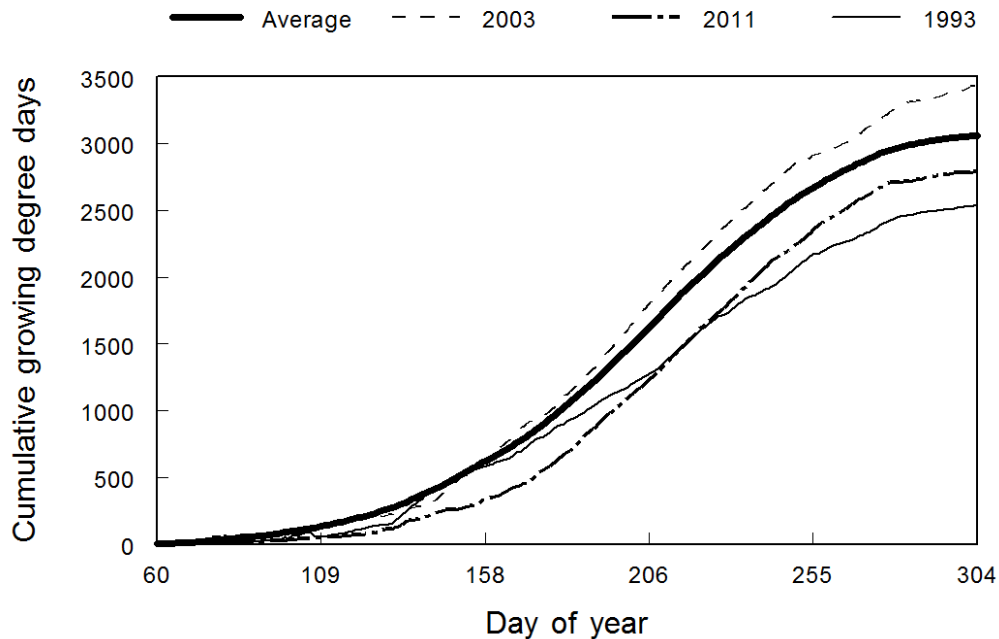


Figure 2. Cumulative growing degree-days (50-86°F) over time for years with the lowest (1993) and the highest (2003) totals since 1990, compared to 2011 and to the 20-year average (1990-2010), Malheur Experiment Station, Oregon State University, Ontario, OR.

Full-Season Trial

The percentage of single-centered bulbs averaged 64.6 percent and ranged from 12 percent for ‘T-433’ to 96.8 percent for ‘NIZ 2020’ (Table 4). The percentage of functionally single centered bulbs averaged 68 percent and ranged from 13.6 percent for T-433 to 98.4 percent for NIZ 2020.

Total yield out of storage averaged 654.5 cwt/acre and ranged from 315.4 cwt/acre for ‘DPR 3073’ to 903.6 cwt/acre for ‘Avalon’ (Table 5). Avalon, ‘Ranchero’, T-433, ‘XON-659Y’, ‘Swale’, ‘Granero’, ‘Belmar’, ‘Arruba’, and ‘Vaquero’ were among the varieties with the highest total yield and marketable yield.

Iris Yellow Spot Virus (IYSV)

Iris yellow spot virus severity in 2011 was low (Table 4). The subjective ratings of IYSV symptom severity for the full-season varieties on September 6, on a scale from 0 to 5, ranged from 0 for numerous varieties to 0.8 for ‘Barbaro’ and averaged 0.3. There were no statistically significant differences between varieties in IYSV symptom severity.

Subjective Quality Evaluation

Subjective quality ratings can be found in Table 6 and explanation of the rating system can be found in Figure 1 and Table 1. Substantial variation was found between varieties in all subjective characteristics.

Acknowledgements

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References

Shock, C.C., R. Flock, E. Feibert, C.A. Shock, A. Pereira, and L. Jensen. 2005. Irrigation monitoring using soil water tension. Oregon State University Extension Service EM 8900.

Table 2. Maturity and single- and multiple-center bulb ratings for early maturing varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Seed company	Variety	Bulb color	Maturity Sept. 6		Multiple center			Single center	
			Tops down	Leaf dryness	large	medium	small	functional*	single
----- % -----									
Nunhems	Montero	Y	56.0	32.0	1.6	16	4	82.4	78.4
Sakata	Ovation	Y	56.0	28.0	13.6	37.6	9.6	48.8	39.2
D. Palmer	DPID1472	Y	24.0	22.0	32.8	20	0.8	47.2	46.4
	Average		45.3	27.3	16.0	24.5	4.8	59.5	54.7
LSD (0.05)			11.8	7.5	10.5	15.7	NS	19.3	15.4

*single + small multiple center

Table 3. Yield and grade performance of early maturing varieties lifted and harvested September 6, 2011, Malheur Experiment Station, Oregon State University, Ontario, OR.

