‘NuMex Allure’ Onion

Christopher S. Cramer^{1,2}

Department of Plant and Environmental Sciences, Box 30003, MSC 3Q, New Mexico State University, Las Cruces, NM 88003-0003

Additional index words. *Allium cepa*, bulb shape index, intermediate-day, pink root, single-centered bulbs

The New Mexico State University (NMSU) Agricultural Experiment Station announces the release of ‘NuMex Allure’ onion (*Allium cepa* L.). ‘NuMex Allure’ is an open-pollinated, late maturing, intermediate-day, onion cultivar with red-colored dry outer scales for winter sowing in southern New Mexico and similar environments. ‘NuMex Allure’ matures in late July to mid-August when winter sown in Las Cruces, NM.

Origin

‘NuMex Allure’ originates from similar germplasm that was used in the development of ‘NuMex Crimson’ (Cramer and Corgan, 2003) and ‘NuMex Grandeur’ (Cramer, 2014) (Fig. 1). NuMex Crimson is a short-day, overwintered cultivar with red-colored dry outer scales that originated from intercrosses between short-day cultivars with red-colored dry outer scales (Kurenai, Red Grano, and Rojo), short-day cultivars with yellow-colored dry outer scales (Henry’s Special and Texas Grano 502 PRR), and an intermediate-day cultivar with yellow-colored dry outer scales (Peckham Yellow Sweet Spanish) (Cramer and Corgan, 2003). Of these cultivars, Peckham Yellow Sweet Spanish and Henry’s Special were also used in the development of NuMex Allure. NMSU 89-78-3 originated from ‘Peckham Yellow Sweet Spanish’ and NMSU 89-78-4 originated from an intercross between ‘Henry’s Special’ and ‘Peckham Yellow Sweet Spanish’.

In August of 1989, seeds of NMSU 89-78-3 and 89-78-4 were sown. In January, plants of both breeding lines that exhibited red outer scale layers were selected and placed in separate crossing cages, 90-53 (89-78-3) and 90-54 (89-78-4). In May 1990, plants in both cages flowered and pollinators were placed in each cage. Once mature, seeds were harvested from each cage. In Feb. 1991, seeds of breeding lines 90-53 and 90-54 were sown in fields at the Fabian Garcia Science Center (FGSC) in Las Cruces, NM, and bulbs that

possessed red-colored dry outer scales, greater bulb height, and fewer symptoms of pink root [causal organism, *Phoma terrestris* (Hansen)], were selected. After selected bulbs from each line broke dormancy in Oct. 1991, they were placed into separate crossing cages numbered 92-31 and 92-33 (Fig. 1). In May 1992, plants in both cages flowered and seeds were harvested. In Feb. 1993, seeds of both breeding lines were sown and bulbs that possessed red-colored dry outer scales, fewer pink root symptoms, and earlier maturity were selected. After selected bulbs from each line broke dormancy in Oct. 1993, they were placed into separate crossing cages numbered 94-23-1 and 94-24-1. In May 1994, plants in both cages flowered and seeds were harvested. In Jan. 1995, seeds of both breeding lines were sown and bulbs that possessed red-colored dry outer scales, thinner dry outer scales, fewer pink root symptoms, and earlier maturity were selected from both lines. In addition, bulbs with the absence of multiple meristems visible in the expanded leaves were selected from the 94-23-1 breeding line. After selected bulbs broke dormancy in Oct. 1995, bulbs from 94-23-1 that were selected for a reduced number of visible meristems were placed as the first entry (-1) in the crossing cage, 96-12 (Fig. 1). Those bulbs selected from 94-23-1 that may have had multiple meristems were placed as the second entry (-2) in the same crossing cage. Bulbs that were selected from 94-23-1 and possessed lighter red dry outer scales than those bulbs placed in 96-12-1 were placed as the first entry (-1) in a second crossing cage numbered 96-22-1. Bulbs selected from 94-24-1 were placed as the second entry (96-22-2) in the same crossing cage (Fig. 1). In May 1996, bulbs of each entry in each cage flowered and pollinators were introduced into each cage. Once mature, seeds were harvested and kept separate from plants of each entry of each cage. In Feb. 1997, seeds of each entry were sown and bulbs that possessed darker red dry outer scale layers, multiple dry outer scale layers, less pink root, and the absence of multiple meristems visible in the expanded leaves were selected from the 96-12-1, 96-22-1, and 96-22-2 breeding lines. Once the bulbs broke dormancy in Oct. 1997, the bulbs selected from 96-12-1 were placed as a single entry in a crossing cage numbered 98-30 while bulbs selected from 96-22-1 and 96-22-2 were placed as two separate entries in a crossing cage numbered 98-26. In May

