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NuMex Enchantment Colored Serrano Chile Pepper (*Capsicum annuum* L.)

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Brightly colored vegetables render high-value products to a growing market of consumers, providing opportunities for small-scale growers to shift from the traditional production of low-value goods toward more premium, market-leading products (Bosland and Coon 2015). Serrano peppers are among the most widely consumed fresh pepper types (Castellon-Martinez et al. 2012; Guzman et al. 2020; Lillywhite et al. 2013). They generally possess a strong citrus-like flavor and higher Scoville heat units than jalapeño peppers. Together with jalapeños, serranos are considered the most popular chile pepper for pico de gallo salsa (Vera-Guzmán et al. 2017). Currently, most serrano peppers are green in the immature stage and turn red upon maturity. They are characterized by small, elongated, torpedo-shaped fruits, which can either be soft and pliable or firm and brittle upon maturity. Serrano peppers can also possess pubescent (with hair) or nonpubescent (hairless) stem and leaves.

Serrano peppers are important sources of phenolic compounds, flavonoids, ascorbic acid, and have antioxidant properties (Alvarez-Parrilla et al. 2011; Becerra-Martínez et al. 2017; Lozada et al. 2023; Villa-Ruano et al. 2019), demonstrating their importance for improving human health and nutrition. The New Mexico State University (NMSU) Chile Pepper Breeding and Genetics Program previously released a yellow serrano pepper, NuMex LotaLutein, a biofortified serrano with improved lutein content (Guzman et al. 2020). The ornamental and aesthetic value of peppers is greatly affected by their color, and together with heat profiles (pungency), these factors substantially affect consumer preferences (Venkatesh et al. 2023). Personal communication with John Hard, chile processor at CaJohns Fiery Foods, indicated the importance of high heat content and yield in the serrano pepper salsa industry. A novel, high heat, colored serrano pepper such as the NuMex Enchantment, developed and released by NMSU, offers unique market opportunities in the spicy food industry and for growers interested in processing value-added serrano peppers.

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Origin

NuMex Enchantment was derived from hybridizing two *C. annuum* L. varieties: Chimayo, a northern New Mexico landrace, and 94-37, a serrano breeding line, in 2008, through pedigree breeding with extensive single plant selections in the field. Chimayo produces fruits that are straight and or curved, with a pointed or lobed end, and that are known for their deep red color and unique flavors (Walker and Havlik 2016). Chimayo fruits mature from green to red during the growing season. Accession 94-37 possesses small, elongated, torpedo-shaped fruits, typically associated with serrano peppers. Single plant selections were performed for four generations (F_5 to F_8; 2012 to 2015 growing seasons) at the Leyendecker Plant Science Research Center (LPSRC) in Las Cruces, NM, as previously described (Bosland and Coon 2015), considering traits such as high heat, yield, plant habit, orange color, and uniformity. Seed increase on the F_9 generation (16C356) was implemented using isolation cages (Bosland 1993) during the 2016 growing season. Subsequent selections of single plants were performed from the F_{10} through the F_{12} generations during the 2017 to 2019 growing seasons. In the 2023 and 2024 growing seasons, the breeding line 19C370-5 was evaluated in replicated trials in multiple environments in Las Cruces (LPSRC and Fabian Garcia Science Center) and Hatch, NM (grower's field; Hillside Farms). This breeding line became the NuMex Enchantment orange-colored serrano chile pepper.

Description and Performance

NuMex Enchantment and an open-pollinated Serrano (Serrano OP) (Stokes Seeds, Inc.,

Fig. 1. Fruits and plant habit of NuMex Enchantment serrano chile pepper (*Capsicum annuum* L.). The photographs were taken at the replicated trials at the Fabian Garcia Science Center, Las Cruces, NM, during the 2024 growing season.

