ONION PRODUCTION FROM SETS, 2009

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Introduction

Increased interest in an earlier start for the onion harvest season has led to interest in over-wintering onions, transplants, and set production. Through 2009 transplants had to be grown locally as required by the local onion white rot quarantine, which prohibits importation of onion transplants from areas outside the Treasure Valley. Our earlier research showed that onions can be harvested in July when grown from transplants started in the winter in a greenhouse (Shock et al. 2004). Greenhouse transplant production in the Treasure Valley is relatively expensive due to the need for heated greenhouses during the winter. Transplants produced in unheated "low tunnel" cold frames have performed poorly compared to transplants produced in a heated greenhouse (Shock et al. 2008, 2009).

Transplants produced from field-grown over-wintering varieties have performed inconsistently (Shock et al. 2006b, 2007a). Also, onion production from fall direct seeded overwintering varieties has been inconsistent (Shock et al. 2005, 2006a, 2007a). In addition, the available over-wintering varieties do not have adequate bulb quality and appearance.

Another alternative is to produce onions from sets. Onion sets are produced by sowing seed very thickly one year, resulting in plants with very small bulbs. These sets are harvested, stored over the winter, and planted in the next spring. Our earlier research screened 48 long-day varieties for bulb production from sets (Shock et al. 2006c). Of the 48 varieties screened, some produced high yields with low bolting and demonstrated the feasibility of bulb production from sets for 6 sweet Spanish long-day varieties. In 2009, we tested bulb production from sets of 15 varieties; 6 short-day varieties, 2 intermediate-day varieties, and 7 long-day varieties that we produced in 2008. Due to the widespread incidence of iris yellow spot virus (IYSV) in the Treasure Valley, sets for the 2009 production trial were grown in Cow Valley at 4,000 ft elevation, approximately 50 miles northwest of Vale, Oregon.

Materials and Methods

For each variety, onion seed was planted at 10 seeds/inch of row on April 24, 2008. Onion seed of each variety was planted in six rows spaced 7 inches apart on a 64-inch bed. Two drip tapes spaced 14 inches apart were laid at 4-inch depth prior to planting (each drip tape irrigated 3 rows). The field was furrow irrigated as necessary to maintain soil water tension at 8-inch depth no drier than 25 cb. Soil water tension was monitored by six granular matrix sensors (GMS, 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 an AM-400 meter (Mike Hansen Co., East Wenatchee, WA). The last irrigation was on July 17.

Emergence started on May 3. On May 23, Prowl® at 2 pints/acre was broadcast on the soil surface. On June 16, Goal® at 10 oz/acre, Buctril® at 12 oz/acre, and Volunteer® at 16 oz/acre were broadcast for weed control. Lannate® at 3 pints/acre and uran at 20 lb N/acre were injected through the drip tape on July 17. The sets were under-cut with a rod weeder on August 22. The sets were harvested on September 17 and 18, placed in nylon mesh bags,. and stored over the winter. The storage was maintained at 65°F and 70 percent relative humidity. Air flow around the bags was maintained by pumping air through ducts underneath the stored bags.

On March 16, 2009, the sets of each variety were sorted into four diameter categories:(<0.5, 0.5-0.75, 0.75-1, and > 1 inch). The sets of each size from each variety were divided into five equal parts to allow for five replications. On March 18, the sets were planted manually in double rows spaced 3 inches apart on 22-inch beds. The sets were planted at 2 sets/ft of single row (6-inch spacing between individual onion plants, or 95,000 plants/acre). The experimental design was a randomized complete block with set size as a split-plot within each variety main plot. Each variety main plot was 4 double rows by 25 ft long and was replicated five times. The four set sizes were planted in each variety main plot The total number of sets of each diameter for each split plot was divided into four to allow planting all four rows of the same length. The sets sizes were planted from largest to smallest in each main plot.

On April 27, Prowl at 2 pints/acre and Select® at 10 oz/acre were broadcast for weed control. On May 11, Goal® at 10 oz/acre, Buctril® at 12 oz/acre, Poast® at 1.2 pints/acre were broadcast for weed control. Aza-Direct® at 8 oz/acre and Success® at 16 oz/acre were broadcast on June 9 and June 18 for thrips control. Lannate at 3 pints/acre was broadcast on July 10 for thrips control. The field was fertilized with a total of 150 lb nitrogen (N)/acre. Fifty lb of N/acre were water run as urea on May 14 and 100 lb N/acre as urea was sidedressed on May 23.

On July 9 and July 16, one of the 2 border rows in each split plot was harvested. On July 23, the middle 2 rows in each split plot were harvested. Prior to each harvest, the length of the individual row or rows to be harvested in each split plot was measured. The onions were topped by hand, bagged, and placed in a shed. The onions were graded soon after harvest. 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 (<2.25 inches), medium (2.25-3 inches), jumbo (3-4 inches), colossal (4-4.25 inches), and supercolossal (>4.25 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.

Bulbs from each split plot from the July 23 harvest were rated for single centers. In each split plot, 25 onions ranging in diameter from 3.5 to 4.25 inches were rated. The onions were cut equatorially through the bulb middle and, if multiple centered, the long axis of the inside diameter of the first single ring was measured. These multiple-centered onions were ranked according to the inner diameter of the first single ring: “small” had diameters less than 1.5 inches, “medium” had diameters of 1.5-2.25 inches, and “large” had diameters greater than 2.25 inches. Onions were considered "functionally single centered" for processing if they were single centered or had a small multiple center.

Treatment differences were compared using repeated measures analysis of variance. Means separation was determined using Fisher’s least significant difference test at the 5 percent probability level, LSD (0.05).

Results and Discussion

Sets of variety ‘Crocket’ decomposed in storage, resulting in insuffcient numbers for planting. Sets of variety ‘Joaquin’ were poorly formed and they also decomposed in storage, but enough were available to evaluate one plot.