1998, bulbs in each cage flowered and pollinators were introduced into each cage. Once mature, seeds were harvested from plants of each entry in each cage.

In Feb. 1999, seeds of 98-30 and 98-26-1 were sown and bulbs that possessed darker red dry outer and internal fleshy scale layers, less pink root, greater bulb height, and greater bulb firmness when hand squeezed were selected from 98-30. Bulbs that possessed darker red dry outer scale layers and less pink root were selected from 98-26-1. Once bulbs broke dormancy in Oct. 1999, single bulbs, selected from each breeding line, were placed in 69 separate, small crossing cages to allow self-pollinations to occur the following year. In May 2000, bulbs in each cage flowered, pollinators were introduced, and seeds were harvested separately from each cage. In Jan. 2001, seeds from each selfing cage were sown, and in July 2001, bulbs that possessed darker red dry outer scale layers and greater bulb height were selected from six different breeding lines (Fig. 1). Once bulbs broke dormancy in Oct. 2001, single bulbs, selected from each breeding line, were placed in 19 separate, small cages to allow self-pollinations to occur the following year. In May 2002, bulbs in each cage flowered, pollinators were introduced, and seeds were harvested separately from each cage. In Jan. 2003, seeds of each crossing cage were sown and in July 2003 bulbs that possessed darker red dry outer scale layers and greater bulb height were selected from nine different breeding lines (Fig. 1). In Oct. 2003, these selected bulbs were placed together in a single crossing cage numbered 04-43. In May 2004, bulbs flowered, pollinators were introduced, and seed was harvested. In Feb. 2005, seeds of 04-43 were sown.

Four additional cycles of phenotypic recurrent selection were conducted in 2006, 2008, 2010, and 2012. Bulbs were selected for greater bulb height, a more rounded and uniform shape, increased bulb firmness when hand squeezed, and darker red-colored dry outer scales. In 2005 and 2007, selected bulbs were cut transversely at the vertical center after 3 months of storage to observe the number of meristems within the center of the bulb. Only bulbs that possessed a single meristem in the center of the bulb were selected. The seed harvested from the 12-43 breeding cage became ‘NuMex Allure’.

Evaluation Procedures

‘NuMex Allure’ was compared with ‘Rumba’ (Nunhems USA, Parma, ID), the standard commercial intermediate-day red onion cultivar grown in southern New Mexico, in replicated trials grown in several fields in the Mesilla Valley of New Mexico (Table 1). The field soil texture at the NMSU FGSC in Las Cruces, NM, was a Glendale loam and a Brazito very fine sandy loam, thick surface (pH 7.6), while the field soil texture at the NMSU Leyendecker Plant Science Research Center (LPSRC), 9 miles south of Las Cruces, NM, was a Glendale

Received for publication 26 Aug. 2015. Accepted for publication 21 Sept. 2015.

This research was funded by the New Mexico Agricultural Experiment Station and the New Mexico Dry Onion Commission.

¹Professor of Horticulture.

²Corresponding author. E-mail: cscramer@nmsu.edu.

Table 1. Bulb maturity, marketable yield, average bulb weight, bulb height, bulb diameter, bulb shape index, bulb firmness rating, percentage of single-centered bulbs, and pink root severity of 'NuMex Allure' as compared with 'Rumba' when sown at the Fabian Garcia Science Center or the Leyendecker Plant Science Research Center in Las Cruces, NM from 2009 to 2014.