Holland, MI, USA) were evaluated for yield and horticultural traits using multiyear, multilocation, completely randomized design with three replications during the 2023 to 2024 growing seasons. Seeds were sown at the Fabian Garcia Science Center in February. In raised beds, seedlings with 8 to 10 true leaves were transplanted approximately 0.30 m (1 ft) apart in 30-ft plots in late April. Standard management practices for growing chile peppers in Southern New Mexico under furrow irrigation were conducted according to recommended approaches (Bosland and Walker 2004). Serrano pepper fruits were harvested from 5 to 10 individual plants in the replicated trials in August, approximately 130 d after transplanting. Analysis of variance was performed for all traits using mixed models accounting for “genotype” as fixed and “replication” and “location” as random effects. Multiple comparisons using Dunnett’s test were implemented considering Serrano OP as the control. All analyses were performed in JMP Pro 17.0.0 (SAS Institute 2013).

NuMex Enchantment initially displays a mature green fruit color [UK Royal Horticultural Society (RHS) color number 140B], which ultimately transitions from orange (RHS color number 24A) to dark orange (RHS color number N25B) at later stages of maturity; a bushy plant habit; high yield; and plant height comparable to the Serrano OP check (Fig. 1; Table 1). The mature fruit pericarp was firm and brittle rather than pliable; stem and leaves were nonpubescent. NuMex Enchantment showed a higher total yield (in tons/ha), although the difference was not statistically significant from Serrano OP. Among the yield components, only the ten-pod weight (in grams) demonstrated a statistically significant difference ($P < 0.001$; Dunnett’s test). Fruit morphology and architecture-related traits were characterized using the Tomato Analyzer (Rodríguez et al. 2010) following a method described previously (Khokhar et al. 2022) using 10 to 15 fruits collected from each genotype per replication (Fig. 2). Overall, NuMex Enchantment had larger fruits, with traits such as average fruit perimeter, area, length, and width showing statistically significant ($P < 0.05$; Dunnett’s test) differences with Serrano OP. Further, various measurements for plant height, width, and architecture traits were collected using a measuring stick based on the methods described by Khokhar et al. (2024). No significant differences were observed among the plant architecture traits.

Heat levels, represented in Scoville heat units (SHU), were determined using mature dried pepper fruits (red and orange for Serrano OP and NuMex Enchantment, respectively) and collected randomly from up to ten individual plants. High-performance liquid chromatography was performed through the Southwest Biolabs, Las Cruces, NM (https://scovilleheatlab.com/), to quantify SHU. NuMex Enchantment, with an average heat level of approximately 61,000 SHU, was significantly more pungent than the Serrano OP, and can be classified as a “very hot” chile pepper, based on a heat level classification system proposed previously by Bosland and Votava (2012). While the NuMex Enchantment has a similar fruit shape and color with other orange-colored specialty peppers such as the Bulgarian Carrot, the former has a higher SHU compared with the latter, which has a moderate heat. They have comparable fruit lengths, and both possess firm and brittle pericarp.

With its vibrant color and excellent horticultural properties, NuMex Enchantment will be an important addition to the serrano pepper industry. Processors would benefit from using this colorful serrano pepper to develop products with higher heat, more appeal, and

Table 1. Average plant and fruit characteristics for the NuMex Enchantment and Serrano OP for multiyear, multilocation trials at Las Cruces and Hatch, NM, USA.

Genotype	Yield (tons/ha)	Green yield (tons/ha)	Other color (red or orange) yield (tons/ha)	Ten-pod wt (g)	Fruit perimeter (cm)	Fruit area (cm^2)	Fruit width (cm)	Fruit length (cm)	Plant height (cm)	Plant width (cm)	Distance to the first node (cm)	Height to the first bifurcation (cm)	Number of basal branches	SHU
NuMex Enchantment	2.62 a	0.29 a	0.35 a	9.50 a	16.57 a	9.82 a	1.91 a	6.89 a	48.10 a	51.82 a	1.93 a	10.24 a	3.42 a	60,583 a
Serrano OP	2.52 a	0.23 a	0.44 a	7.11 b	14.24 b	7.49 b	1.78 b	5.70 b	52.04 a	47.67 a	2.24 a	8.80 a	3.10 a	4,461 b

Means followed by the same letter are not significantly different ($P > 0.05$) using Dunnett’s test; Serrano OP as control. SHU = Scoville heat units.

