2012 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, yield, and grade out of storage. Two early season yellow varieties were planted in March and were harvested and graded in mid-August. Forty-nine full-season varieties (40 yellow, 6 red, and 3 white) were planted in March, harvested in September 2012, and graded out of storage in January 2013. 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 objectively for maturity, bolting, onion thrips, yield, grade, single centers, and storability. Varieties are evaluated subjectively for iris yellow spot virus, bulb shape, bulb shape uniformity, color, and skin retention.

Materials and Methods

Onions were grown on an Owyhee silt loam with a pH of 7.6 and 2.1 percent organic matter, previously planted to wheat. In the fall of 2011, the wheat stubble was shredded and the field was irrigated. Based on a soil analysis, 100 lb of phosphorus/acre, 200 lbs of sulfur/acre, 1,000 lbs of gypsum/acre, and 1 lb of boron/acre were broadcast. The field was then disked, moldboard plowed, and groundhogged. On September 25, the field was fumigated with Vapam® (metam sodium) at 15 gal/acre and bedded at 22 inches.

Both the full-season trial and the early maturing trial were planted on March 27, adjacent to each other, and in plots 4 double rows wide and 27 ft long. The early maturing trial had 2 varieties from 2 seed companies (Tables 1 and 2) and the full-season trial had 46 varieties from 9 seed companies (Tables 3 and 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 April 16. On May 21, alleys 4 ft wide were cut between plots, leaving plots 23 ft long. On May 21-23, 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. Roundup® at 1 lb ai/acre was broadcast on April 6 prior to onion emergence. On April 23, Prowl® H_2O at 0.83 lb ai/acre (2 pt/acre) was applied for weed control. On June 1, Goal® at 0.19 lb ai/acre (12 oz/acre), Buctril® at 0.32 lb ai/acre (20 oz/acre), and

Select® at 0.19 lb ai/acre (12 oz/acre) were applied for weed control. On June 12, Outlook® at 0.5 lb ai/acre (11 oz/acre) was applied for weed control. On May 31 and June 8, Movento® at 5 oz/acre was applied for thrips control. On June 18 and June 25, Radiant® at 10 oz/acre was applied for thrips control. The field received aerial applications of Lannate® at 0.9 lb ai/acre on July 14, July 21, August 3, and August 11 for thrips control.

Based on analyses of root tissue samples taken on June 18 and July 2, a total of 250 lb nitrogen/acre and 0.4 lb boron/acre were applied during the season. Nitrogen was applied at 100 lb/acre as urea sidedressed to both sides of the bed on May 24. Nitrogen was applied at 50 lb/acre as water run URAN (urea + ammonium nitrate) on July 5, July 13, and July 20.

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, 2010). Starting in early June, soil water tension was monitored by six granular matrix sensors (Watermark Soil Moisture Sensors Model 200SS, Irrometer Co. Inc., Riverside, CA) centered at 8-inch depth below the onion row. The sensors were automatically read three times a day with a datalogger (Irrometer Monitor Model 950 R1). The last irrigation was on August 31.

The early maturing trial was evaluated for maturity on August 15. 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.

On June 4, onions in each plot of the full-season trial were evaluated for severity of injury in response to postemergence herbicide application on June 1. Each plot was given a subjective rating on a scale of 0 to 10 of increasing severity of leaf damage. The thrips counts on each of 15 plants in each plot were made on June 6 and June 28. Onions in each plot of the full-season trial were evaluated for maturity and severity of thrips leaf damage on August 15. For thrips leaf damage, each plot was given a subjective rating on a scale of 0 to 10 of increasing severity of leaf damage from thrips feeding. Onions in each plot were evaluated for severity of symptoms of iris yellow spot virus (IYSV) on August 22. Each plot was given a subjective rating on a scale of 0 to 5 of increasing severity of IYSV 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.

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 and bagged on August 20. The onions were graded on August 24.

The onions in the full-season trial were lifted on September 12 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 21. The bags were put in storage on September 27. Before being placed in storage each bag was weighed. 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 8 and 9, 2013.

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 supercolossal (>4¼ inches). Bulb counts per 50 lb of supercolossal onions were determined for each plot of every variety by weighing and counting all supercolossal bulbs during grading. Marketable yield consists of No.1 bulbs larger than 2¼ inches.

After grading, two replicates of each variety were evaluated for subjective quality characteristics on January 11, 2013 (Fig. 1, Table 1). The quality characteristics were evaluated by a consensus of 15-20 people without knowing the variety identities. Evaluators included Oregon State University and seed company employees. The characteristics evaluated were: bulb shape, skin color, bulb shape uniformity, firmness, skin retention, and flesh brightness.

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. 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.

Results

The rate of accumulation of growing degree-days (50-86°F) in 2012 was close to the 22-year average (Fig. 1). The soil water tension at 8-inch depth was substantially drier than the ideal of 25 cb several times, reaching above 40 cb three times (Fig. 2). One episode of soil water tension reaching 60 cb at the 8-leaf stage (late June/early July) can reduce marketable onion yield (Shock et al. 2006). Drier than ideal soil was caused by delayed irrigations during hand weeding operations. During July, irrigations were required every 3 to 4 days to maintain the soil water tension below 25 cb.