All of the short-day varieties had poor yield at the first harvest (July 9)(Table 2). At the second harvest, all of the short-day varieties had poor yield except ‘Kalahari’ (Table 3). Kalahari, averaged over the set sizes, had 401 cwt/acre jumbo yield. At the third harvest (July 23), all of the short-day varieties had poor yield, except Kalahari (Table 4). By the third harvest all of the short-day varieties had started to show pronounced decomposition. ‘Exacta’ and ‘Golden Spike’ (intermediate-day varieties) had good yields at each harvest, but also had substantial bolting. Exacta also started to decompose rapidly after harvest. Of the long-day varieties, ‘Vaquero’ and ‘Montero’ had more than 400 cwt/acre jumbo yield, averaged over the set sizes, at the first and second harvests with little bolting. At the third harvest, Vaquero and ‘Pulsar’ had more than 500 cwt/acre jumbo yield with little bolting or decomposition.

Averaged over varieties and harvest dates, bolting increased with set size (Table 5). However, the effect of set size on bolting was only expressed by the short-day and intermediate-day varieties (‘Chaco’ excepted). The long-day varieties chosen for this trial had very little bolting. Averaged over varieties and harvest dates, marketable and jumbo yield increased with set size.

All of the long-day varieties (averaged over set sizes) had more than 90 percent functionally single-centered bulbs (Table 6). Of the short- and intermediate-day varieties, only Chaco, Kalahari, and 'Sweet Sunrise' averaged over 90 percent functionally single-centered bulbs. Set sizes less than 0,75 inch had fewer single-centered bulbs than the larger sets. Set sizes of 0,75 inch or less had fewer functionally single-centered bulbs than the larger sets.

In terms of subjective external appearance after harvest and grading, the short-day varieties and Exacta (intermediate-day variety) had substantial skin loss (bald bulbs) and some showed rapid decomposition (Table 1). Of the long-day varieties, Vaquero had the best appearance; the others had excessive layers of dry skin.

Conclusions

The short- and intermediate-day varieties performed poorly (low yield, high bolting and decomposition). Some of the long-day varieties, such as Vaquero, performed well, with high yield, little bolting, and a high percentage of single-centered bulbs. The long-day varieties chosen for this trial did not have an increase in bolting with an increase in set size. For these varieties, larger sets resulted in higher yields and more single=centered bulbs.

References

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Acknowledgments

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Table 1. Onion varieties evaluated for production from sets, maturity type (season length), and bulb external appearance after grading.

Maturity type	Company	Variety	Bulb external appearance
short	Bejo	Crocket	none available
short	Lockhart	Chaco	bald
short	Nunhems	Don Victor	bald
short	Nunhems	Kalahari	bald, rapid decomposition
short	Nunhems	Olga	bald
short	Nunhems	Sweet Sunrise	bald, rapid decomposition
intermediate	Seminis	Exacta	rapid decomposition
intermediate	Seminis	Golden Spike	good
long	Nunhems	Joaquin	good, ugly skin
long	Nunhems	Vaquero	very good
long	Nunhems	Montero	good, lots of dry skin
long	Nunhems	Sabroso	heavy dry skin
long	Nunhems	Pulsar	heavy dry skin
long	Bejo	Talon	heavy dry skin
long	D. Palmer	Generation X	heavy dry skin

Table 2. Yield and grade of onion varieties grown from sets and harvested on July 9, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR.

Maturity group		Set	Total	Marketable yield by grade					Bulb counts	Total	Bolting
Company	Variety	diameter	yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in	rot	
		inches	cwt/acre						#/50 lb	%	%
Short-day											
Lockhart	Chaco	> 1									
		0.75 - 1	378.6	251.6	0.0	0.0	0.0	251.6		0.0	4.6
		0.5 - 0.75	316.6	256.7	0.0	0.0	69.3	187.4		0.0	0.0
		< 0.5	286.0	247.8	0.0	0.0	60.9	186.9		0.0	0.0
		average	327.1	252.0	0.0	0.0	43.4	208.6		0.0	1.5
Nunhems	Don Victor	> 1								0.0	
		0.75 - 1	414.1	336.5	0.0	0.0	176.9	159.6		0.0	34.5
		0.5 - 0.75	379.6	343.2	0.0	0.0	147.6	195.6		0.0	16.6
		< 0.5	383.3	344.6	0.0	0.0	148.4	196.2		0.0	6.3
		average	392.3	341.4		0.0	157.7	183.8		0.0	19.1
Nunhems	Kalahari	> 1									
		0.75 - 1	493.9	467.1	0.0	0.0	288.7	178.4		0.0	9.0
		0.5 - 0.75	511.8	483.0	0.0	0.0	348.0	135.0		0.0	2.8
		< 0.5	420.3	394.2	0.0	0.0	279.0	115.3		0.0	0.6
		average	475.3	448.1		0.0	305.2	142.9		0.0	7.6
Nunhems	Olga	> 1								0.0	
		0.75 - 1	477.3	308.8	0.0	0.0	0.0	308.8		0.0	20.0
		0.5 - 0.75	341.7	298.3	0.0	0.0	108.7	189.6		0.0	11.6
		< 0.5	348.7	326.4	0.0	0.0	111.7	214.7		0.0	2.8
		average	357.2	312.0			100.2	211.8		0.0	8.4
Nunhems	Sweet	> 1	347.8	151.0	0.0	0.0	29.5	121.5		0.0	74.4
	Sunrise	0.75 - 1	344.2	237.7	0.0	0.0	63.5	174.3		0.0	40.2
		0.5 - 0.75	333.0	291.8	0.0	0.0	107.3	184.4		0.0	13.9
		< 0.5	294.3	242.4	0.0	0.0	58.3	184.1		0.0	1.1
		average	327.5	236.5		0.0	66.3	170.2		0.0	28.6
Intermediate-day											
Seminis	Exacta	> 1	827.9	822.7	0.0	88.9	681.1	52.7		0.0	15.0
		0.75 - 1	645.9	631.8	0.0	66.0	472.7	93.0		0.0	12.8
		0.5 - 0.75	568.8	557.1	0.0	13.0	467.9	76.2		0.0	7.4
		< 0.5	438.6	418.3	0.0	11.6	336.1	70.7		0.0	0.0
		average	609.0	595.5		43.5	476.4	75.7		0.0	8.7
Seminis	Golden	> 1	544.0	503.8	0.0	76.9	352.0	74.8		0.0	29.2
		0.75 - 1	490.9	472.3	0.0	27.8	359.0	85.5		0.0	23.4
		0.5 - 0.75	483.4	463.3	0.0	13.8	369.2	80.3		0.0	4.3
		< 0.5	441.2	426.6	0.0	11.5	361.7	53.4		0.0	0.0
		average	489.9	466.5		32.5	360.5	73.5		0.0	15.0
Long-day											
Nunhems	Vaquero	> 1	615.3	615.3	0.0	0.0	575.8	39.4		0.0	0.0
		0.75 - 1	603.6	603.6	0.0	0.0	545.6	57.9		0.0	0.0
		0.5 - 0.75	493.6	484.0	0.0	0.0	378.9	105.1		0.0	0.0
		< 0.5	451.6	431.2	0.0	0.0	339.8	91.4		0.0	0.0
		average	533.2	525.0		0.0	446.8	78.3		0.0	0.0