Entry (cultivar)	Maturity date (DAS) ^z	Marketable yield (t·ha ⁻¹) ^y	Avg bulb wt (g) ^x	Bulb ht (cm) ^w	Bulb diam (cm) ^v	Bulb shape index ^u	Bulb firmness ^t	Single centers (%) ^s	Pink root severity ^r
Trial 1 (16 Feb. 2009 sowing date) ^q									
NuMex Allure	27 July (161)	20.8	145	7.1	7.3	0.98	7.0	93.0	1.8
Rumba	30 July (164)	13.2	125	6.2	7.0	0.90	7.8	91.0	2.5
	NS	*	*	*	NS	*	+	NS	*
Trial 2 (31 Jan. 2011 sowing date)									
NuMex Allure	21 Aug. (204)	20.4	162	7.5	7.3	1.03	6.5	89.0	2.2
Rumba	18 Aug. (199)	6.5	99	5.1	6.0	0.86	7.2	90.7	2.5
	+	***	***	**	*	*	**	NS	NS
Trial 3 (31 Jan. 2011 sowing date)									
NuMex Allure	16 Aug. (197)	23.1	173	6.6	7.0	0.95	6.8	93.0	2.3
Rumba	10 Aug. (191)	10.9	133	5.9	6.7	0.91	7.4	87.9	2.4
	NS	**	+	***	NS	NS	+	NS	NS
Trial 4 (14 Feb. 2012 sowing date)									
NuMex Allure	13 Aug. (180)	35.6	272	7.6	9.2	0.83	7.3	68.0	2.0
Rumba	7 Aug. (174)	27.7	213	7.1	8.8	0.80	7.7	61.0	2.3
	NS	NS	*	+	+	NS	+	NS	*
Trial 5 (18 Feb. 2014 sowing date)									
NuMex Allure	17 July (150)	15.9	147	6.6	6.9	0.98	7.5	80.0	1.1
Rumba	17 July (150)	16.6	109	6.3	6.5	0.97	7.9	85.0	1.2
	NS	NS	*	NS	NS	NS	**	NS	*

^zA plot was considered mature when 80% of the tops were down and was harvested at that time. DAS = days after sowing.

^yMarketable bulb yield (t·ha⁻¹) was calculated by weighing the marketable bulbs per plot and adjusting the plot size to one ha.

^xAverage bulb weight was calculated by dividing the marketable bulb weight by the number of marketable bulbs.

^vBulb height is the distance from the bottom of the bulb to the top of the bulb.

^wBulb diameter is the widest distance from one side of the bulb to the other.

^uBulb shape index is calculated as bulb height divided by bulb diameter.

^tBulbs were rated on a scale of 1 (soft) to 9 (hard) when they were squeezed by hand at two separate points at the vertical center.

^sThe percentage of bulbs with single centers (single growing points) was determined by cutting each bulb transversely at the vertical center and measuring the number of growing points that extended 1.3 cm beyond the bulb's center.

^rRoot systems of 20 bulbs per plot were rated based on a scale of 1 (no infected roots) to 9 (completely infected roots).

^qDrip irrigation was used for trials 1, 2, 3, and 5 conducted in separate fields at the Fabian Garcia Science Center, while furrow flood irrigation was used for trial 4 conducted at the Leyendecker Plant Science Research Center. 'NuMex Allure' was tested as New Mexico State University (NMSU) 07-38-1 for trial 1, as NMSU 09-38 for trials 2, 3, 4, and as 'NuMex Allure' for trial 5.

NS, +, *, **, ***Nonsignificant at $P = 0.10$, significant at $P = 0.10$, significant at $P = 0.05$, significant at $P = 0.01$, and significant at $P = 0.001$, respectively. Test was conducted at $\alpha = 0.05$.

hand at two separate points at the vertical center. In addition, five bulbs from each plot were measured for bulb height and diameter. Bulb height was measured from the basal plate at the bottom of the bulb to the top of the bulb. Bulb diameter was measured at the widest distance perpendicular to the vertical height of the bulb. A bulb shape index was generated by dividing the bulb height by bulb diameter.

