

‘NuMex Fabian Garcia’ Onion

Christopher S. Cramer^{1,3} and Joe N. Corgan²

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

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The New Mexico State Univ. Agricultural Experiment Station announces the release of ‘NuMex Fabian Garcia’ onion (*Allium cepa* L.). ‘NuMex Fabian Garcia’ is an open-pollinated, highly single-centered, late-maturing, intermediate-day, yellow skin onion cultivar for winter sowing in southern New Mexico and similar environments. ‘NuMex Fabian Garcia’ matures in late July to mid-August when winter-sown in Las Cruces, NM.

Origin

‘NuMex Fabian Garcia’ (Fig. 1) originates from ‘NuMex Jose Fernandez’, a cultivar released by the New Mexico State Univ. (NMSU) onion breeding program in 1994 (Corgan, 1994). In 1994, bulbs that possessed increased bulb firmness and size, a more rounded bulb shape, and a lighter dry scale color were selected from ‘NuMex Jose Fernandez’ using phenotypic recurrent selection. The selected bulbs were placed together in a crossing cage that was numbered 95-16. The next year, the selected bulbs flowered and pollinators were introduced into the cage and were allowed to pollinate flowers from all plants. Several months later, seed was harvested from each plant, bulked together, and labeled as NMSU 95-16. That fall, seed of NMSU 95-16 was sown. The next February of 1996, resulting plants of NMSU 95-16 were removed from the soil and transplanted to another location. Later that summer, bulbs were selected that possessed superior pink root [causal organism, *Phoma terrestris* (Hansen)] resistance, an increased bulb size, a more rounded bulb shape, and a later bulb maturity than that of ‘NuMex Jose Fernandez’. The fields used for evaluation have been used for several decades and are assumed to have higher incidence levels of pink root as compared with farmers’ fields. The selected bulbs were placed together in a crossing cage numbered 97-13. The next year, pollinators were introduced into the cage and allowed to pollinate flowers from all plants. Several months later, seed was harvested from each plant, bulked together, and labeled as NMSU 97-13.

Seed from NMSU 97-13 was sown the next year and bulb selections were made. Six additional cycles of phenotypic recurrent selection were conducted in 1998, 2000, 2002, 2004, 2006, and 2008. Bulbs were selected for later and more uniform maturity, a more rounded and uniform shape, increased bulb firmness, and additional layers of darker, dry outer scale tissue. For the selections made in 2006 and 2008, 35 and 34 bulbs were selected from NMSU 05-19 and NMSU 07-19-1, respectively. The seed harvested from the 09-20 crossing cage became ‘NuMex Fabian Garcia’.

Evaluation Procedures

For 3 years, ‘NuMex Fabian Garcia’ was compared with ‘NuMex Jose Fernandez’ in replicated trials grown in several fields (Table 1). The field soil at the Fabian Garcia Science Center was a Glendale loam and a Brazito very fine sandy loam, thick surface (pH 7.6), whereas the field soil at the Leyendecker Plant Science Research Center was a Glendale loam (pH 7.7). Seeds were sown \approx 1 to 2 cm deep in two rows 6 cm apart from late January to mid-February depending on field location and year. For each two-row plot, 1.5 g of seed was sown and plants were thinned to 10 cm between plants within the row. Each plot was 2.4 m long and 1 m wide and separated by an alley of 0.6 m from the next plot on the same bed. The trials were conducted in randomized complete block designs with four replications. Standard cultural practices to produce winter-sown onions in southern New Mexico were followed (Walker et al., 2009). For each field, diammonium phosphate (18N–20P–0K; Helena Chemical Co., Collierville, TN) was applied at a rate of 170 kg·ha⁻¹ before seeding as a band 10 cm below the soil surface. Drip irrigation was used for Trials 2, 3, and 4, whereas furrow flood irrigation was used for Trial 1. Subsurface drip irrigation lines (T Tape; T-Systems International, San Diego, CA), that had emitters every 20 cm, were placed 10 cm deep in the center of each bed. Irrigation was applied as needed. A urea-based liquid fertilizer (26N–0P–0K–6S; Western Blend, Inc., Las Cruces, NM) was applied as needed to Field 1, whereas a fish fertilizer (2.2N–4.4P–0.3K–0.2S; Neptune’s Harvest Fertilizer, Gloucester, MA) was applied as needed to the other fields.