Table 2. Yield and grade of onion varieties grown from sets and harvested on July 9, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR, (continued).

Maturity group		Set	Total	Marketable yield by grade					Bulb counts	Total	Bolting
Company	Variety	diameter	yield	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in	rot	
		inches	---------- cwt/acre ----------						#/50 lb	%	%
Nunhems	Montero	> 1	607.0	602.2	0.0	66.8	522.1	13.2		0.0	5.4
		0.75 - 1	495.6	489.1	0.0	0.0	399.6	89.5		0.0	0.0
		0.5 - 0.75	493.7	487.2	0.0	0.0	378.2	109.0		0.0	0.0
		< 0.5	424.1	405.0	0.0	0.0	284.6	120.4		0.0	0.0
		average	514.1	506.0	0.0	18.6	408.5	78.9		0.0	1.5
Nunhems	Sabroso	> 1	460.6	425.9	0.0	0.0	247.1	178.8		0.0	0.0
		0.75 - 1	418.2	394.3	0.0	0.0	258.8	135.5		0.0	0.0
		0.5 - 0.75	371.3	345.5	0.0	0.0	188.8	156.7		0.0	0.0
		< 0.5	295.7	276.3	0.0	0.0	112.7	163.6		0.0	0.0
		average	382.5	357.1	0.0	0.0	199.5	157.6		0.0	0.0
Nunhems	Pulsar	> 1	571.0	542.3	0.0	0.0	272.7	269.6		0.0	0.0
		0.75 - 1	471.4	464.1	0.0	0.0	280.7	183.4		0.0	0.0
		0.5 - 0.75	466.0	457.7	0.0	0.0	342.4	115.3		0.0	0.0
		< 0.5	421.9	407.8	0.0	0.0	308.4	99.4		0.0	0.0
		average	482.6	468.0	0.0	0.0	301.1	166.9		0.0	0.0
Bejo	Talon	> 1	540.3	531.7	0.0	0.0	440.5	91.2		0.0	0.0
		0.75 - 1	391.1	370.7	0.0	0.0	166.2	204.5		0.0	0.0
		0.5 - 0.75	381.0	365.1	0.0	0.0	172.4	192.7		0.0	0.0
		< 0.5	396.9	391.2	0.0	0.0	241.0	150.2		0.0	0.0
		average	441.9	428.1	0.0	0.0	271.3	156.8		0.0	0.0
D. Palmer	Generation X	> 1	505.1	487.4	0.0	0.0	428.8	58.6		0.0	0.0
		0.75 - 1	436.8	425.6	0.0	10.2	296.3	119.2		0.0	0.0
		0.5 - 0.75	377.2	357.2	0.0	0.0	230.4	126.8		0.0	0.0
		< 0.5	321.1	295.1	0.0	0.0	179.4	115.7		0.0	0.0
		average	404.1	385.7	0.0	3.0	272.8	109.9		0.0	0.0
	Average	> 1	518.5	480.4	0.0	26.6	352.8	100.9		0.0	13.5
		0.75 - 1	462.1	426.3	0.0	9.1	277.7	139.5		0.0	11.7
		0.5 - 0.75	418.1	391.7	0.0	2.0	247.2	142.5		0.0	4.9
		< 0.5	368.8	342.5	0.0	1.9	201.9	138.7		0.0	1.5
LSD (0.05)	Variety X date		55.1	51.7	3.7	21.7	69.5	40.1	NS	5.2	NS
	Variety X set size X date		110.2	103.4	NS	NS	139.0	80.2	NS	10.3	NS

Table 3. Yield and grade of onion varieties grown from sets and harvested on July 16, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR.