After firmness rating and shape measurements, 25 bulbs were cut transversely at the widest point on the vertical axis to determine the percent of bulbs possessing a single meristem. If a bulb possessed a single meristem or multiple meristems within 1.3 cm of the bulb center, then the bulb was considered single centered. The F test in the general linear models procedure of the SAS statistical software (version 9.2; SAS Institute, Cary, NC) was used to determine the differences between means of 'NuMex Allure' and 'Rumba' for each trait. The Proc Means statement was used to calculate the cultivar means across four replications.

Description and Performance

'NuMex Allure' (Fig. 2) is a late-maturing, intermediate-day, open-pollinated, globe-shaped onion with red-colored dry outer scales, which matures from 17 July to 21 Aug.

when winter-sown in Las Cruces, NM (Table 1). Suggested planting dates at Las Cruces are 15 Jan. to 28 Feb. Earlier maturity dates would be expected when 'NuMex Allure' is grown for transplant production. When direct-sown, 'NuMex Allure' matures at a similar time as 'Rumba' (Table 1). In three out of the five environments tested, 'NuMex Allure' produced a greater marketable yield than 'Rumba' (Table 1). Some of this yield difference could be attributed to difference in bulb size as 'NuMex Allure' produced a greater average bulb size (20–63 g) than 'Rumba' in all five environments (Table 1). In terms of bulb shape, bulbs of 'NuMex Allure' exhibited greater bulb height (0.5–2.4 cm) than bulbs of 'Rumba' in four trials (Table 1). A greater bulb height or "depth" is desirable if accompanied by a similar increase in bulb diameter. In two trials, the bulb diameter of 'NuMex Allure' was greater than the diameter of 'Rumba' (Table 1). Bulbs that possess a shape index close to 1 tend to be more rounded in shape, which is more commercially desirable. In two trials, 'NuMex Allure' exhibited a greater bulb shape index than 'Rumba' (Table 1).

When bulbs were hand squeezed, bulbs of 'Rumba' possessed greater firmness than bulbs of 'NuMex Allure' (Table 1). Some of this difference in bulb firmness may be

Fig. 2. 'NuMex Allure' onion bulbs.

attributed to differences in average bulb size between the two cultivars. Smaller bulbs tend to have a greater firmness than larger bulbs. Hand harvesting would be recommended for bulbs of 'NuMex Allure' instead of mechanical harvesting. In southern New Mexico, intermediate-day onion cultivars that possess red dry outer scales are often hand harvested as these bulbs are sold as fresh-market onions in which mechanical damage is detrimental to sales and prices. The percentage of single-centered bulbs produced by a red onion bulb cultivar is desirable for visual display when the bulb is cut transversely. In each environment, 'NuMex Allure' produced a moderate to high percentage of single-centered bulbs and a percentage that was comparable to the percentage produced by 'Rumba' (Table 1). The percentage of single-centered bulbs is

Table 2. Scale color, adherence, thickness, number, and quality ratings of NuMex Allure as compared with Rumba when grown at the Fabian Garcia Research Center or the Leyendecker Plant Science Research Center in Las Cruces, NM, from 2009 to 2014.

Cultivar	Scale color ^z	Scale adherence ^y	Scale thickness ^x	Scale number ^w	Scale quality ^v
Trial 1 (16 Feb. 2009 sowing date) ^u					
NuMex Allure	3.4	1.1	2.2	1.8	3.0
Rumba	3.2	1.1	2.2	2.8	3.1
	NS	NS	NS	*	NS
Trial 2 (31 Jan. 2011 sowing date)					
NuMex Allure	3.0	1.5	2.3	1.3	2.8
Rumba	2.6	1.2	2.2	2.4	2.5
	+	NS	NS	*	+
Trial 3 (31 Jan. 2011 sowing date)					
NuMex Allure	2.8	1.5	2.2	1.7	2.6
Rumba	2.4	1.4	2.2	2.4	2.3
	+	NS	NS	**	NS
Trial 4 (14 Feb. 2012 sowing date)					
NuMex Allure	3.3	1.5	2.4	1.9	3.0
Rumba	3.3	1.7	2.3	2.5	3.1
	NS	NS	NS	NS	NS
Trial 5 (18 Feb. 2014 sowing date)					
NuMex Allure	3.6	1.9	2.4	1.3	3.1
Rumba	2.9	2.0	2.4	1.8	2.7
	**	NS	NS	***	**

^zDry outer scale color of 20 bulbs per plot was rated on a scale of 1 (very light pink) to 9 (dark purple color) after bulbs were graded.

