‘NuMex Odyssey’, a New Mexico–type Green Chile Pepper for Mechanical Harvest

Stephanie J. Walker

Department of Extension Plant Sciences, New Mexico State University, Las Cruces, NM 88003

Paul Funk

USDA-ARS, Cotton Ginning Laboratory, Las Cruces, NM 88047

Israel Joukhadar

Department of Extension Plant Sciences, New Mexico State University, Las Cruces, NM 88003

Tom Place and Charles Havlik

Los Lunas Agricultural Science Center, Los Lunas, NM 87031

Bradley Tonnessen

Department of Extension Plant Sciences, New Mexico State University, Las Cruces, NM 88003

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The New Mexico State University (NMSU) Agricultural Experiment Station announces the release of ‘NuMex Odyssey’, a New Mexican–type chile pepper (*Capsicum annuum*) cultivar that is efficient for mechanical harvest of green fruit. This cultivar is an open-pollinated New Mexican fruit type for green chile pepper processing. ‘NuMex Odyssey’ was developed with an emphasis on traits critical for efficient mechanical harvest with an inclined double-helix–type picking mechanism. Such traits include a high percentage of plants with single stems and increased height to fruit set (main bifurcation). ‘NuMex Odyssey’ possesses traditional New Mexican green chile pepper flavor, low heat, and provides a higher percentage of mechanically harvested, marketable green chile pepper fruit compared with current, standard industry New Mexican–type green chile pepper cultivars. ‘NuMex Odyssey’ is recommended for direct seeding in the spring in southern and central New Mexico and will provide a harvest of full-sized green fruit ≈ 145 d after planting.

New Mexican–type green chile pepper is currently only hand harvested, so the development of a new cultivar efficient for mechanical

harvest was contingent on critical, preliminary research including 1) evaluation of currently available commercial and experimental chile pepper harvester equipment, 2) testing commercially available New Mexican–type green chile pepper cultivars with mechanical harvesters, 3) determination of optimum field production protocols for mechanical harvest efficiency, and 4) determination of key plant architectural traits positively impacting mechanical harvest that could be used as breeding and selection objectives. Research was conducted in these areas simultaneously to initiate breeding efforts for New Mexican–type green chile pepper with improved efficiency for mechanization.

Currently, more than 80% of New Mexico’s red chile pepper crop is harvested mechanically. It was previously unknown how the more delicate green fruit would be impacted by red chile pepper harvesting equipment. Mechanical harvesters currently used for commercial red chile pepper, as well as experimental picking heads, were evaluated in New Mexico green chile pepper fields. These efforts identified the Yung-Etgar machine (Bet-Lehem-Haglili, Israel), a commercially available chile pepper picker manufactured in Israel, as the most efficient harvester of undamaged, marketable green chile pepper fruit (Funk and Walker, 2010). Early trials indicated that single stemmed plants without basal branches, and fruit set higher off the ground contributed to mechanical harvest efficiency (Joukhadar et al., 2018). Research quickly confirmed that field management was critical to the success of mechanical harvest. Plant architecture traits were noticeably impacted by planting method. Direct seeded chile pepper plants resulted in taller, more upright plants amenable to

mechanical harvest, while transplanted plants were shorter, bushier, and more easily uprooted by the harvester. In addition, increasing plant density within the row proved to be a valuable method to increase mechanical harvest efficiency. The current standard spacing for New Mexican–type green chile is 12 inches between plants, but decreasing this distance to as low as 4 inches significantly increased the mechanically harvested yield without adversely affecting green chile pepper fruit size. While none of the currently grown commercial New Mexican–type green chile cultivars were developed for efficient mechanical harvest, ‘NuMex Joe E. Parker’ tended to be the best performer in early trials (Havlik et al., 2018).