Maturity group		Set diameter	Total yield	Marketable yield by grade					Bulb counts	Total rot	Bolting
Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	cwt/acre						#/50 lb	%	%
Short-day											
Lockhart	Chaco	> 1									
		0.75 - 1	475.8	314.5	0.0	0.0	80.4	234.1		17.0	0.0
		0.5 - 0.75	357.8	263.3	0.0	0.0	76.9	186.5		7.4	0.0
		< 0.5	323.6	257.8	0.0	0.0	91.6	166.2		8.2	0.0
		average	385.7	278.6			83.0	195.6		10.8	0.0
Nunhems	Don Victor	> 1									
		0.75 - 1	487.9	344.8	0.0	0.0	133.1	211.7		10.1	50.6
		0.5 - 0.75	433.6	369.3	0.0	0.0	214.4	154.9		4.1	13.8
		< 0.5	446.1	391.1	0.0	0.0	191.0	200.2		5.6	1.0
		average	455.9	368.4	0.0	0.0	179.5	188.9		6.6	21.7
Nunhems	Kalahari	> 1									
		0.75 - 1	707.1	674.8	0.0	37.3	445.7	191.8		0.0	18.8
		0.5 - 0.75	552.2	512.7	0.0	0.0	364.4	148.3		3.4	1.6
		< 0.5	511.1	493.5	0.0	7.9	381.9	103.7		0.0	0.6
		average	590.1	560.3	0.0	15.1	397.3	147.9		1.1	7.0
Nunhems	Olga	> 1									
		0.75 - 1	601.6	360.9	0.0	0.0	115.3	245.6		17.1	50.0
		0.5 - 0.75	422.6	327.2	0.0	0.0	116.6	210.6		10.8	13.8
		< 0.5	424.1	393.4	0.0	0.0	173.8	219.6		0.0	5.3
		average	443.2	360.4	0.0	0.0	141.9	218.5		6.7	13.9
Nunhems	Sweet	> 1	497.3	330.9	0.0	0.0	95.0	235.9		7.0	70.3
	Sunrise	0.75 - 1	432.4	331.7	0.0	0.0	146.0	185.7		0.0	34.4
		0.5 - 0.75	463.6	398.3	0.0	0.0	198.1	200.2		3.2	14.3
		< 0.5	347.6	289.2	0.0	0.0	138.5	150.6		1.9	1.0
		average	426.2	334.7	0.0	0.0	147.1	187.7		2.6	26.1
Intermediate-day											
Seminis	Exacta	> 1	826.7	809.2	0.0	178.8	572.9	57.6		0.0	39.0
		0.75 - 1	901.2	867.0	0.0	192.5	600.2	74.3		0.0	11.8
		0.5 - 0.75	702.7	682.5	0.0	85.6	554.8	42.2		0.5	6.0
		< 0.5	557.9	539.0	20.1	47.2	408.4	63.2	28.7	0.0	0.0
		average	741.8	728.0	5.0	126.9	535.8	60.4		0.1	12.5
Seminis	Golden Spike	> 1	655.3	602.7	0.0	24.8	465.0	112.9		0.0	37.0
		0.75 - 1	647.3	617.7	0.0	78.3	445.0	94.4		0.0	15.4
		0.5 - 0.75	631.0	619.2	13.5	42.3	500.9	62.5	26.9	0.0	5.6
		< 0.5	488.8	472.5	0.0	50.3	394.1	28.1		0.0	2.5
		average	605.6	578.0	3.4	49.0	451.2	74.4		0.0	17.3
Long-day											
Nunhems	Vaquero	> 1	710.7	692.3	0.0	89.8	575.5	27.1		0.0	0.0
		0.75 - 1	757.9	749.3	0.0	85.8	623.8	39.7		0.0	0.0
		0.5 - 0.75	713.5	687.3	0.0	42.1	630.9	14.3		0.0	0.0
		< 0.5	615.3	594.0	0.0	17.3	524.4	52.2		0.0	0.0
		average	702.6	684.8	0.0	55.6	594.2	35.0		0.0	0.0

Table 3. Yield and grade of onion varieties grown from sets and harvested on July 16, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR, (continued).

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Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	---------- cwt/acre ----------						#/50 lb	%	%
Nunhems	Montero	> 1	727.8	727.8	0.0	35.6	692.2	0.0		0.0	2.8
		0.75 - 1	656.9	649.8	0.0	24.2	563.7	62.0		0.0	2.2
		0.5 - 0.75	627.2	613.2	0.0	9.4	563.6	40.1		0.0	0.0
		< 0.5	574.7	549.4	0.0	0.0	431.7	117.7		0.0	0.0
		average	654.6	644.6	0.0	19.2	577.4	48.0		0.0	1.4
Nunhems	Sabroso	> 1	728.2	660.0	0.0	0.0	531.8	128.2		0.0	0.0
		0.75 - 1	572.3	547.3	0.0	0.0	414.5	132.8		0.0	0.0
		0.5 - 0.75	490.6	466.9	0.0	0.0	373.7	93.2		0.0	0.0
		< 0.5	434.8	398.5	0.0	0.0	244.8	153.7		0.0	0.0
		average	547.4	510.7	0.0	0.0	383.8	126.9		0.0	0.0
Nunhems	Pulsar	> 1	802.8	606.4	0.0	0.0	532.3	74.1		0.0	0.0
		0.75 - 1	635.7	635.7	0.0	25.0	545.7	64.9		0.0	0.0
		0.5 - 0.75	548.5	541.9	0.0	0.0	461.1	80.8		0.0	0.0
		< 0.5	556.6	527.7	0.0	0.0	368.2	159.5		0.0	0.0
		average	627.1	577.9	0.0	6.3	476.8	94.9		0.0	0.0
Bejo	Talon	> 1	643.7	621.9	0.0	0.0	451.5	170.4		0.0	2.8
		0.75 - 1	484.6	460.1	0.0	0.0	277.0	183.1		0.0	0.0
		0.5 - 0.75	475.3	462.5	0.0	0.0	327.8	134.7		0.0	0.0
		< 0.5	602.6	583.9	0.0	0.0	497.5	86.4		0.0	0.0
		average	547.2	527.4	0.0	0.0	369.6	157.8		0.0	1.0
D. Palmer	Generation X	> 1	562.9	562.9	0.0	0.0	503.0	59.9		0.0	0.0
		0.75 - 1	556.8	534.8	0.0	0.0	298.1	236.8		0.0	0.0
		0.5 - 0.75	450.7	426.4	0.0	0.0	322.3	104.1		0.0	0.0
		< 0.5	398.0	363.8	0.0	0.0	226.8	136.9		0.0	0.0
		average	489.3	467.6	0.0	0.0	324.6	143.0		0.0	0.0
	Average	> 1	670.1	612.7	0.0	25.8	482.4	104.5		0.6	15.4
		0.75 - 1	611.1	568.7	0.0	38.0	390.0	140.7		1.8	12.8
		0.5 - 0.75	523.0	484.9	1.1	12.3	357.1	114.3		2.2	4.1
		< 0.5	467.3	432.4	1.5	9.8	289.9	131.2		1.4	0.7
LSD (0.05)	Variety X date		55.1	51.7	3.7	21.7	69.5	40.1	NS	5.2	NS
	Variety X set size X		110.2	103.4	NS	NS	139.0	80.2	NS	10.3	NS