^yDry outer scale adherence of 20 bulbs per plot was rated on a scale of 1 (scales easily removed when force is applied) to 5 (scales remained attached to bulb when force is applied) after bulbs were graded.

^xDry outer scale thickness of 20 bulbs per plot was rated on a scale of 1 (very thin) to 5 (very thick) after bulbs were graded.

^wNumber of dry outer scales that remain on the bulb after grading of 20 bulbs per plot.

^vDry outer scale quality of 20 bulbs per plot was rated on a scale of 1 (poor) to 9 (very excellent) after bulbs were graded. Poor scale quality characteristics included very light pink dry outer scale color, few scale layers, easily-removed dry outer scale such that no scale remained on the bulb, dry outer scale browning or discoloration, and/or nonuniform dry outer scale color. Excellent scale characteristics included tendency to have dark purple dry outer scale color, multiple dry outer scale layers, excellent scale adherence such that multiple scale layers remain on the bulb after grading, uniform dry outer scale color, and/or absence of dry outer scale discoloration or browning.

^uDrip irrigation was used for trials 1, 2, 3, and 5 conducted in separate fields at the Fabian Garcia Science Center, while furrow flood irrigation was used for trial 4 conducted at the Leyendecker Plant Science Research Center. NuMex Allure was tested as New Mexico State University (NMSU) 07-38-1 for trial 1, as NMSU 09-38 for trials 2, 3, 4, and as 'NuMex Allure' for trial 5.

NS, +, *, **, ***Nonsignificant at $P = 0.10$, significant at $P = 0.10$, significant at $P = 0.05$, significant at $P = 0.01$, and significant at $P = 0.001$, respectively. Test was conducted at $\alpha = 0.05$.

often a function of bulb size as smaller bulbs tend to have fewer elongated meristems while larger bulbs tend to have more. Even though the average bulb size of 'NuMex

Allure' was greater than that of 'Rumba', both cultivars exhibited a similar percentage of single-centered bulbs. In three out of five environments tested, bulbs of 'NuMex Allure'

exhibited fewer pink root symptoms than bulbs of 'Rumba' (Table 1).

As scale characteristics and bulb firmness were important characters evaluated during the selection process, the scale color, adherence, thickness, number, and quality of 'NuMex Allure' were compared with the same characters for 'Rumba' (Table 2). For three of the five trials, bulbs of 'NuMex Allure' were rated as having a darker outer dry scale color than bulbs of 'Rumba' (Table 2). A darker red dry outer scale color is more desirable by commercial onion buyers. Bulbs of 'Rumba' tended to have more outer dry scale layers than bulbs of 'NuMex Allure' (Table 2). Although a greater number of dry outer scale layers are beneficial for harvesting, a greater number may lead to a greater incidence of black mold, causal agent *Aspergillus niger*, when warm, humid conditions are present at harvest time. These climatic conditions often occur during the months of July and August with the arrival of the summer monsoon in southern New Mexico. The dry outer scale quality of 'NuMex Allure' bulbs was rated as comparable to or better than that of 'Rumba' bulbs (Table 2).

Availability

Interested parties should contact Terry Lombard, Arrowhead Center, MSC 700, Box 30001, New Mexico State Univ., Las Cruces, NM 88003-8001, (575) 646-2791, tlombard@nmsu.edu.

Literature Cited

- Cramer, C.S. 2014. 'NuMex Grandeur' onion. HortScience 49:350-353.
Cramer, C.S. and J.N. Corgan. 2003. 'NuMex Crimson' onion. HortScience 38:306-307.
Walker, S., J. Ashigh, C.S. Cramer, T. Sammis, and B. Lewis. 2009. Bulb onion culture management for southern New Mexico. New Mexico Coop. Ext. Serv. Circ. 563.