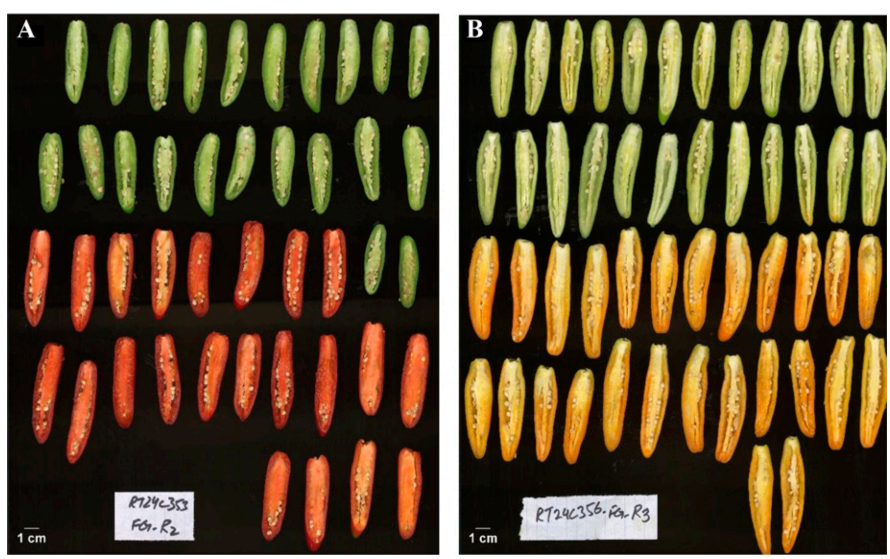

Fig. 2. Cross-sections of NMSU-24C353 (Serrano OP) (**A**) and NMSU-24C356 (NuMex Enchantment) (**B**) mature serrano pepper fruits demonstrating variation in fruit architecture and morphology-related traits. The samples were collected at the replicated trials at the Fabian Garcia Science Center, Las Cruces, NM, during the 2024 growing season.

added value and quality to increase acceptance and consumption of *Capsicum* spp. in the market.

Availability

NuMex Enchantment serrano pepper seeds are available from the Chile Pepper Institute, New Mexico State University, Las Cruces, NM 88003. The Chile Pepper Institute can be contacted at https://cpi.nmsu.edu/ or by phone (575)646-3028.

References Cited

Alvarez-Parrilla E, de la Rosa LA, Amarowicz R, Shahidi F. 2011. Antioxidant activity of fresh and processed Jalapeno and Serrano peppers. J Agric Food Chem. 59(1):163–173. https://doi.org/10.1021/jf103434u.

Becerra-Martínez E, Florentino-Ramos E, Pérez-Hernández N, Gerardo Zepeda-Vallejo L, Villa-Ruano N, Velázquez-Ponce M, García-Mendoza F, Bañuelos-Hernández AE. 2017. ^{1}H NMR-based metabolomic fingerprinting to determine metabolite levels in serrano peppers (*Capsicum annum* L.) grown in two different regions. Food Res Int. 102:163–170. https://doi.org/10.1016/j.foodres.2017.10.005.

Bosland PW. 1993. An effective plant field cage to increase the production of genetically pure chile (*Capsicum* spp.) seed. HortScience. 28(10):1053. https://doi.org/10.21273/HORTSCI.28.10.1053.

Bosland PW, Coon D. 2015. 'NuMex Lemon Spice', 'NuMex Pumpkin Spice', and 'NuMex Orange Spice' jalapenos. HortScience. 50(7):1104–1105. https://doi.org/10.21273/HORTSCI.50.7.1104.