Table 4. Yield and grade of onion varieties grown from sets and harvested on July 23, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR.

Maturity group		Set diameter	Total yield	Marketable yield by grade					Bulb counts	Total rot	Bolting
Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	---------- cwt/acre ----------						#/50 lb	%	%
Short-day											
Lockhart	Chaco	> 1	404.7	197.9	0.0	0.0	62.0	136.0		41.5	2.2
		0.75 - 1	374.6	264.0	0.0	0.0	86.4	177.6		19.6	0.0
		0.5 - 0.75	345.7	253.1	0.0	0.0	107.5	145.6		16.9	0.0
		< 0.5	321.8	266.4	0.0	0.0	94.1	172.3		10.2	0.0
		average	347.5	254.7	0.0	0.0	95.7	159.0		17.2	0.2
Nunhems	Don Victor	> 1									
		0.75 - 1	419.2	254.9	0.0	14.3	99.0	141.7		28.8	36.5
		0.5 - 0.75	427.1	341.6	0.0	54.6	175.0	112.0		14.9	16.6
		< 0.5	402.7	325.2	0.0	38.8	181.1	105.3		17.5	2.9
		average	416.3	307.2	0.0	35.9	151.7	119.7		20.4	18.7
Nunhems	Kalahari	> 1	1060.5	731.7	0.0	0.0	648.8	82.9		23.7	8.3
		0.75 - 1	778.0	615.5	0.0	0.0	438.5	177.0		14.9	17.0
		0.5 - 0.75	591.9	486.2	0.0	3.0	388.7	94.6		16.3	6.4
		< 0.5	529.5	446.8	0.0	3.6	364.4	78.8		13.8	0.0
		average	659.8	529.6	0.0	2.1	412.9	114.7		15.6	7.8
Nunhems	Olga	> 1									
		0.75 - 1	602.8	346.2	0.0	0.0	173.8	172.4		18.9	39.1
		0.5 - 0.75	421.2	274.9	0.0	0.0	116.4	158.4		29.8	13.6
		< 0.5	392.5	320.6	0.0	0.0	163.4	157.3		12.3	3.8
		average	424.7	302.2	0.0	0.0	143.0	159.2		20.8	11.5
Nunhems	Sweet Sunrise	> 1	533.0	307.3	0.0	0.0	40.2	267.1		20.8	74.5
		0.75 - 1	435.6	299.9	0.0	0.0	118.8	181.1		17.0	43.0
		0.5 - 0.75	435.2	340.9	0.0	0.0	163.1	177.8		15.8	17.0
		< 0.5	366.8	253.0	0.0	0.0	101.1	151.8		24.1	1.7
		average	432.4	297.0	0.0	0.0	110.2	186.9		19.5	30.3
Intermediate-day											
Seminis	Exacta	> 1	856.8	780.9	22.6	222.5	477.8	58.0	20.0	4.0	34.2
		0.75 - 1	840.5	791.8	3.5	185.2	529.7	73.5	30.1	4.6	19.7
		0.5 - 0.75	832.5	786.5	20.3	115.0	615.2	36.0	37.8	4.4	3.2
		< 0.5	626.2	597.5	29.0	166.5	371.3	30.6	37.9	2.6	0.0
		average	788.0	739.9	17.7	170.0	501.7	50.5	32.7	4.0	13.4
Seminis	Golden Spike	> 1	735.3	715.9	17.7	143.3	487.0	67.9	28.7	1.1	92.3
		0.75 - 1	652.3	625.0	0.0	39.2	522.3	63.5		1.4	23.3
		0.5 - 0.75	718.5	712.1	0.0	154.6	516.8	40.7		0.0	4.0
		< 0.5	562.1	551.5	5.5	96.2	419.2	30.5	27.5	0.0	0.5
		average	667.0	651.1	5.8	108.3	486.3	50.7	28.1	0.6	30.0
Long-day											
Nunhems	Vaquero	> 1	790.3	783.2	19.5	231.8	524.7	7.1	39.7	0.0	0.0
		0.75 - 1	774.5	769.8	10.5	152.5	589.0	17.7	42.4	0.0	1.0
		0.5 - 0.75	795.6	795.6	11.0	161.9	602.7	20.0	49.5	0.0	0.0
		< 0.5	639.5	637.2	12.7	79.2	489.5	55.9	43.1	0.0	3.5
		average	744.9	741.9	12.1	142.3	559.8	27.8	43.7	0.0	1.3

Table 4. Yield and grade of onion varieties grown from sets and harvested on July 23, 2009. Malheur Experiment Station, Oregon State University, Ontario, OR, (continued).