Origin

‘NuMex Odyssey’ originated from a hybridization between two open-pollinated, New Mexican–type green chile pepper cultivars, ‘Despanado’ (118W09-2) and ‘NuMex Joe E. Parker’ (115W09) in 2009. The maternal parent was an easy-destemming field selection from a population of ‘Despanado’, a chile pepper cultivar developed by Mr. Ed Curry (Curry Chile & Seed Co., Pearce, AZ). The paternal parent, ‘NuMex Joe E. Parker’, is a cultivar released by Dr. Paul Bosland and the NMSU Agricultural Experiment Station for the New Mexico chile pepper processing industry (Coon and Bosland, 2018). The F1 population (135W09) was grown in the greenhouse to produce F2 seed. In 2010, the F2 (138W10) and F3 (148W10) populations were also grown in the greenhouse to prevent outcrossing and to increase the amount of seed available for single seed descent field planting. In 2011, 307 observational plots were established from the F3 seed. Exceptional plots possessing tall plants with single main stems (no basal branching), high relative yields, and large green chile pepper fruit were selected. Seed from the selected lines was planted in the field in 2012. Single plant selections were made in the field from this germplasm in 2013. These exceptional plants were dug up at the end of the season before a killing frost, stripped of fruit and flowers, and potted in the greenhouse to generate self-pollinated seed. One of these selections (31W13-4) contributed to the pedigree of ‘NuMex Odyssey’. In 2014, an additional round of single plant selections refined mechanical harvest traits using the same selection criteria. Single plant selection 20W14-7 became ‘NuMex Odyssey’. This line was planted in 2015 (25W15) within an insect-excluding seed cage (Bosland, 1993) to increase seed quantity. During this growing season, off-type plants within the seed cage were removed to refine seed quality.

Evaluation Procedure

‘NuMex Odyssey’ was evaluated in replicated mechanical harvest field trials over 3 years (2016, 2017, 2018) at NMSU’s Los Lunas Agricultural Science Center, located ≈ 24 miles south of Albuquerque in central New Mexico. Trials were arranged in

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S.J.W. is the corresponding author. E-mail: swalker@nmsu.edu.

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Fig. 1. Etgar Moses 1010 chile harvester.

randomized complete block design with five replications in 2016, and seven replications in 2017 and 2018. The field soil texture at the Los Lunas Agricultural Science Center is Vinton loam. The fields were direct seeded then thinned to single plants spaced ≈ 8 inches apart. Row spacing was 30 inches and the field was furrow irrigated and fertilized according to standard local practices for New Mexican-type green chile peppers (Bosland and Walker, 2014). Data were collected from the inner 20 ft of the 30-ft single-row plots. ‘AZ-1904’, the most widely grown New Mexican-type green chile pepper cultivar for large-scale processing, and ‘NuMex Joe E. Parker’, shown to be the most efficient for mechanical harvest in previous tests that compared commercially available New Mexican-type green chile pepper cultivars (Havlik et al., 2018), were grown as standard controls in the trials.

Harvest was scheduled for peak season when most fruit were fully sized and marketable for green chile peppers (horticulturally mature) and not predominately red (physiologically mature). Immediately before harvest, plant attributes were measured in the same experimental plots used for mechanical harvest trials. Thirty plants within each plot were measured for height, width, height to main stem bifurcation, stem diameter, and number of basal branches (branches originating below the main bifurcation that bear fruit).

Plots were harvested with a one-row, tractor powered Etgar Series MOSES 1010 (Bet-Lehem-Haglilit, Israel) (Fig. 1) mechanical harvester equipped with a picking head equivalent to the commercial Yung-Etgar evaluated in earlier field tests. Although there was a negligible amount of fruit on the ground, all fruit and debris on the ground alongside the harvest areas were manually removed immediately before harvest. The machine proceeded through the field at 1.1 mph; the counter-rotating helix head speed was adjusted as needed for even flow of fruit on the conveyors at the start of the trial. All material picked from each plot was bagged separately. Chile pepper fruit left in each plot following the harvest was collected according to the categories “fruit attached to the plant” and “fruit knocked on the ground”

Fig. 2. NuMex Odyssey marketable green fruit.

during the harvest operation. Fresh fruit weights obtained from these two categories represented field loss. The harvested material was promptly transferred to a plant processing laboratory and sorted into categories: marketable green fruit (Fig. 2), broken or damaged fruit, red fruit, diseased fruit, and extraneous plant material (stems and leaves). The fresh

weight was obtained for each category of sorted material for each plot. Material in the red and diseased categories was insignificant and uniform among cultivars and is therefore not included in the reported data. A subset of 10 representative fruit from the marketable material in each plot was sampled for additional fruit measurements. Measurements taken on these fruits included length, width, and pericarp thickness. In addition, heat level was measured on composite samples of the marketable fruit using the protocol developed at NMSU that uses a reverse-phase high-performance liquid chromatography system with fluorescence detectors (Collins et al., 1995).