Bosland PW, Votava EJ (eds). 2012. Peppers: Vegetable and spice capsicums. CABI, Cambridge, UK.

Bosland PW, Walker SJ. 2004. Growing chiles in New Mexico. New Mexico State University, Cooperative Extension Service Guide H-230.

Castellon-Martinez E, Chávez-Servia JL, Carrillo-Rodriguez JC, Vera-Guzman AM. 2012. Consumption preferences of pepper (*Capsicum annuum* L.) landraces in the central valleys of Oaxaca, Mexico. Rev Fitotec Mex. 35:27–35.

Guzman I, Coon D, Vargas K, Bosland PW. 2020. NuMex LotaLutein, a lutein-rich serrano pepper. HortScience. 55(12):2052–2055. https://doi.org/10.21273/HORTSCI14949-20.

Khokhar ES, Lozada DN, Ali M, Khan MI, Nourbakhsh SS, Walker S. 2024. Marker-trait association analysis for easy fruit destemming and mechanical harvestability traits in New Mexican chile pepper (*Capsicum annuum* L.). Front Hortic. 3:1448159. https://doi.org/10.3389/fhort.2024.1448159.

Khokhar ES, Lozada DN, Nankar AN, Hernandez S, Coon D, Kaur N, Nourbakhsh SS. 2022. High-throughput characterization of fruit phenotypic diversity among New Mexican chile pepper (*Capsicum* spp.) using the Tomato Analyzer software. HortScience. 57(12):1507–1517. https://doi.org/10.21273/HORTSCI16815-22.

Lillywhite JM, Simonsen JE, Uchanski ME. 2013. Spicy pepper consumption and preferences in the United States. HortTechnology. 23(6):868–876. https://doi.org/10.21273/HORTTECH.23.6.868.

Lozada DN, Pulicherla SR, Holguin FO. 2023. Widely targeted metabolomics reveals metabolite diversity in jalapeno and serrano chile peppers (*Capsicum annuum* L.). Metabolites. 13(2):288. https://doi.org/10.3390/metabo13020288.

Rodríguez GR, Moyseenko JB, Robbins MD, Morejón NH, Francis DM, van der Knaap E. 2010. Tomato Analyzer: A useful software application to collect accurate and detailed morphological and colorimetric data from two-dimensional objects. J Vis Exp. 37:e1856.

SAS Institute. 2013. JMP. SAS Institute, Cary, NC, USA.

Venkatesh J, Lee S-Y, Back S, Kim T-G, Kim GW, Kim J-M, Kwon J-K, Kang B-C. 2023. Update on the genetic and molecular regulation of the biosynthetic pathways underlying pepper fruit color and pungency. Curr Plant Biol. 35–36:100303. https://doi.org/10.1016/j.cpb.2023.100303.

Vera-Guzmán AM, Aquino-Bolaños EN, García EH, Carrillo-Rodríguez JC, Hernández-Delgado S, Chávez-Servia JL. 2017. Flavonoid and capsaicinoid contents and consumption of Mexican chili pepper (*Capsicum annuum* L.) landraces. In: Justino GC (ed). Flavonoids: From biosynthesis to human health. IntechOpen, Rijeka, Croatia.

Villa-Ruano N, Ramírez-Meraz M, Méndez-Aguilar R, Zepeda-Vallejo LG, Álvarez-Bravo A, Pérez-Hernández N, Becerra-Martínez E. 2019. ^{1}H NMR-based metabolomics profiling of ten new races from *Capsicum annuum* cv 'serrano' produced in Mexico. Food Res Int. 119:785–792. https://doi.org/10.1016/j.foodres.2018.10.061.

Walker SJ, Havlik C. 2016. The landrace chiles of northern New Mexico. New Mexico State University College of Agricultural, Consumer and Environmental Sciences Cooperative Extension Service 679.