The application of herbicide on June 1 (Goal® at 0.19 lb ai/acre, Buctril® at 0.32 lb ai/acre, and Select® at 0.19 lb ai/acre) resulted in visible injury, observed as prostrate and twisted foliage. This higher than normal herbicide injury could have been caused by the application of insecticide with a spreader/penetrant adjuvant the previous day. The adjuvant could have weakened the waxy leaf cuticle that protects the onion foliage from herbicide damage. In 2012, the IYSV pressure was low and did not vary by variety (data not shown). The varieties differed substantially in the number of thrips per plant and thrips damage (Table 3).

Early Maturing Trial

The percentage of single-centered bulbs averaged 46.8 percent and ranged from 33.6 percent for 'Spanish Medallion' to 60 percent for 'Montero' (Table 1). Functionally single-centered onions averaged 94 percent and ranged from 88 percent for Spanish Medallion to 100 percent for Montero.

Total yield averaged 859 cwt/acre and ranged from 759.2 cwt/acre for Montero to 958 cwt/acre for Spanish Medallion (Table 2).

Full-season Trial

'Joaquin', 'Cometa', 'Granero', and 'Scout' were among the varieties with the lowest herbicide injury ratings from herbicide application on June 1 (Table 3). 'Advantage', 'Oracle', 'Morpheus', 'Avalon', 'Maverick', Joaquin, and DPLD 1476 were among the varieties with the lowest thrip leaf damage ratings. In comparing varieties for herbicide injury and thrips damage, varieties with lower herbicide injury (Fig. 3) or lower thrips damage (Fig. 4) tended to have higher marketable yield.

The percentage of single-centered bulbs averaged 50 percent and ranged from 0 percent for 'Rio Rojo' to 88 percent for 'Annilo' (Table 4). The percentage of functionally single-centered bulbs averaged 54.9 percent and ranged from 4.1 percent for Rio Rojo to 92 percent for Annilo. The herbicide damage may have reduced the single centers observed in the 2012 onion variety trial (Fig. 5).

Marketable yield averaged 702 cwt/acre and ranged from 8.4 cwt/acre for Rio Rojo to 1,115 cwt/acre for Avalon (Table 5). Avalon had the highest marketable yield followed by 'Ranchero', Maverick, Oracle, Scout, Joaquin, 'Ruffian', and Advantage.

Subjective Quality Evaluation

Subjective quality ratings can be found in Table 7 and explanation of the bulb shape rating system can be found in Figure 6 and Table 6. Significant variation was found between varieties in all subjective characteristics except flesh brightness.

Acknowledgements

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References

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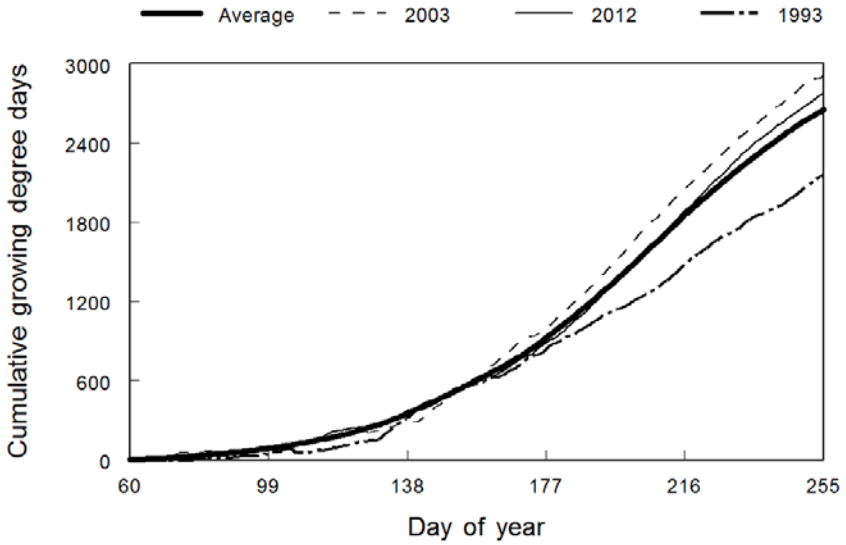

Figure 1. Cumulative growing degree-days (50-86°F) over time for years with lowest (1993) and highest (2003) totals since 1990, compared to 2012 and to the 22-year average (1990-2011), Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

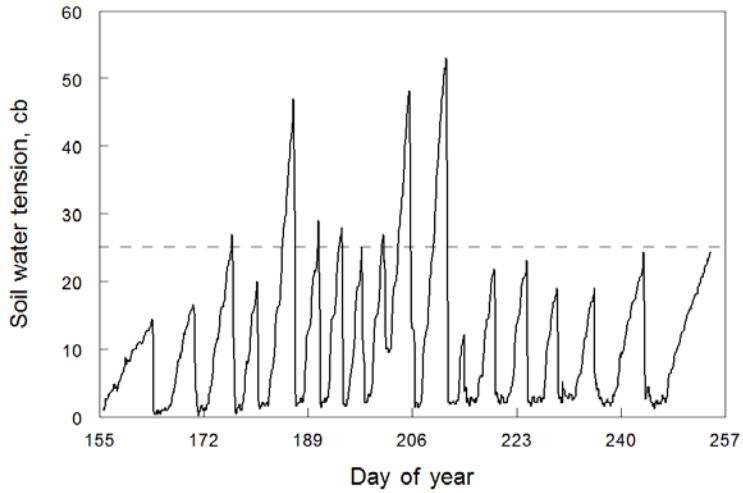

Figure 2. Soil water tension at 8-inch depth over time for onions furrow irrigated at 25 cb, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012. The soil became substantially drier than the ideal range.