Seed company	Variety	Bulb color	Total yield	Marketable yield by grade							Bulb counts >4¼ in
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	No. 2s	Small	
----- cwt/acre -----											
Nunhems	Montero	Y	842.6	835.4	6.9	135.7	671.0	21.9	0.0	7.2	31.5
Sakata	Ovation	Y	905.9	901.4	45.0	316.2	529.8	10.4	0.6	3.9	34.8
D. Palmer	DPID1472	Y	669.7	651.5	16.3	95.4	510.8	29.0	7.9	10.2	35.6
	Average		806.1	796.1	22.7	182.4	570.5	20.4	2.8	7.1	34.0
LSD (0.05)			89.6	87.4	28.8	77.9	59.4	11.9	4.4	NS	NS

Table 4. Single- and multiple-centered bulb rating, maturity, and iris yellow spot virus (IYSV) rating for full-season varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2011.

Seed company	Variety	Bulb color	Multiple center			Single center		Maturity Sept. 6		IYSV rating ^b
			large	medium	small	Functional single center ^a	Single center	Tops down	Leaf dryness	
----- % -----										
A. Takii	Centerstone	Y	46.8	40.8	10.4	37.6	27.2	26	34	0.6
	T-433	Y	6.6	60.0	1.6	13.6	12.0	14	12	0.0
Bejo	Calibra	Y	7.1	28.8	5.6	36.8	31.2	50	28	0.4
	Crockett	Y	3.5	25.6	4.0	64.0	60.0	22	24	0.2
	Delgado	Y	10.6	30.4	7.2	42.4	35.2	36	26	0.6
	Legend	Y	8.2	30.4	7.2	47.2	40.0	22	18	0.4
	Sedona	Y	2.9	17.6	5.6	68.8	63.2	30	30	0.6
Crookham	The Rock	Y	0.0	3.2	3.2	96.8	93.6	18	18	0.4
	White Cloud	W	3.5	48.8	4.0	30.4	26.4	44	26	0.2
	Oracle	Y	0.3	8.8	0.8	88.8	88.0	16	12	0.0
	Advantage	Y	0.0	4.8	0.8	95.2	94.4	12	16	0.4
	Avalon	Y	2.7	34.4	6.4	54.4	48.0	46	26	0.0
	Pontiac	Y	0.7	10.4	1.6	87.2	85.6	30	32	0.4
	Trigger	Y	20.0	1.6	1.6	97.6	96.0	18	18	0.4
D. Palmer	DPL 1473	Y	20.4	36.0	2.4	41.6	39.2	24	22	0.6
	DPL 1474	Y	13.6	24.3	5.2	43.0	37.8	24	26	0.4
	DPL 1476	Y	17.2	29.6	2.4	18.4	16.0	16	18	0.2
	DPL 1477	Y	9.5	24.0	8.0	44.8	36.8	26	30	0.4
	DPR 3071	R	10.4	12.0	4.0	62.4	58.4	22	28	0.2
	DPR 3072	R	14.6	14.4	4.0	54.4	50.4	28	28	0.6
	DPR 3073	R	18.9	18.4	2.4	43.2	40.8	30	30	0.2
	DPLD 2055	W	3.2	28.0	11.2	61.6	50.4	32	30	0.0
	DPLD 2056	W	14.8	26.4	4.0	38.4	34.4	24	22	0.4
Nickerson-Zwaan	NIZ 2025	Y	4.3	20.0	1.6	71.2	69.6	20	24	0.4
	NIZ 2020	Y	0.0	1.6	1.6	98.4	96.8	40	28	0.4
	37-2035	Y	0.4	7.2	0.0	90.4	90.4	22	20	0.2
Nippon Norin	NN65	Y	3.0	14.9	5.6	80.4	74.8	18	24	0.6
Nunhems	Ranchero	Y	3.9	22.5	2.3	70.5	68.3	32	20	0.2
	Granero	Y	1.6	24.0	5.6	71.2	65.6	30	24	0.0
	Vaquero	Y	6.4	16.8	1.6	76.0	74.4	34	26	0.2
	Arcero	Y	0.6	6.4	0.8	91.2	90.4	28	26	0.4
	Joaquin	Y	0.8	8.7	0.0	89.7	89.7	24	18	0.2
	NUN 7015	Y	5.0	2.4	1.6	96.8	95.2	34	26	0.6
	NUN 7202	Y	0.1	3.2	0.0	96.0	96.0	20	20	0.4
	Solstice	W	0.5	12.0	7.2	84.0	76.8	36	24	0.2
	Cometa	W	0.3	10.4	3.2	88.0	84.8	20	20	0.4
	NUN 8003	W	0.0	1.6	4.0	98.4	94.4	40	24	0.0
	Marengo	R	0.5	16.6	2.4	81.8	79.4	52	42	0.0
Sakata	Arruba	Y	3.4	25.6	2.4	64.8	62.4	30	20	0.0
	Bello Blanco	W	4.6	18.4	1.6	72.0	70.4	30	24	0.4
	XON-659Y	Y	11.2	33.6	0.8	56.0	55.2	38	20	0.0
Seminis	Barbaro	Y	0.2	13.6	3.2	84.8	81.6	22	22	0.8
	Belmar	Y	1.6	16.0	0.8	79.2	78.4	32	26	0.4
	Ruffian	Y	8.7	15.9	0.8	75.5	74.7	38	26	0.4
	Swale	Y	1.7	17.6	3.2	76.0	72.8	28	22	0.2
	EX14593	R	2.7	9.6	1.6	83.2	81.6	32	32	0.8
	Mercury	R	3.2	26.4	4.0	50.4	46.4	62	42	0.0
	average		6.4	19.2	3.4	68.0	64.6	29.2	24.6	0.3
LSD (0.05)			NS	12.2	NS	14.8	14.7	10.3	6.9	NS