Maturity group		Set diameter	Total yield	Marketable yield by grade					Bulb counts	Total rot	Bolting
Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	---------- cwt/acre ----------						#/50 lb	%	%
Nunhems	Montero	> 1	753.6	606.6	13.7	143.2	411.6	38.0	32.5	21.6	3.2
		0.75 - 1	631.7	601.5	4.2	33.4	511.7	52.1	40.3	3.8	1.8
		0.5 - 0.75	655.7	639.6	0.0	58.7	537.2	43.8		2.1	0.8
		< 0.5	638.7	590.5	0.0	40.7	499.6	50.2		6.6	0.0
		average	673.4	611.6	5.0	72.2	489.0	45.6	36.4	8.7	1.6
Nunhems	Sabroso	> 1	641.0	640.8	0.0	17.7	566.0	57.1		0.0	0.0
		0.75 - 1	554.5	537.3	0.0	0.0	436.1	101.1		1.9	0.0
		0.5 - 0.75	529.3	508.8	0.0	0.0	418.9	90.0		2.7	0.0
		< 0.5	443.5	410.3	0.0	0.0	293.3	117.0		1.3	0.0
		average	536.9	518.2	0.0	3.7	421.3	93.1		1.6	0.0
Nunhems	Pulsar	> 1	744.9	719.9	0.0	0.0	650.1	69.8		2.2	0.0
		0.75 - 1	651.8	649.1	0.0	3.9	585.3	59.9		0.0	0.3
		0.5 - 0.75	586.2	584.4	0.0	0.0	537.5	46.8		0.0	0.0
		< 0.5	535.2	524.9	0.0	6.5	450.6	67.8		0.0	0.0
		average	629.5	619.6	0.0	2.6	555.9	61.1		0.6	0.1
Bejo	Talon	> 1	561.5	544.1	0.0	0.0	453.2	90.9		1.6	1.8
		0.75 - 1	465.9	449.6	0.0	0.0	285.2	164.4		2.0	2.4
		0.5 - 0.75	431.1	426.1	0.0	0.0	309.4	116.7		0.0	1.5
		< 0.5	481.5	446.6	0.0	0.0	289.9	156.6		5.1	2.4
		average	491.2	476.4	0.0	0.0	352.4	124.0		1.5	1.9
D. Palmer	Generation X	> 1	740.5	479.5	0.0	96.8	357.1	25.6		36.5	0.0
		0.75 - 1	603.3	588.1	0.0	6.7	537.3	44.2		2.5	0.0
		0.5 - 0.75	510.3	497.3	0.0	14.0	398.8	84.4		1.1	0.0
		< 0.5	444.4	406.0	0.0	0.0	299.7	106.3		4.9	0.0
		average	551.7	500.6	0.0	18.6	412.1	70.0		6.9	0.0
	Average	> 1	698.5	612.3	7.0	74.2	450.8	80.4	30.2	9.9	23.5
		0.75 - 1	609.8	545.8	1.4	36.1	406.0	102.3	37.6	7.9	13.6
		0.5 - 0.75	551.8	501.5	1.9	39.5	369.0	91.1	43.6	8.3	4.9
		< 0.5	482.3	432.8	3.4	32.4	299.7	97.3	36.6	8.1	1.1
LSD (0.05)	Variety X date		55.1	51.7	3.7	21.7	69.5	40.1	NS	5.2	NS
	Variety X set size X date		110.2	103.4	NS	NS	139.0	80.2	NS	10.3	NS

Table 5. Yield and grade of onion varieties grown from sets averaged over three harvest dates. Malheur Experiment Station, Oregon State University, Ontario, OR, 2009.

Maturity Group		Set diameter	Total yield	Marketable yield by grade					Bulb counts	Total rot	Bolting
Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	cwt/acre						#/50 lb	%	%
Short-day											
Lockhart	Chaco	> 1	245.9	136.6	0.0	0.0	20.7	115.9		20.7	0.7
		0.75 - 1	409.7	276.7	0.0	0.0	55.6	221.1		18.3	1.5
		0.5 - 0.75	340.0	257.7	0.0	0.0	84.5	173.2		12.1	0.0
		< 0.5	309.6	256.7	0.0	0.0	81.4	175.3		9.1	0.0
		average	332.4	250.8	0.0	0.0	73.8	177.0		12.7	0.3
Nunhems	Don Victor	> 1									
		0.75 - 1	440.4	312.0	0.0	4.8	136.3	171.0		19.5	40.5
		0.5 - 0.75	413.4	351.4	0.0	18.2	179.0	154.2		9.5	15.6
		< 0.5	410.7	353.6	0.0	12.9	173.5	167.2		11.5	3.4
		average	421.5	339.0	0.0	12.0	162.9	164.1		13.5	19.8
Nunhems	Kalahari	> 1	631.3	505.4	0.0	0.0	410.9	94.6		11.9	22.8
		0.75 - 1	659.7	585.8	0.0	12.4	391.0	182.4		7.5	14.9
		0.5 - 0.75	552.0	494.0	0.0	1.0	367.0	125.9		9.9	3.6
		< 0.5	491.7	448.4	0.0	4.1	346.2	98.1		6.9	0.2
		average	573.4	510.4	0.0	5.5	371.3	133.7		8.3	7.4
Nunhems	Olga	> 1									
		0.75 - 1	560.6	338.7	0.0	0.0	96.4	242.3		18.0	36.4
		0.5 - 0.75	393.2	298.2	0.0	0.0	113.7	184.4		21.4	12.9
		< 0.5	385.9	343.5	0.0	0.0	147.9	195.6		6.8	3.8
		average	406.1	322.5	0.0	0.0	127.5	195.1		14.5	11.1
Nunhems	Sweet Sunrise	> 1	459.3	263.0	0.0	0.0	54.9	208.2		13.9	72.9
		0.75 - 1	404.1	289.8	0.0	0.0	109.4	180.4		8.5	39.3
		0.5 - 0.75	410.6	343.7	0.0	0.0	156.2	187.5		9.5	15.0
		< 0.5	336.2	261.5	0.0	0.0	99.3	162.2		13.0	1.3
		average	395.4	289.4	0.0	0.0	107.8	181.6		11.0	28.3
Intermediate-day											
Seminis	Exacta	> 1	837.1	804.3	7.5	163.4	577.2	56.1	20.0	2.0	29.4
		0.75 - 1	788.4	763.5	1.2	147.9	534.2	80.3	30.1	2.6	14.8
		0.5 - 0.75	701.3	675.4	6.8	71.2	546.0	51.4	37.8	2.5	5.5
		< 0.5	540.9	518.3	16.4	75.1	371.9	54.8	34.8	1.3	0.0
		average	712.3	687.8	7.6	113.4	504.6	62.2	32.1	2.1	11.5
Seminis	Golden Spike	> 1	644.9	607.5	5.9	81.7	434.7	85.2	28.7	0.6	52.8
		0.75 - 1	596.8	571.6	0.0	48.5	442.1	81.1		0.7	20.7
		0.5 - 0.75	610.9	598.2	4.5	70.2	462.3	61.2	26.9	0.0	4.6
		< 0.5	497.4	483.5	1.8	52.7	391.7	37.3	27.5	0.0	0.6
		average	587.5	565.2	3.1	63.3	432.7	66.2	27.7	0.3	21.0
Long-day											
Nunhems	Vaquero	> 1	705.4	696.9	6.5	107.2	558.7	24.5	39.7	0.0	0.0
		0.75 - 1	712.0	707.5	3.5	79.4	586.2	38.4	42.4	0.0	0.3
		0.5 - 0.75	667.6	655.6	3.7	68.0	537.5	46.4	49.5	0.0	0.0
		< 0.5	568.8	554.1	4.2	32.2	451.2	66.5	43.1	0.0	1.2
		average	660.2	650.6	4.0	65.9	533.6	47.0	43.7	0.0	0.4

