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‘NuMex Lemon Spice’, ‘NuMex Pumpkin Spice’, and ‘NuMex Orange Spice’ Jalapeños

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Colorful produce has become more important at farmer’s markets and on produce shelves in grocery stores. The vibrant spectrum of colorful produce can be seen in many crops ranging from radish (*Raphanus sativa* L.), Swiss chard (*Beta vulgaris* L.), carrot (*Daucus carota* L.), tomato (*Solanum lycopersicum* L.), and bell peppers to New Mexican-type chile peppers (*Capsicum annuum* L.). Colorful vegetables provide high value products to a growing market of upscale consumers, and in turn furnish opportunities for small-scale farmers to make a transition from traditional production of low-value commodities toward the production of produce with greater value. A study by Frank et al. (2001) found that colorful vegetables were most often used for enhancement of food preparation. They also reported that growers receive a premium for produce with novel coloration. Simonne et al. (1997) found that color was far more important in the purchase decision by the consumer than retail price or vitamin content.

The New Mexico State University Chile Pepper Breeding Program has released vibrantly colored chile peppers in the past. ‘NuMex Sunrise’, ‘NuMex Sunset’, and ‘NuMex Eclipse’ are New Mexican pod-type chile peppers that change from green to yellow, orange, and brown, as they mature, respectively (Bosland et al., 1990). In addition, the New Mexico State University Chile Pepper Breeding Program released colored de arbol type chiles, ‘NuMex Sunburst’ and ‘NuMex Sunglo’, that instead of maturing from green to red, matured from green to orange and green to yellow, respectively (Bosland, 1992).

The jalapeño pepper is a popular garden, fresh market, and processed crop. Currently, all jalapeño cultivars have green to red fruits. New Mexico State University has released three green to red jalapeño cultivars with unique characteristics, such as mildness, phytophthora blight disease resistance, or large fruit size (Bosland, 2010a, 2010b; Votava and Bosland, 1998). ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’ jalapeños provide unique mature fruit colors, yellow, orange, and pumpkin orange, respectively, which are not currently available in the marketplace.

Origin

‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’, originated from hybridization between ‘Permagreen’ bell pepper and ‘Early Jalapeno’ in 1995. ‘Permagreen’ bell pepper produces a bell pepper that is green from immaturity to maturity, and ‘Early Jalapeno’ produces fruit that are green at immaturity and red at maturity. In segregating generations from this hybridization, several fruit colors are found for mature fruits, i.e., green, yellow, orange, brown, and red. There are also shades or hues of each of these colors. ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’, jalapeño were developed using a pedigree breeding method with three backcrosses to a jalapeño pod type and single plant selection (Fig. 2).

At the Leyendecker Plant Science Research Center located 5 km south of Las Cruces, NM, with field soil that is a Glendale loam (pH 7.7) single plant selections were made within the segregating generations, e.g., the backcross-1 selfed generation (Fig. 2). Each selected plant was selfed by striping fruits and open flowers and then placing an isolation cage over the individual plant to exclude any outcrossing. During each generation of selection, phenotypic traits considered to be important to a jalapeño pod type were selected (Bosland and Votava, 2012). After four generations of single plant selection, the selected plants were again hybridized to ‘Early Jalapeno’ to incorporate additional jalapeño fruit phenotypic traits. After three cycles of single plant selection the selected plants were hybridized to an advanced jalapeño breeding line. Another six cycles of single plant selection were accomplished. Seed from the single plant selection, New Mexico Breeding Line 09c392-9, New Mexico Breeding Line 09c401-9, and New Mexico Breeding Line 09c405-1 were increased under insect-proof cages (Bosland, 1993), and this increased seed became ‘NuMex Orange Spice’, ‘NuMex Pumpkin Spice’, and ‘NuMex Lemon Spice’, respectively.

Description and Performance

The plants were grown using standard growing practices commonly found in southern New Mexico (Bosland and Walker, 2014). ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’ are adapted to the high temperatures and low humidity of New Mexico. The concentrated set of fruit on compact (36 to 45 cm) plants makes them ideally suited for commercial production and home gardens. Each cultivar is green when immature, turning its respective

Fig. 1. Fruits of ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’.

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NuMex Lemon Spice, NuMex Orange Spice, and NuMex Pumpkin Spice are open-pollinated, jalapeño type (*Capsicum annuum* L.) cultivars released from the New Mexico State University Chile Pepper Breeding Program. ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’ each provide a unique mature fruit color not currently available in commerce, thus supplying alternative mature fruit colors for jalapeño. Mature fruits of ‘NuMex Lemon Spice’, ‘NuMex Orange Spice’, and ‘NuMex Pumpkin Spice’ are yellow, orange, and pumpkin orange, respectively.
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color at maturity. 'NuMex Lemon Spice', 'NuMex Orange Spice', and 'NuMex Pumpkin Spice' are yellow (Munsell color rating–5Y 7/10), orange (10R 4/12), and pumpkin orange (7.5 YR 7/14) at maturity, respectively (Fig. 1) (Munsell Book of Color, 1980).