All plots were harvested when 80% of the plants in the plot had lodged. The harvest date was considered the maturity date and the number of days from sowing until harvest

was counted for each plot. The root systems of 20 bulbs from each plot were rated for the severity of pink root symptoms on a scale of 1 (no infected roots) to 9 (completely infected roots). After rating, bulbs were placed in mesh sacks and, on the same day, transferred indoors to an onion shed. Bulbs were cured for 3 to 4 d under ambient conditions to reduce storage losses and decay. After curing, the total bulb fresh weight was measured for each plot. Bulbs were graded to remove culls (diseased bulbs, bulbs under 3.8 cm in diameter, split and double bulbs). The number of culls was subtracted from the total bulb number to obtain the marketable bulb number per plot. After bulbs were graded, they were weighed again to obtain marketable bulb weight per plot. The average bulb weight was calculated by dividing marketable bulb weight by marketable bulb number. For 20 bulbs per plot, dry outer scale color, adherence, thickness, and quality were rated for each bulb. Color was rated on a scale of 1 (very light yellow) to 9 (dark brown). Adherence 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). Thickness was rated on a scale of 1 (very thin) to 5 (very thick). Quality was rated on a scale of 1 (poor) to 9 (very excellent). Poor scale quality characteristics included very light dry outer scale color, few scale layers, easily removed dry outer scale such that no scale remained on the bulb, fleshy scale greening, dry outer scale staining or discoloration, and/or nonuniform dry outer scale color. Excellent scale characteristics included tendency to have darker 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, absence of dry outer scale discoloration or staining, and/or absence of fleshy scale greening. In addition, the number of dry outer scales that remain on the bulb after grading was recorded for 20 bulbs per plot. After rating for scale characteristics, 20 bulbs per plot were rated for firmness. Bulbs 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. After firmness rating, 25 bulbs were cut transversely at the widest point on the vertical axis to determine the percent of bulbs possessing a single



Fig. 1. Harvested bulbs of ‘NuMex Fabian Garcia’ onion.

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¹Professor of Horticulture.

²Professor Emeritus.

³To whom reprint requests should be addressed; e-mail cscramer@nmsu.edu.

Table 1. Bulb maturity, marketable yield, average bulb weight, percentage of single centers, and pink root severity of 'NuMex Fabian Garcia' as compared with 'Exacta' and 'NuMex Jose Fernandez' when sown at the Fabian Garcia Science Center or the Leyendecker Plant Science Research Center in Las Cruces, NM, from 2008 to 2011.

Entry (%) ^w	Maturity date (DAS) ^z	Marketable yield (t·ha ⁻¹) ^y	Avg bulb wt (g) ^x	Single centers	Pink root severity ^v
<i>Trial 1 (4 Feb. 2008 sowing date)^u</i>					
Exacta	4 Aug. (181) ± 0.3	64.6 ± 6.9	305 ± 38.8	91.0 ± 8.9	5.3 ± 0.7
NuMex Fabian Garcia	3 Aug. (180) ± 3.0	39.9 ± 3.9	209 ± 12.5	96.0 ± 4.6	4.7 ± 0.5
NuMex Jose Fernandez	1 Aug. (178) ± 0.0	26.1 ± 2.6	190 ± 19.3	88.0 ± 3.3	5.2 ± 0.4
LSD (5%)	NS	7.9***	44***	6.0*	0.5 [†]
<i>Trial 2 (10 Feb. 2008 sowing date)</i>					
Exacta	2 Aug. (173) ± 3.5	25.2 ± 2.9	148 ± 23.8	95.0 ± 6.0	5.3 ± 0.7
NuMex Fabian Garcia	4 Aug. (175) ± 3.0	24.7 ± 8.3	220 ± 62.7	96.9 ± 4.0	4.9 ± 0.2
NuMex Jose Fernandez	25 July (164) ± 6.9	14.0 ± 5.2	159 ± 27.5	86.6 ± 3.8	5.0 ± 0.3
LSD (5%)	9 d [†]	6.4**	69 [†]	8.9 [†]	NS
<i>Trial 3 (16 Feb. 2009 sowing date)</i>					
Exacta	28 July (162) ± 3.0	28.3 ± 7.6	178 ± 37.7	82.0 ± 7.7	2.0 ± 0.3
NuMex Fabian Garcia	30 July (164) ± 0.0	42.4 ± 3.2	241 ± 14.0	88.0 ± 5.7	2.0 ± 0.1
NuMex Jose Fernandez	18 July (152) ± 2.5	30.7 ± 5.8	194 ± 16.9	73.0 ± 14.4	2.2 ± 0.2
LSD (5%)	3 d***	12.0 [†]	50 [†]	NS	NS
<i>Trial 4 (31 Jan. 2011 sowing date)</i>					
Exacta	18 Aug. (199) ± 3.5	27.9 ± 2.7	181 ± 19.4	90.0 ± 5.2	3.3 ± 0.7
NuMex Fabian Garcia	21 Aug. (202) ± 3.5	30.0 ± 3.3	185 ± 30.4	91.0 ± 8.2	3.0 ± 0.3
NuMex Jose Fernandez	7 Aug. (188) ± 3.0	21.5 ± 4.1	165 ± 27.3	81.0 ± 7.6	2.7 ± 0.4
LSD (5%)	7 d***	4.5**	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 1 ha.