^a single center + small multiple center. ^b IYSV: 0 = no symptoms, 1 = 1-25% of foliage diseased, 2 = 26-50% of foliage diseased, 3 = 51-75% of foliage diseased, 4 = 76-99% of foliage diseased, and 5 = 100% of foliage diseased.

Table 5. Yield and grade of full-season experimental and commercial onion varieties graded out of storage in January 2012, Malheur Experiment Station, Oregon State University, Ontario, OR. Continued on next page.

Seed company	Variety	Bulb color	Total yield	Marketable yield by grade						No. 2s	Small	Total rot	Neck rot	Plate rot	Black mold	Bulb counts >4¼ in #/50 lb
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	% of total yield							
A. Takii	Centerstone	Y	565.4	548.3	0.0	4.3	487.5	56.5	0.0	14.0	0.6	0.0	0.6	0.0		
	T-433	Y	858.0	844.2	20.3	264.8	526.4	32.9	7.3	9.5	0.5	0.0	0.5	0.0	22.7	
Bejo	Calibra	Y	584.8	557.1	0.0	35.2	465.4	56.5	2.4	17.5	2.1	0.6	1.5	0.0		
	Crockett	Y	552.7	539.1	1.0	16.6	443.4	78.1	4.8	12.4	0.2	0.1	0.1	0.0	51.0	
	Delgado	Y	719.8	698.4	11.4	108.9	549.4	28.8	6.9	9.0	1.6	0.6	0.4	0.6	42.6	
	Legend	Y	659.1	637.7	3.8	47.1	559.9	26.9	2.7	14.0	1.1	0.6	0.6	0.0	40.5	
	Sedona	Y	552.5	535.7	1.2	41.4	440.1	52.9	4.1	12.9	0.7	0.0	0.7	0.0	43.1	
Crookham	The Rock	Y	656.1	639.9	8.4	74.5	512.7	44.4	1.3	14.3	0.3	0.1	0.2	0.0	42.3	
	White Cloud	W	742.4	706.1	5.1	136.2	546.4	18.4	0.0	11.7	2.9	0.8	0.6	1.5	30.1	
	Oracle	Y	745.7	721.2	27.9	147.2	512.9	33.1	0.0	13.3	1.4	1.0	0.4	0.0	42.9	
	Advantage	Y	671.9	653.4	12.1	82.2	525.5	33.7	0.0	12.7	0.9	0.5	0.4	0.0	46.0	
	Avalon	Y	903.6	880.3	34.5	321.4	499.5	25.0	2.1	7.3	1.8	0.9	0.4	0.5	33.1	
	Pontiac	Y	493.3	458.3	1.3	13.7	359.8	83.5	0.0	31.8	0.6	0.3	0.4	0.0	40.3	
	Trigger	Y	696.7	684.4	16.4	151.4	479.9	36.8	0.0	12.2	0.0	0.0	0.0	0.0	39.2	
D. Palmer	DPL 1473	Y	546.6	533.5	0.0	8.8	459.4	65.3	5.5	10.9	0.4	0.0	0.4	0.0		
	DPL 1474	Y	439.8	417.1	0.0	26.7	319.1	71.3	18.8	15.9	1.6	0.8	0.8	0.0		
	DPL 1476	Y	522.5	501.7	0.0	21.1	428.9	51.7	72.1	17.3	0.7	0.1	0.6	0.0		
	DPL 1477	Y	386.6	367.6	1.3	13.2	254.2	98.9	5.9	17.1	0.5	0.0	0.5	0.0	40.3	
	DPR 3071	R	469.6	442.3	0.0	2.1	333.1	107.1	18.7	23.2	0.8	0.3	0.5	0.0		
	DPR 3072	R	390.5	358.1	0.0	0.0	245.0	113.2	18.7	31.4	0.2	0.2	0.1	0.0		
	DPR 3073	R	315.4	274.6	0.0	0.0	157.2	117.4	24.7	38.3	1.0	0.3	0.7	0.0		
	DPLD 2055	W	633.9	613.6	0.0	44.1	510.4	59.1	3.0	13.2	1.0	0.3	0.7	0.0		
	DPLD 2056	W	662.3	643.1	5.5	86.1	518.2	33.2	23.4	11.1	1.1	0.2	0.3	0.6	30.7	
Nickerson-Zwaan	NIZ 2025	Y	728.2	708.4	23.0	153.7	497.1	34.6	0.0	11.4	1.4	0.3	1.1	0.0	38.7	
	NIZ 2020	Y	542.9	517.2	6.3	50.5	415.5	44.8	0.0	17.2	1.6	0.6	1.0	0.0	39.6	
	37-2035	Y	642.3	621.2	9.6	96.5	488.3	26.9	0.6	11.7	1.7	0.4	1.3	0.0	50.0	