Replicated trials were carried out for 3 years in a randomized complete block design with at least four replications. From each replication, 30 randomly selected fruits were used to calculate averages for fruit quality traits. The average fruit wall thickness ranged from 2.3 to 2.6 mm, and were not significantly different among the cultivars nor from 'Early Jalapeno'. Similar results were observed with the pod width ranging from 2.19 to 2.79 cm and were not significantly different among the cultivars nor 'Early Jalapeno'. 'NuMex Orange Spice' and 'NuMex Pumpkin Spice' had significantly longer pods than 'Early Jalapeno', while 'NuMex Lemon Spice' was not significantly different from 'Early Jalapeno' nor 'NuMex Orange Spice' and 'NuMex Pumpkin Spice' (Table 1). 'NuMex Orange Spice' fruit has epidermal reticulation ("corkiness"), which is similar to 'Early Jalapeno' fruit, while 'NuMex Lemon Spice' and 'NuMex Pumpkin Spice' lack the epidermal reticulation.

The heat level was determined on a dry weight basis by a reverse-phase high-performance liquid chromatography system with fluorescence detectors (Collins et al., 1995). 'NuMex Lemon Spice' and 'NuMex Pumpkin Spice' had heat levels of ≈25,000 Scoville Heat Units, which was similar to 'Early Jalapeno' (Table 1). 'NuMex Orange Spice' was significantly hotter with an average heat level of 80,000 Scoville Heat Units.

These new hot and colorful jalapeño cultivars will be a valuable addition to growers needing a competitive edge in the marketplace, and gardeners desiring jalapenos with new fruit colors. In addition, the food processing industry can use the colorful jalapeño fruits to add more appeal to their product on the shelf.

NuMex Lemon Spice: 95c180-9 ('Early Jalapeno') X 95c21 ('Permagreen' bell pepper) →95c210-4_{F1} X Early Jalapeno →96c356$_{BC1}$ →96c2397-6_{S1} →98c2402-3_{S2} →00c1949-1_{S3} →01c1147-1_{S4} X Early Jalapeno →01c1628$_{BC2S1}$→02c1203-1_{S2} →02c2168-1_{S3} X advanced jalapeno breeding line →03c1042$_{BC3S1}$ →05c444-11_{S2} → 06c1222-1_{S3} →07c995-2_{S4} →08c851-1_{S5} →09c405-1_{S6} →10c637$_{(mass\ selfed)}$ →11c906 (NuMex Lemon Spice)

NuMex Orange Spice: 95c180-9 ('Early Jalapeno') X 95c21 ('Permagreen' bell pepper) →95c210-4_{F1} X Early Jalapeno →96c356$_{BC1}$ →96c2397-6_{S1} →98c2402-3_{S2} →00c1949-1_{S3} →01c1147-1_{S4} X Early Jalapeno →01c1628$_{BC2S1}$→02c1203-1_{S2} →02c2168-1_{S3} X advanced jalapeno breeding line →03c1042$_{BC3S1}$ →05c444-11_{S2} → 06c1222-1_{S3} →07c995-2_{S4} →08c851-1_{S5} →09c392-9_{S6} →10c589 $_{(mass\ selfed)}$ →11c904 (NuMex Orange Spice)

NuMex Pumpkin Spice: 95c180-9 ('Early Jalapeno') X 95c21 ('Permagreen' bell pepper) →95c210-4_{F1} X Early Jalapeno →96c356$_{BC1}$ →96c2397-6_{S1} →98c2402-3_{S2} →00c1949-1_{S3} →01c1147-1_{S4} X Early Jalapeno →01c1628$_{BC2S1}$→02c1203-1_{S2} →02c2168-1_{S3} X advanced jalapeno breeding line →03c1042$_{BC3S1}$ →05c444-9_{S2} →06c1246-1_{S3} →07c1019-4_{S4} →08c869-1_{S5} →09c401-9_{S6} →10c617$_{(mass\ selfed)}$ →11c905 (NuMex Pumpkin Spice)

Fig. 2. Pedigrees of 'NuMex Lemon Spice', 'NuMex Orange Spice', and 'NuMex Pumpkin Spice'.

Table 1. Plant and fruit characteristics for 'NuMex Lemon Spice', 'NuMex Orange Spice', 'NuMex Pumpkin Spice', and 'Early Jalapeno' for 3 years at the Leyendecker Plant Science Research Center.

	Fruit[z]		Yield[y]	Heat[x]
	Length cm (inches)	Per fruit wt (g)	Mt/ha (tons/acre)	Scoville Heat Units
NuMex Lemon Spice	6.1 (2.4) a[w]	18 a	5.7 (12.7) a	25,086 c
NuMex Orange Spice	6.4 (2.5) a	12 b	9.6 (21.5) a	79,442 a
NuMex Pumpkin Spice	5.9 (2.3) ab	18 a	10.6 (23.7) b	22,198 c
Early Jalapeno	5.3 (2.0) b	18 a	8.1 (18.2) a	30,388 c

[z]Fruit length was the mean of 10 fruits from each of four replications over 3 years.
[y]Yield is the per fruit weight multiplied by the number of fruit per plant of four replications per year over 3 years.
[x]Scoville Heat Units (SHU) were calculated from the conversion of 1 mg·kg^{-1} capsaicinoid = 16 SHU per dry weight basis. The average SHU was obtained from 10 fruits from each of four replications over 3 years.
[w]Means followed by the same letter are not significantly different by least significant difference at $P \leq 0.05$.

Availability

Breeder seed of 'NuMex Lemon Spice', 'NuMex Orange Spice', and 'NuMex Pumpkin Spice' will be maintained by the New Mexico State University Chile Pepper Breeding Program for at least 5 years after release. Seed packets or larger quantities of seeds are available from the Chile Pepper Institute, New Mexico State University, P.O. Box 30003, MSC 3Q, Las Cruces, NM 88003. The Chile Pepper Institute can be contacted at http://www.chilepepperinstitute.org, hotchile@nmsu.edu, or phone: (575) 646–3028.

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