Table 1. Maturity and single- and multiple-center bulb ratings for early maturing onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Seed company	Variety	Bulb color	Maturity Aug. 15		Multiple center			Single center	
			Tops down	Leaf dryness	large	medium	small	functional*	single
			%						
Nunhems	Montero	Y	52.0	30.0	0.0	0.0	40.0	100.0	60.0
Sakata	Spanish Medallion	Y	42.0	20.0	4.0	8.0	54.4	88.0	33.6
	Average		47.0	25.0	2.0	4.0	47.2	94.0	46.8
LSD (0.05)			NS	NS	NS	6.1	NS	7.0	15.9

*single + small double

Table 2. Yield and grade performance of early maturing onion varieties lifted and harvested August 20, 2012, Malheur Experiment Station, Oregon State University, Ontario, OR.

Seed company	Variety	Bulb color	Total yield	Marketable yield by grade							Bulb counts
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	No. 2s	Small	>4¼ in
			cwt/acre								#/50 lb
Nunhems	Montero	Y	759.2	744	0	10.4	627.2	106.5	0	15.2	
Sakata	Spanish Medallion	Y	958	944.6	3.3	101.5	770.4	69.4	0	13.3	31.5
	Average		858.6	844.3	1.6	55.9	698.8	87.9	0	14.3	31.5
	LSD (0.05)		115	110.3	NS	77.1	55.1	NS	NS	NS	NS

Table 3. Maturity, subjective herbicide injury, thrips counts, and subjective thrips damage of full-season experimental and commercial onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012. Herbicide and thrips injury: 0 = no injury, 10 = highest injury.

Seed company	Variety	Bulb color	Maturity Aug. 15		Herbicide injury	Thrips counts		Thrips leaf damage
			Tops down	Leaf dryness		6 Jun	28 Jun	
			---------- % ----------		0-10	--- No./plant ---		0-10
A. Takii	Centerstone	Y	12	28	6.0	6.5	11.0	6.6
	TTA-747	Y	8	8	4.6	8.3	10.9	5.2
Bejo	Calibra	Y	32	28	6.6	8.7	5.5	6.6
	Crockett	Y	10	18	4.8	9.5	10.3	6.4
	Delgado	Y	18	16	6.2	5.8	7.7	5.8
	Legend	Y	10	12	5.0	6.5	8.0	5.8
	Sedona	Y	10	14	5.0	11.0	10.7	6.2
	Hamilton	Y	6	14	5.6	8.5	18.9	5.6
Crookham	Red Beret	R	26	36	6.2	9.6	12.1	7.6
	Oracle	Y	12	6	5.4	4.0	4.1	3.2
	Advantage	Y	10	10	7.0	3.8	5.0	3.0
	Avalon	Y	22	12	5.0	5.6	7.1	3.8
	Pontiac	Y	16	26	6.0	4.5	12.2	7.4
	Trigger	Y	4	8	5.6	3.4	4.5	4.2
	Scout	Y	22	14	3.0	7.1	8.3	5.6
	Morpheus	Y	14	6	4.6	4.0	5.8	3.6
	Esteem	Y	10	20	5.6	5.5	6.5	7.2
Nickerson-Zwaan	NIZ 37-81	Y	14	18	3.4	5.1	8.3	5.4
	NIZ 37-85	Y	20	16	4.2	8.6	6.1	6.4
	Cruiser	Y	14	20	5.6	7.5	8.0	6.4
	Frontino	Y	9	9	6.8	5.1	7.4	4.8
	Maverick	Y	10	10	3.6	6.0	6.3	4.0
	Outlaw	Y	26	24	4.0	7.6	7.9	6.8
	Ventura	Y	36	30	3.8	8.8	10.1	7.4
Nippon Norin	NN65	Y	8	12	4.6	9.9	10.1	5.0
Nunhems	Ranchero	Y	14	12	5.0	6.8	7.5	4.8
	Granero	Y	10	14	2.8	5.5	7.7	5.2
	Vaquero	Y	10	14	4.6	7.1	8.8	5.6
	Arcero	Y	10	14	3.4	5.5	6.1	5.6
	Joaquin	Y	8	6	2.0	5.4	8.1	4.0
	Pandero	Y	8	10	5.6	5.8	5.7	4.2
	Annilo	Y	14	14	3.4	7.9	8.7	5.6
	Cometa	W	6	6	2.2	6.9	13.4	4.2
	Marenge	R	40	40	5.8	8.6	11.2	7.2
Sakata	XON-659Y	Y	22	8	5.4	5.0	5.9	4.6
Seminis	Barbaro	Y	12	14	3.6	6.9	6.4	5.0
	Belmar	Y	14	18	5.0	5.4	7.6	6.0
	Ruffian	Y	12	10	3.6	6.1	7.0	5.2
	Swale	Y	16	12	4.0	7.0	9.8	4.8
D. Palmer	DPID 1472	Y	20	22	4.8	3.8	8.1	6.0
	DPL 1473	Y	10	24	5.8	4.3	10.8	5.4
	DPLD 1476	Y	10	10	7.0	5.3	6.2	4.0
	DPLD 1477	Y	16	24	7.2	7.2	9.6	6.8
	DPR 3071	R	10	22	8.6	4.7	8.5	7.2
	DPR 3072	R	12	26	7.6	7.9	10.8	6.4
	DPR 3073	R	16	28	7.4	6.0	12.3	6.6
	Rio Rojo	R	92	52	4.0	4.0	2.9	na
	DPLD 2056	W	6	12	5.0	5.2	6.9	4.4
	DPLD 2057	W	16	20	7.4	4.5	4.9	5.6
	Average		16.0	17.3	5.1	6.4	8.3	5.5
LSD (0.05)			8.4	7.5	0.9	3.2	3.4	1.1