Table 5. Continued.

Seed company	Variety	Bulb color	Total yield	Marketable yield by grade					No. 2s	Small	Total rot	Neck rot	Plate rot	Black mold	Bulb counts >4¼ in
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in							
				----- cwt/acre -----					----- % of total yield -----					#/50 lb	
Nippon Norin	NN65	Y	700.3	684.8	6.0	93.8	560.8	24.3	0.8	10.2	0.7	0.3	0.1	0.3	38.4
Nunhems	Ranchero	Y	889.6	867.9	28.7	264.8	549.0	25.4	0.0	12.0	1.0	0.4	0.0	0.6	35.0
	Granero	Y	802.2	789.5	11.5	151.2	603.9	22.9	0.0	9.0	0.5	0.3	0.2	0.0	40.2
	Vaquero	Y	797.4	779.0	3.8	170.2	582.7	22.3	0.4	10.4	0.9	0.7	0.3	0.0	41.0
	Arcero	Y	648.1	628.9	1.6	88.3	494.1	45.0	0.9	14.5	0.7	0.1	0.6	0.0	32.5
	Joaquin	Y	743.1	720.5	23.6	149.5	518.6	28.8	0.0	10.7	1.5	1.2	0.4	0.0	42.1
	NUN 7015	Y	648.2	623.8	4.9	59.1	513.4	46.4	1.0	16.9	1.3	0.7	0.6	0.0	43.8
	NUN 7202	Y	646.7	635.7	0.0	18.7	579.0	38.0	0.8	6.4	0.7	0.2	0.5	0.0	
	Solstice	W	712.3	694.6	4.2	60.7	597.5	32.2	2.8	13.4	0.6	0.1	0.1	0.4	36.4
	Cometa	W	762.6	744.5	3.7	137.4	576.8	26.6	0.0	7.9	1.4	0.2	0.6	0.6	42.5
	NUN 8003	W	734.7	662.1	5.6	82.1	533.7	40.6	2.0	59.1	1.7	0.3	0.2	1.3	42.1
Marengo	R	480.7	465.7	10.8	38.8	357.7	58.4	3.3	12.1	0.6	0.0	0.1	0.5	45.3	
Sakata	Arruba	Y	798.8	780.6	31.5	246.5	478.0	24.6	3.0	13.7	0.6	0.0	0.0	0.6	33.6
	Bello Blanco	W	764.0	715.7	15.2	139.7	534.7	26.2	1.5	10.2	4.7	0.4	0.6	3.6	35.7
	XON-659Y	Y	856.1	842.9	9.1	236.9	572.7	24.2	1.9	10.6	0.3	0.1	0.2	0.1	34.1
Seminis	Barbaro	Y	760.4	741.7	6.4	145.2	566.8	23.3	0.0	8.7	1.3	0.2	1.1	0.0	40.6
	Belmar	Y	798.4	785.3	6.9	124.4	615.7	38.3	2.2	7.6	0.7	0.4	0.1	0.2	40.0
	Ruffian	Y	790.5	765.2	29.2	218.0	476.6	41.5	0.0	11.3	1.7	0.6	0.8	0.2	30.4
	Swale	Y	803.4	789.5	5.4	154.8	608.3	21.1	2.0	9.5	0.6	0.1	0.5	0.0	38.6
	EX14593	R	441.9	414.1	0.0	16.1	288.8	109.3	1.8	23.5	1.0	0.4	0.2	0.3	
	Mercury	R	498.3	474.6	0.0	4.6	387.6	82.4	0.0	20.5	0.7	0.1	0.5	0.0	
	average		654.5	632.1	8.4	96.8	479.4	47.5	5.3	15.1	1.1	0.3	0.5	0.3	39.0
LSD (0.05)			115.9	115.2	17.0	86.0	113.0	29.3	11.6	22.7	NS	NS	NS	1.4	8.9