Table 5. Yield and grade of onion varieties grown from sets averaged over three harvest dates. Malheur Experiment Station, Oregon State University, Ontario, OR, 2009, (continued).

Maturity Group		Set diameter	Total yield	Marketable yield by grade					Bulb counts	Total rot	Bolting
Company	Variety			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	>4¼ in		
		inches	---------- cwt/acre ----------						#/50 lb	%	%
Nunhems	Montero	> 1	696.1	645.5	4.6	81.9	542.0	17.1	32.5	10.8	3.8
		0.75 - 1	594.7	580.1	1.4	19.2	491.7	67.9	40.3	1.9	1.3
		0.5 - 0.75	592.2	580.0	0.0	22.7	493.0	64.3		1.0	0.3
		< 0.5	545.8	515.0	0.0	13.6	405.3	96.1		3.3	0.0
		average	614.0	587.4	1.7	36.6	491.6	57.5	36.4	4.4	1.5
Nunhems	Sabroso	> 1	609.9	575.6	0.0	5.9	448.3	121.4		0.0	0.0
		0.75 - 1	515.0	492.9	0.0	0.0	369.8	123.1		0.9	0.0
		0.5 - 0.75	463.7	440.4	0.0	0.0	327.1	113.3		1.4	0.0
		< 0.5	391.3	361.7	0.0	0.0	217.0	144.7		0.7	0.0
		average	488.9	462.0	0.0	1.2	334.9	125.9		0.8	0.0
Nunhems	Pulsar	> 1	699.3	667.3	0.0	0.0	519.6	147.7		1.2	0.0
		0.75 - 1	586.3	583.0	0.0	9.7	470.6	102.7		0.0	0.1
		0.5 - 0.75	533.5	528.0	0.0	0.0	447.0	81.0		0.0	0.0
		< 0.5	504.6	486.8	0.0	2.2	375.7	108.9		0.0	0.0
		average	578.9	564.6	0.0	3.0	452.1	109.4		0.3	0.0
Bejo	Talon	> 1	581.8	565.9	0.0	0.0	448.4	117.5		0.8	1.6
		0.75 - 1	447.2	426.8	0.0	0.0	242.8	184.0		1.0	0.8
		0.5 - 0.75	429.1	417.9	0.0	0.0	269.9	148.0		0.0	0.5
		< 0.5	493.7	473.9	0.0	0.0	342.8	131.0		2.5	0.8
		average	493.4	477.3	0.0	0.0	331.1	146.2		0.8	1.0
D. Palmer	Generation X	> 1	585.6	513.7	0.0	24.2	438.7	50.8		14.6	0.0
		0.75 - 1	532.3	516.2	0.0	5.6	377.2	133.4		1.3	0.0
		0.5 - 0.75	446.1	427.0	0.0	4.7	317.2	105.1		0.5	0.0
		< 0.5	387.8	355.0	0.0	0.0	235.3	119.7		2.4	0.0
		average	480.3	450.3	0.0	7.0	335.0	108.4		3.3	0.0
Set size	Average	> 1	632.6	578.0	2.3	42.5	435.8	97.3	30.2	5.2	17.6
		0.75 - 1	563.0	516.1	0.5	27.8	359.5	128.3	37.6	4.9	12.5
		0.5 - 0.75	498.8	460.7	1.0	18.0	325.4	116.3	38.1	5.3	4.4
		< 0.5	440.6	403.8	1.6	14.7	265.0	122.4	35.0	4.8	0.9
Date	Average	9-Jul	441.0	410.4	0.0	8.4	267.1	134.8			7.0
		16-Jul	557.4	518.9	0.7	21.2	372.2	124.9	27.8	1.6	7.6
		23-Jul	574.4	514.4	3.0	42.6	374.8	93.9	35.9	8.4	9.4
LSD (0.05)	Variety		51.7	63.6	2.6	21.0	61.9	29.7	NS	3.5	13.6
	Set size		28.7	35.3	NS	NS	34.3	16.5	NS	NS	7.6
	Var. X set size		103.4	127.3	NS	NS	123.8	59.4	NS	7.0	27.2
	Date		15.3	14.3	NS	NS	NS	NS	NS	NS	NS

Table 6. Bulb multiple-center rating for onion grown from sets and harvested on July 23, 2009. Malheur Experiment Station, Oregon State Univeristy, Ontario, OR.