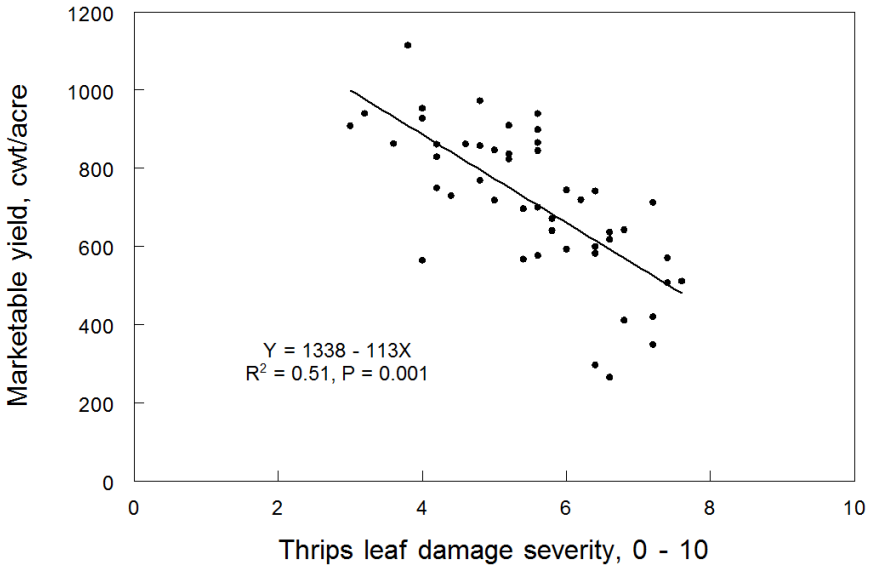

Figure 3. Relationship between severity of thrips leaf damage and marketable yield. Each data point represents one onion variety (average of 5 replicates). Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

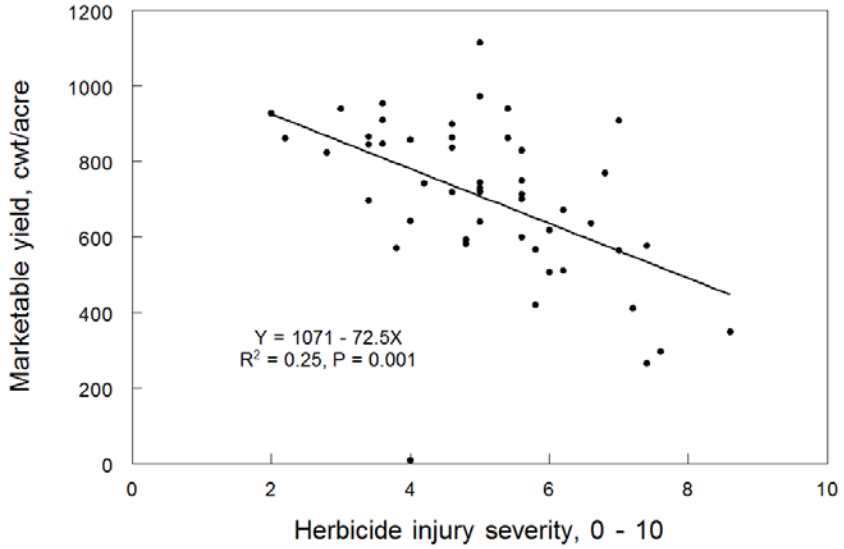

Figure 4. Relationship between severity of herbicide injury from the Goal, Buctril, and Select application on June 1 and marketable yield. Each data point represents one variety (average of 5 replicates). Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

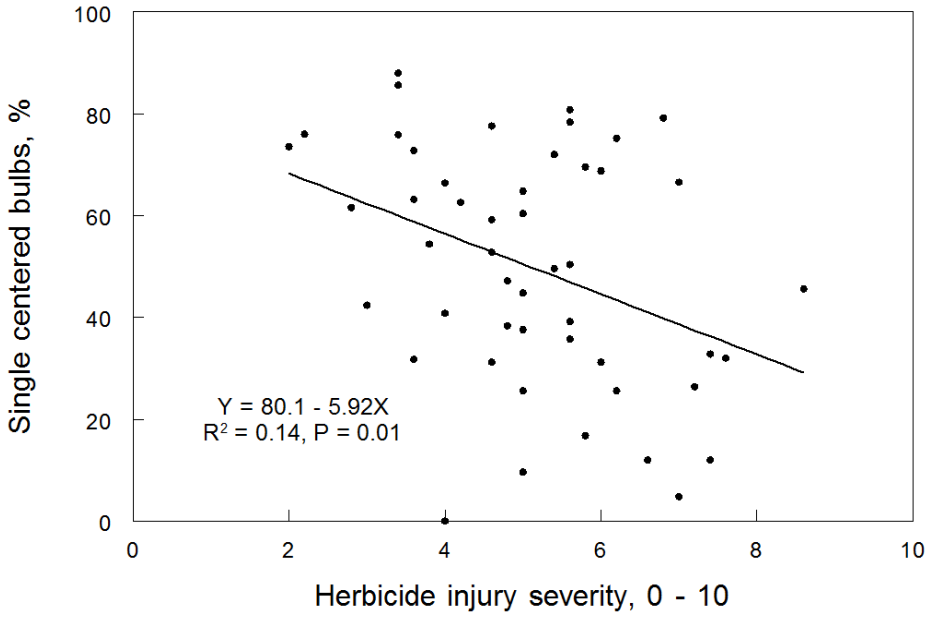

Figure 5. Relationship between severity of herbicide injury from the Goal, Buctril, and Select application on June 1 and the percentage of single-centered onion bulbs. Each data point represents one variety (average of 5 replicates). Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

Table 4. Single- and mutiple-centered bulb rating for full-season onion varieties, Malheur Experiment Station, Oregon State University, Ontario, OR, 2012.