Table 6. Onion variety subjective quality evaluation on January 20, 2012, Malheur Experiment Station, Oregon State University, Ontario, OR.

Company	Variety	Color	Bulb shape ^a	Skin color ^b	Bulb shape uniformity ^b	Firmness ^b	Scale retention ^b	Flesh brightness ^b
			A–H			1–5		
A. Takii	Centerstone	Y	D	3	4	2	4	3
	T-433	Y	B	3	4	4	4	2
Bejo	Calibra	Y	F	5	3	4	5	3
	Crockett	Y	H	5	2	4	5	2
	Delgado	Y	B	4	3	3	4	3
	Legend	Y	F	5	1	4	5	2
	Sedona	Y	F	4	4	4	5	4
Crookham	The Rock	Y	E	4	1	2	4	3
	White Cloud	W	E	2	4	3	2	2
	Oracle	Y	F	4	4	3	5	3
	Advantage	Y	H	4	4	2	4	3
	Avalon	Y	F	3	4	2	3	4
	Pontiac	Y	F	4	4	4	4	2
	Trigger	Y	F	4	4	3	5	3
D. Palmer	DPL 1473	Y	F	4	4	3	5	3
	DPL 1474	Y	B	5	2	3	5	2
	DPL 1476	Y	B	5	2	4	5	4
	DPL 1477	Y	G	5	2	4	5	2
	DPR 3071	R	G	4	4	5	5	5
	DPR 3072	R	G	4	3	4	5	5
	DPR 3073	R	G	5	4	4	5	4
	DPLD 2055	W	E	3	4	4	4	3
DPLD 2056	W	E	3	3	3	4	4	
Nickerson-Zwaan	NIZ 2025	Y	D	3	3	3	4	4
	NIZ 2020	Y	G	4	4	3	4	4
	37-2035	Y	D	4	4	4	4	3
Nippon Norin	NN65	Y	F	4	3	4	4	3
Nunhems	Ranchero	Y	E	4	4	3	4	4
	Granero	Y	E	5	4	4	5	3
	Vaquero	Y	F	4	4	4	5	4
	Arcero	Y	D	4	4	3	5	4
	Joaquin	Y	D	4	4	4	5	4
	NUN 7015	Y	E	4	4	4	4	4
	NUN 7202	Y	D	4	5	4	5	3
	Solstice	W	E	3	4	4	4	3
	Cometa	W	E	3	4	4	4	2
	NUN 8003	W	E	4	4	4	4	2
	Marenge	R	G	4	4	3	3	5
Sakata	Arruba	Y	E	3	4	4	4	4
	Bello Blanco	W	F	3	3	4	4	4
	XON-659Y	Y	B	3	4	3	3	4
Semini	Barbaro	Y	D	4	4	4	4	4
	Belmar	Y	D	4	4	3	5	4
	Ruffian	Y	B	4	4	3	3	4
	Swale	Y	B	4	5	3	4	3
	EX14593	R	G	3	4	4	4	5
	Mercury	R	G	2	3	3	3	5

^aBulb shape: see Figure 1. ^bSubjective ratings are described in Table 1.