Maturity Group		Set diameter	Multiple center			Single center	
Company	Variety		large	medium	small	functional	bullet
		inches	---------- % ----------				
Short-day							
Lockhart	Chaco	> 1	0.0	0.0	4.0	100.0	96.0
		0.75 - 1	0.0	0.0	2.0	100.0	98.0
		0.5 - 0.75	0.0	0.0	0.8	100.0	99.2
		< 0.5	0.0	0.0	5.0	100.0	95.0
		average	0.0	0.0	2.7	100.0	97.3
Nunhems	Don Victor	> 1					
		0.75 - 1	0.8	4.4	7.0	94.8	87.8
		0.5 - 0.75	5.6	13.6	26.4	80.8	54.4
		< 0.5	8.0	15.2	14.4	76.8	62.4
		average	4.8	11.1	15.9	84.1	68.2
Nunhems	Kalahari	> 1	0.0	0.0	31.3	100.0	68.8
		0.75 - 1	0.0	0.8	0.0	99.2	99.2
		0.5 - 0.75	0.0	2.4	3.1	97.6	94.5
		< 0.5	0.8	15.2	13.7	84.0	70.3
		average	0.3	5.8	7.2	94.0	86.8
Nunhems	Olga	> 1					
		0.75 - 1	5.9	0.0	11.8	94.1	82.4
		0.5 - 0.75	0.8	16.9	22.9	82.3	59.4
		< 0.5	5.7	21.8	30.0	72.4	42.4
		average	3.5	17.6	25.1	78.9	53.8
Nunhems	Sweet	> 1	0.0	2.6	10.2	97.4	87.2
	Sunrise	0.75 - 1	0.0	0.8	4.0	99.2	95.2
		0.5 - 0.75	0.0	0.0	11.0	100.0	89.0
		< 0.5	1.9	4.9	22.5	93.2	70.8
		average	0.6	2.1	12.2	97.3	85.1
Intermediate-day							
Seminis	Exacta	> 1	2.7	5.3	8.7	92.0	83.3
		0.75 - 1	2.9	10.9	8.3	86.1	77.8
		0.5 - 0.75	1.0	11.0	9.2	88.0	78.8
		< 0.5	7.0	12.0	16.0	81.0	65.0
		average	3.4	10.2	10.5	86.4	75.9
Seminis	Golden Spike	> 1	1.1	12.0	16.2	87.0	70.8
		0.75 - 1	4.1	7.8	12.7	88.1	75.5
		0.5 - 0.75	4.0	12.3	21.7	83.7	62.0
		< 0.5	6.3	27.3	16.4	66.4	50.0
		average	3.9	14.8	16.7	81.3	64.6
Long-day							
Nunhems	Vaquero	> 1	0.0	0.0	8.0	100.0	92.0
		0.75 - 1	1.3	0.0	2.0	98.8	96.8
		0.5 - 0.75	2.7	2.7	1.3	94.7	93.3
		< 0.5	2.7	0.0	1.3	97.3	96.0
		average	1.9	0.7	2.2	97.4	95.2

Table 6. Bulb multiple-center rating for onion grown from sets and harvested on July 23, 2009. Malheur Experiment Station, Oregon State Univeristy, Ontario, OR, (continued).

Maturity Group		Set diameter	Multiple center			Single center	
Company	Variety		large	medium	small	functional	bullet
		inches	---------- % ----------				
Nunhems	Montero	> 1	3.1	1.3	1.1	95.7	94.6
		0.75 - 1	0.0	1.6	1.6	98.4	96.8
		0.5 - 0.75	0.0	0.8	3.2	99.2	96.0
		< 0.5	8.3	0.0	1.4	91.7	90.3
		average	2.2	1.0	1.9	96.7	94.9
Nunhems	Sabroso	> 1	0.0	0.0	0.0	100.0	100.0
		0.75 - 1	0.0	0.0	0.8	100.0	99.2
		0.5 - 0.75	0.0	0.8	3.2	99.2	96.0
		< 0.5	0.0	1.6	0.0	98.4	98.4
		average	0.0	0.6	1.1	99.4	98.3
Nunhems	Pulsar	> 1	0.8	0.0	1.3	99.2	97.9
		0.75 - 1	0.8	0.8	4.5	98.4	93.9
		0.5 - 0.75	0.0	5.6	7.2	94.4	87.2
		< 0.5	21.6	5.6	4.8	72.8	68.0
		average	5.8	3.0	4.5	91.2	86.7
Bejo	Talon	> 1	1.1	1.1	4.0	97.8	93.8
		0.75 - 1	1.0	2.0	5.0	97.0	92.0
		0.5 - 0.75	2.0	7.0	9.0	91.0	81.9
		< 0.5	0.0	0.0	8.0	100.0	92.0
		average	1.3	3.0	6.0	95.8	89.8
D. Palmer	Generation X	> 1	0.0	0.0	0.0	100.0	100.0
		0.75 - 1	0.8	0.8	0.0	98.4	98.4
		0.5 - 0.75	2.4	3.2	0.0	94.4	94.4
		< 0.5	1.0	0.0	1.0	99.0	98.0
		average	1.3	1.3	0.3	97.5	97.3
	Average	> 1	1.1	2.7	6.1	96.2	90.1
		0.75 - 1	1.1	2.6	4.3	96.3	92.0
		0.5 - 0.75	1.4	6.0	9.4	92.6	83.2
		< 0.5	5.3	9.4	11.4	85.3	74.0
LSD (0.05)	Variety		NS	3.6	5.5	5.9	7.9
	Set size		NS	NS	2.2	5.7	5.6
	Var. X set size		NS	NS	8.1	NS	NS