			Multiple center			Single center	
Seed company	Variety	Bulb color	large	medium	small	functional single center[a]	single center
			---------- % ----------				
A. Takii	Centerstone	Y	20.8	45.6	2.4	33.6	31.2
	TTA-747	Y	17.6	48.8	2.4	33.6	31.2
Bejo	Calibra	Y	30.3	52.1	5.6	17.6	12.0
	Crockett	Y	9.6	40.0	3.2	50.4	47.2
	Delgado	Y	21.6	48.8	4.0	29.6	25.6
	Legend	Y	31.2	55.2	4.0	13.6	9.6
	Sedona	Y	16.8	35.2	3.2	48.0	44.8
	Hamilton	Y	17.6	37.6	5.6	44.8	39.2
Crookham	Red Beret	R	5.6	15.2	4.0	79.2	75.2
	Oracle	Y	6.4	21.6	0.0	72.0	72.0
	Advantage	Y	6.4	26.3	0.8	67.3	66.6
	Avalon	Y	19.2	40.8	2.4	40.0	37.6
	Pontiac	Y	6.4	20.0	4.8	73.6	68.8
	Trigger	Y	4.0	11.2	4.0	84.8	80.8
	Scout	Y	12.8	41.6	3.2	45.6	42.4
	Morpheus	Y	4.0	9.6	8.8	86.4	77.6
	Esteem	Y	0.8	19.2	1.6	80.0	78.4
Nickerson-Zwaan	NIZ 37-81	Y	4.8	18.5	0.8	76.7	75.9
	NIZ 37-85	Y	8.0	26.2	3.2	65.8	62.6
	Cruiser	Y	11.0	48.4	4.8	40.5	35.8
	Frontino	Y	3.2	14.4	3.2	82.4	79.2
	Maverick	Y	13.3	49.5	5.4	37.2	31.8
	Outlaw	Y	11.2	31.2	16.8	57.6	40.8
	Ventura	Y	6.4	27.2	12.0	66.4	54.4
Nippon Norin	NN65	Y	1.6	21.6	17.6	76.8	59.2
Nunhems	Ranchero	Y	4.0	29.9	5.7	66.1	60.4
	Granero	Y	4.0	32.0	2.4	64.0	61.6
	Vaquero	Y	10.4	34.4	2.4	55.2	52.8
	Arcero	Y	2.4	9.6	2.4	88.0	85.6
	Joaquin	Y	0.0	22.4	4.0	77.6	73.6
	Pandero	Y	11.2	37.6	0.8	51.2	50.4
	Annilo	Y	0.8	7.2	4.0	92.0	88.0
	Cometa	W	0.8	18.4	4.8	80.8	76.0
	Marenge	R	5.6	19.2	5.6	75.2	69.6
Sakata	XON-659Y	Y	12.0	35.2	3.2	52.8	49.6
Seminis	Barbaro	Y	4.8	17.6	4.8	77.6	72.8
	Belmar	Y	8.0	24.0	3.2	68.0	64.8
	Ruffian	Y	8.0	28.0	0.8	64.0	63.2
	Swale	Y	4.0	28.0	1.6	68.0	66.4
D. Palmer	DPID 1472	Y	24.8	34.4	2.4	40.8	38.4
	DPL 1473	Y	32.8	48.0	2.4	19.2	16.8
	DPLD 1476	Y	58.4	24.0	12.8	17.6	4.8
	DPLD 1477	Y	27.2	32.8	13.6	40.0	26.4
	DPR 3071	R	19.2	31.2	4.0	49.6	45.6
	DPR 3072	R	28.8	32.8	6.4	38.4	32.0
	DPR 3073	R	40.0	43.2	4.8	16.8	12.0
	Rio Rojo	R	87.9	8.0	4.1	4.1	0.0
	DPLD 2056	W	40.0	31.2	3.2	28.8	25.6
	DPLD 2057	W	17.6	33.6	16.0	48.8	32.8
	Average		15.2	30.0	4.9	54.9	50.0
LSD (0.05)			9.9	16.0	9.4	15.6	14.1