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

^vThe 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.

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

^uDrip irrigation was used for Trials 2, 3, and 4 at the Fabian Garcia Science Center, whereas furrow flood irrigation was used for Trial 1 at the Leyendecker Plant Science Research Center. 'NuMex Fabian Garcia' was tested as NMSU 07-19-1 for Trials 1, 2, and 3 and as NMSU 09-20 for Trial 4. Mean ± sd.

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 $\alpha = 0.05$.

LSD = least significant difference.

Table 2. Scale color, adherence, thickness, number, and quality ratings and bulb firmness rating of 'NuMex Fabian Garcia' as compared with 'Exacta' and 'NuMex Jose Fernandez' when grown at the Fabian Garcia Research Center, Las Cruces, NM, in 2009 and 2011.

Entry	Scale color ^z	Scale adherence ^y	Scale thickness ^x	Scale number ^w	Scale quality ^v	Bulb firmness ^u
<i>Trial 1 (16 Feb. 2009 sowing date)^y</i>						
NuMex Fabian Garcia	1.6 ± 0.1	1.1 ± 0.1	1.9 ± 0.2	2.1 ± 0.2	2.1 ± 0.2	7.2 ± 0.3
NuMex Jose Fernandez	1.5 ± 0.1	1.1 ± 0.1	1.9 ± 0.1	2.0 ± 0.3	2.0 ± 0.2	7.2 ± 0.1
	NS	NS	NS	NS	NS	NS
<i>Trial 2 (31 Jan. 2011 sowing date)</i>						
Exacta	1.8 ± 0.3	1.2 ± 0.1	2.3 ± 0.0	2.3 ± 0.5	2.2 ± 0.1	7.2 ± 0.2
NuMex Fabian Garcia	1.5 ± 0.4	1.2 ± 0.1	2.2 ± 0.2	1.8 ± 0.3	2.1 ± 0.1	7.0 ± 0.1
NuMex Jose Fernandez	1.3 ± 0.1	1.7 ± 0.3	2.3 ± 0.3	1.7 ± 0.1	1.6 ± 0.2	7.7 ± 0.2
LSD (5%)	NS	0.3*	NS	NS	0.3**	0.3**

^zDry outer scale color of 20 bulbs per plot was rated on a scale of 1 (very light yellow) to 9 (dark brown) 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 dry outer scale color, few scale layers, easily removed dry outer scale such that no scale remained on the bulb, fleshy scale greening, dry outer scale staining or discoloration, and/or nonuniform dry outer scale color. Excellent scale characteristics included tendency to have darker 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, absence of dry outer scale discoloration or staining, and/or absence of fleshy scale greening.

^uBulbs 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.

^y'NuMex Fabian Garcia' was tested as NMSU 07-19-1 for Trial 1 and as NMSU 09-20 for Trial 2.

Mean ± sd.

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

LSD = least significant difference.

growing point. If a bulb possessed a single growing point or multiple growing points 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 (SAS Institute, Cary, NC; Version 9.2) was used to determine differences among means of

'NuMex Fabian Garcia', 'Exacta', and 'NuMex Jose Fernandez' for each trait. The Proc Means statement was used to calculate the cultivar means across four replications. Mean separation was performed using Fisher's protected least significant difference among different entries at the 5% level of significance.

Description and Performance

'NuMex Fabian Garcia' is a late-maturing, intermediate-day, open-pollinated, yellow, globe onion that matures from 30 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. In three of the