[a]single + small double

Table 5. Yield and grade of full-season experimental and commercial onion varieties graded out of storage in January 2013, 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
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in							
			cwt/acre								% of total yield				#/50 lb
A. Takii	Centerstone	Y	636.0	618.0	0.0	8.7	537.5	71.9	3.6	11.8	0.4	0.0	0.4	0.0	
	TTA-747	Y	861.8	837.1	5.6	168.9	637.1	25.5	1.7	7.9	1.6	1.4	0.2	0.0	37.0
Bejo	Calibra	Y	657.7	636.7	0.0	13.8	582.2	40.7	10.2	8.2	0.4	0.2	0.1	0.0	
	Crockett	Y	603.2	582.8	0.0	7.0	514.7	61.1	4.8	14.8	0.1	0.1	0.1	0.0	
	Delgado	Y	698.1	671.7	0.0	32.7	600.3	38.6	16.3	6.9	0.5	0.3	0.2	0.0	
	Legend	Y	671.5	640.7	0.0	29.5	560.8	50.4	10.8	8.8	1.8	1.2	0.5	0.0	
	Sedona	Y	740.9	719.9	0.0	41.5	621.2	57.2	2.8	14.2	0.5	0.4	0.1	0.0	
	Hamilton	Y	715.4	700.7	1.7	29.3	625.3	44.4	2.5	11.3	0.1	0.0	0.1	0.0	30.1
Crookham	Red Beret	R	534.2	511.3	0.0	4.4	365.8	141.1	2.3	18.4	0.4	0.3	0.1	0.0	
	Oracle	Y	958.2	940.1	0.0	350.7	574.8	14.5	1.0	7.0	1.1	1.0	0.0	0.1	
	Advantage	Y	951.1	908.7	24.6	308.4	511.9	63.8	1.2	9.9	3.1	3.0	0.0	0.0	33.5
	Avalon	Y	1143.3	1114.5	76.7	512.8	500.1	24.9	2.2	9.9	1.4	1.1	0.2	0.2	32.1
	Pontiac	Y	525.8	507.6	0.0	7.7	391.4	108.5	0.9	15.7	0.3	0.1	0.1	0.0	
	Trigger	Y	758.9	749.9	14.1	152.1	556.1	27.6	0.0	5.8	0.4	0.4	0.0	0.0	36.6
	Scout	Y	1000.2	940.0	38.5	355.8	503.8	42.0	1.4	7.1	4.6	2.8	0.5	1.3	31.1
	Morpheus	Y	890.5	863.7	16.1	271.5	535.4	40.7	0.9	8.6	1.9	1.7	0.1	0.0	32.8
	Esteem	Y	729.2	712.9	1.7	45.0	626.2	40.1	0.0	10.8	0.7	0.1	0.6	0.0	31.3
Nickerson-Zwaan	NIZ 37-81	Y	711.4	696.6	4.4	160.3	498.2	33.6	0.0	11.1	0.5	0.2	0.3	0.0	35.6
	NIZ 37-85	Y	756.2	742.0	3.4	124.4	587.9	26.3	3.6	9.6	0.1	0.0	0.1	0.0	30.7
	Cruiser	Y	609.2	600.0	0.0	24.1	523.8	52.1	0.8	6.9	0.2	0.0	0.2	0.0	
	Frontino	Y	784.5	769.3	0.0	167.2	577.8	24.3	2.4	6.5	0.8	0.3	0.4	0.0	
	Maverick	Y	977.1	953.5	12.3	350.0	567.8	23.4	4.4	9.0	1.1	0.6	0.5	0.0	33.8
	Outlaw	Y	660.1	642.8	0.0	31.7	561.2	49.8	4.5	11.2	0.2	0.0	0.2	0.0	
	Ventura	Y	592.8	571.0	1.5	21.9	458.2	89.3	2.9	18.7	0.0	0.0	0.0	0.0	33.3
Nippon Norin	NN65	Y	739.5	718.8	0.0	97.8	560.6	60.4	0.0	15.5	0.7	0.2	0.5	0.0	

Table 5. Yield and grade out of storage January 2013. 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
Nunhems	Ranchero	Y	996.8	972.7	54.7	339.8	547.5	30.8	4.3	9.2	1.1	0.9	0.2	0.0	33.9
	Granero	Y	841.5	823.9	0.0	148.3	652.9	22.7	2.5	11.0	0.5	0.4	0.1	0.0	
	Vaquero	Y	916.6	899.1	15.9	272.2	594.3	16.6	1.4	5.0	1.2	0.9	0.1	0.2	34.9
	Arcero	Y	882.8	866.1	0.0	196.9	646.0	23.2	0.0	9.3	0.9	0.5	0.3	0.0	
	Joaquin	Y	945.5	927.9	32.7	439.7	437.5	18.0	0.0	9.4	0.8	0.3	0.5	0.0	36.3
	Pandero	Y	848.1	829.2	3.3	237.7	548.1	40.1	3.8	11.8	0.5	0.0	0.5	0.0	31.3
	Annilo	Y	865.3	845.2	1.9	122.1	690.6	30.5	0.0	8.5	1.3	0.5	0.8	0.0	27.2
	Cometa	W	893.3	861.6	2.4	181.1	648.9	29.2	0.0	13.0	2.1	1.6	0.5	0.0	32.5
	Marenge	R	451.2	420.5	0.0	0.0	316.1	104.4	1.7	26.6	0.5	0.3	0.2	0.0	
Sakata	XON-659Y	Y	871.2	862.4	9.1	315.0	515.8	22.6	2.9	4.3	0.2	0.2	0.0	0.0	33.2
Seminis	Barbaro	Y	864.1	847.2	19.8	251.5	550.2	25.7	2.4	10.5	0.5	0.2	0.3	0.0	36.5
	Belmar	Y	763.5	744.6	0.0	93.3	611.5	39.9	0.0	13.5	0.7	0.5	0.2	0.0	
	Ruffian	Y	930.5	909.7	47.8	349.7	481.8	30.4	3.1	11.8	0.7	0.4	0.1	0.2	34.0
	Swale	Y	872.8	857.7	10.6	232.9	583.0	31.2	0.0	7.8	0.9	0.4	0.5	0.0	32.6
D. Palmer	DPID 1472	Y	644.5	593.6	0.0	81.3	462.5	49.7	31.9	13.5	0.8	0.1	0.6	0.0	
	DPL 1473	Y	609.3	567.6	0.0	5.0	472.2	90.5	22.4	18.0	0.2	0.0	0.2	0.0	
	DPLD 1476	Y	753.2	564.8	2.8	68.8	452.7	40.5	172.8	15.0	0.1	0.0	0.1	0.0	37.0
	DPLD 1477	Y	461.7	411.2	0.0	0.0	264.2	147.0	20.1	23.4	1.6	0.5	1.1	0.0	
	DPR 3071	R	408.7	349.4	0.0	0.0	181.4	168.0	20.3	38.0	0.2	0.2	0.0	0.0	
	DPR 3072	R	378.9	296.9	0.0	2.2	139.4	155.3	35.7	41.9	1.1	0.1	0.1	0.9	
	DPR 3073	R	362.9	265.5	0.0	0.0	134.4	131.1	46.6	47.1	1.0	0.0	0.0	1.0	
	Rio Rojo	R	176.5	8.4	0.0	0.0	1.9	6.5	9.9	13.2	84.8	10.1	0.1	74.6[a]	
	DPLD 2056	W	846.5	730.2	6.7	128.1	554.0	41.4	69.2	15.2	3.8	2.0	1.8	0.0	30.8
	DPLD 2057	W	613.6	577.2	0.0	5.0	490.6	81.6	9.8	18.3	1.4	1.1	0.3	0.0	
	average		736.8	701.7	8.3	138.5	501.2	53.7	11.1	13.5	2.6	0.7	0.3	1.6	33.2
LSD (0.05)			112.6	110.3	21.8	86.7	113.4	33.8	13.2	11.0	5.4	3.1	0.6	7.5	2.5

[a]many types of decomposition were present on these bulbs.

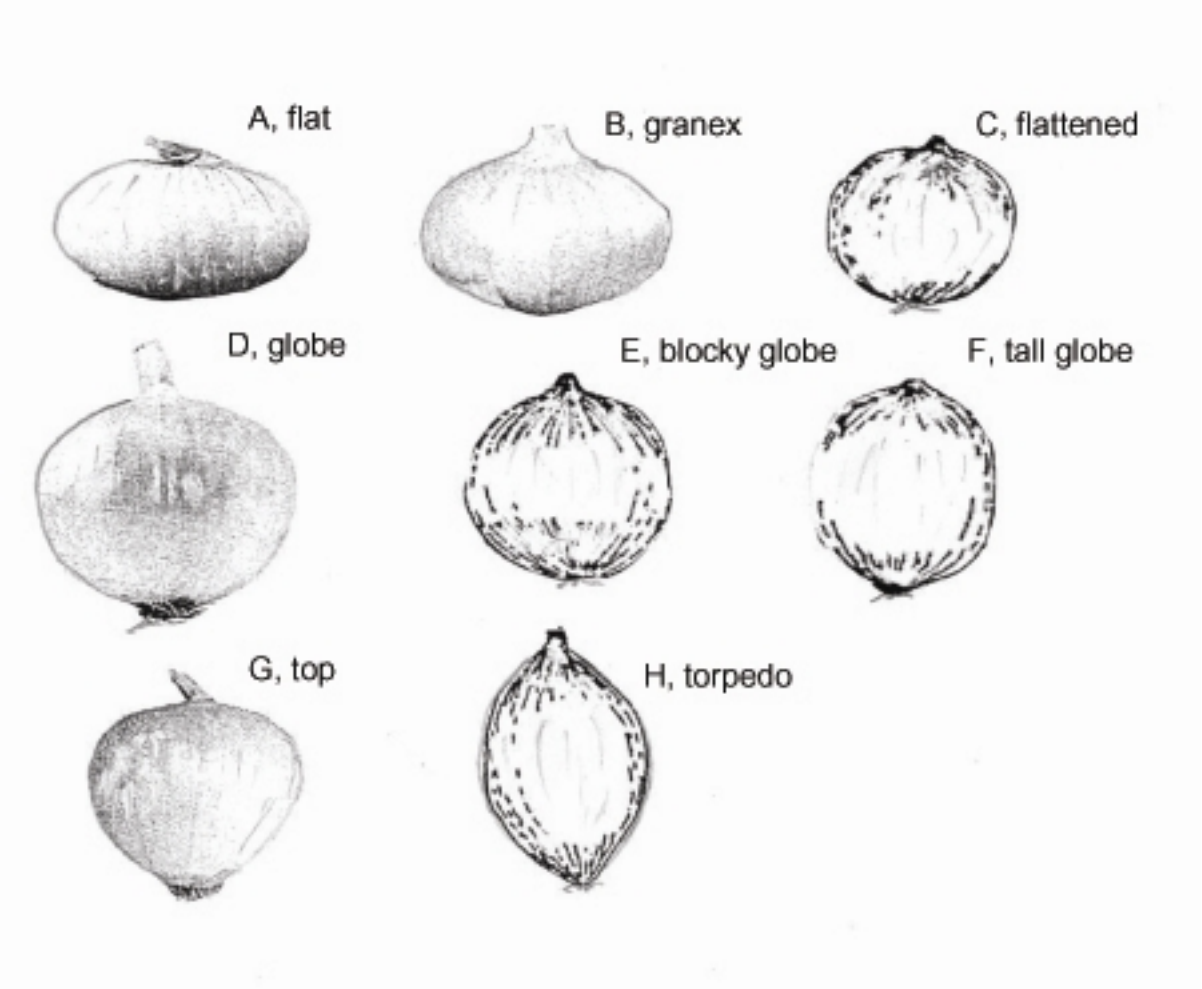

Figure 6. Onion bulb shape rating system. Malheur Experiment Station, Oregon State University, Ontario, OR.

Table 6. Onion variety subjective quality evaluation rating system.

Characteristic	Scale	Description
Bulb shape	A-H	see Fig. 6
Skin color[a]	1-5	1 = light, 5 = dark
Bulb shape uniformity	1-5	1 = disuniform 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 red varieties: 1 = dark red, 5 = pale red white varieties: 1 = less white, 5 = very white

[a]Yellow varieties varied from light yellow to yellow-brown. Red varieties varied from pale red to intense red. White varieties varied from off-white to intense white.

Table 7. Onion variety subjective quality evaluation on January 11, 2013, 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]
				1-5				
A. Takii	Centerstone	Y	c	3.0	3.5	3.0	2.5	2.5
	TTA-747	Y	d	5.0	3.5	3.0	4.0	3.0
Bejo	Calibra	Y	d	6.0	3.5	3.0	4.0	3.0
	Crockett	Y	d	6.0	4.0	4.0	5.0	3.0
	Delgado	Y	e	5.0	4.0	4.0	5.0	2.5
	Legend	Y	d	5.5	4.0	4.0	4.5	2.5
	Sedona	Y	e	4.0	3.0	3.5	4.5	3.0
	Hamilton	Y	e	6.0	3.5	4.0	4.5	2.5
Crookham	Red Beret	R	c	5.5	2.5	3.0	3.0	3.5
	Oracle	Y	f	5.0	3.5	3.0	5.0	3.0
	Advantage	Y	f	4.0	3.5	3.0	4.0	3.0
	Avalon	Y	d	3.5	3.0	2.0	2.5	3.0
	Pontiac	Y	e	5.5	3.0	3.0	4.0	3.0
	Trigger	Y	f	5.0	4.0	3.5	3.5	3.0
	Scout	Y	c	3.0	4.0	2.0	2.5	3.5
	Morpheus	Y	e	4.0	3.5	2.5	4.5	3.5
	Esteem	Y	c	3.5	2.5	2.5	3.0	3.0
Nickerson-Zwaan	NIZ 37-81	Y	e	4.0	3.5	3.0	4.0	3.0
	NIZ 37-85	Y	d	5.5	4.0	3.0	3.5	3.0
	Cruiser	Y	e	5.0	3.0	3.0	3.5	2.5
	Frontino	Y	e	5.0	3.5	3.0	4.0	3.0
	Maverick	Y	d	4.5	3.0	3.0	4.0	3.5
	Outlaw	Y	d	5.0	3.0	3.0	3.5	3.0
	Ventura	Y	e	5.5	3.0	3.0	4.0	2.5
Nippon Norin	NN65	Y	f	4.0	4.0	3.0	4.5	3.5
Nunhems	Ranchero	Y	c	4.0	3.5	3.0	3.5	3.0
	Granero	Y	d	6.5	4.0	3.5	5.0	3.0
	Vaquero	Y	d	4.0	3.5	3.0	4.0	3.0
	Arcero	Y	d	5.5	3.5	3.0	5.0	4.0
	Joaquin	Y	e	5.5	3.5	3.0	5.0	3.0
	Pandero	Y	c	5.0	4.0	3.0	4.0	2.0
	Annilo	Y	d	5.5	3.5	4.0	5.0	3.0
	Cometa	W	d	2.0	4.0	3.0	5.0	3.0
	Marenge	R	c	6.5	3.5	2.5	2.0	3.0
Sakata	XON-659Y	Y	c	3.0	4.0	3.0	4.0	3.5
Seminis	Barbaro	Y	e	4.0	3.0	2.0	3.0	2.5
	Belmar	Y	c	5.0	3.5	3.0	3.0	2.5
	Ruffian	Y	c	3.0	3.5	2.0	2.5	3.0
	Swale	Y	c	5.0	4.0	3.0	4.0	3.0
D. Palmer	DPID 1472	Y	c	3.0	3.5	3.0	3.0	3.0
	DPL 1473	Y	e	6.0	4.0	4.0	5.0	3.0
	DPLD 1476	Y	c	6.5	2.0	3.0	5.0	2.0
	DPLD 1477	Y	d	7.0	2.5	4.0	4.5	2.0
	DPR 3071	R	c,g	8.0	3.0	3.0	4.0	4.0
	DPR 3072	R	c	8.0	4.0	3.0	4.0	4.0
	DPR 3073	R	c	7.5	3.5	3.5	3.0	3.5
	Rio Rojo	R	na	7.0	na	na	na	na
	DPLD 2056	W	d		3.5	3.0	4.5	3.0
	DPLD 2057	W	d	3.0	2.5	3.0	3.5	2.5
	Average		d	5.0	3.4	3.1	3.9	3.0
LSD (0.05)				1.2	1.1	0.6	0.8	NS

[a]Bulb shape: see Figure 6.

[b]Subjective ratings are described in Table 6. na: not available due to excessive decomposition.