Performance/Results

‘NuMex Odyssey’ produced a significantly greater mechanically harvested marketable green chile pepper fruit yield compared with both ‘AZ-1904’ and ‘NuMex Joe E. Parker’ in combined data from trials conducted in 2016, 2017, and 2018 (Table 1). Contributing to

Table 1. Weight of marketable green fruit, damaged fruit, and extraneous plant material harvested with an Etgar Series MOSES 1010 chile harvester, and marketable fruit left in the field following harvest for 3 years (2016, 2017, 2018) at Los Lunas Agricultural Science Center.

Cultivar	Marketable fruit yield ^z (tons/acre)	Damaged fruit ^y (tons/acre)	Extraneous plant material ^x (tons/acre)	Field loss (tons/acre)	
				Plant ^w	Ground ^v
NuMex Odyssey	8.0 a ^u	1.5 b	2.2 a	0.1 b	0.7
NuMex Joe E. Parker	7.3 b	1.6 b	2.0 b	0.6 a	0.9
AZ-1904	6.0 c	2.3 a	1.7 b	0.6 a	1.0
	+	+	+	+	NS

^zMarketable fruit yield is the fresh weight of undamaged, full-sized green fruit mechanically harvested.

^yDamaged fruit is the fresh weight of full-sized green fruit broken, cut, or otherwise damaged during mechanical harvest.

^xExtraneous plant material is the fresh weight of sticks, stems, leaves, and other nonfruit plant material mechanically harvested.

^wField loss plant is the fresh weight of marketable green fruit remaining on the plant following mechanical harvest.

^vField loss ground is the fresh weight of marketable green fruit knocked to the ground and not recovered by the machine during mechanical harvest.

^uWithin columns, values followed by the same letter are not significantly different according to Tukey’s mean separation test ($P \leq 0.05$).

NS = nonsignificant at $P = 0.05$; + = significant at $P = 0.05$ by least square difference.

Table 2. Plant attribute comparison for ‘NuMex Odyssey’, ‘NuMex Joe E. Parker’, and ‘AZ-1904’ for 3 years (2016, 2017, 2018) at the Los Lunas Agricultural Science Center.

Cultivar	Plant ht ^z (cm)	Plant width ^y (cm)	Ht to bifurcation ^x (cm)	Stem diam ^w (mm)	No. of basal branches ^v
NuMex Odyssey	60.5 a ^u	52.4 b	21.5 a	14.5	0.5 c
NuMex Joe E. Parker	59.2 a	55.2 a	20.4 a	14.3	1.4 a
AZ-1904	57.2 b	52.4 b	18.2 b	14.0	1.0 b
	+	+	+	NS	+

^zPlant height is the distance from the ground to the highest point of the naturally laying plant.

^yPlant width is the widest point of the naturally laying plant.

^xHeight to bifurcation is the distance from the ground to the first main branch of the plant where first fruit set typically occurs.

^wStem diameter is measured with a caliper at ground level.

^vBasal branches is the count per plant of major branches emerging below the first main plant bifurcation.

^uWithin columns, values followed by the same letter are not significantly different according to Tukey’s mean separation test ($P \leq 0.05$).

NS = nonsignificant at $P = 0.05$; + = significant at $P = 0.05$ by least square difference.

Table 3. Fruit characteristic comparison for ‘NuMex Odyssey’, ‘NuMex Joe E. Parker’, and ‘AZ-1904’ for 3 years (2016, 2017, 2018) at the Los Lunas Agricultural Science Center.

Cultivar	Fruit width ^z (cm)	Fruit length ^y (cm)	Pericarp thickness ^x (mm)	Heat ^w (SHU)
NuMex Odyssey	4.16	18.0 b ^v	3.3 b	302
NuMex Joe E. Parker	4.23	17.0 c	3.3 b	417
AZ-1904	4.39	19.4 a	3.4 a	297
	NS	+	+	

^zFruit width is measured at widest point of the shoulders of individual fruit.

^yFruit length is measured from the point of pedicel attachment to the fruit to the tip of the fruit.

^xPericarp thickness is measured by cutting fruit at the shoulder and measuring fruit flesh thickness with a caliper.

^wHeat is reported in Scoville Heat Units (SHU) and is the average, composite obtained from 10 random fruit sampled in each year using the procedure outlined in Collins et al. (1995).

^vWithin columns, values followed by the same letter are not significantly different according to Tukey’s mean separation test ($P \leq 0.05$).

NS = nonsignificant at $P = 0.05$; + = significant at $P < 0.05$ by least square difference test.

the mechanical harvest efficiency of ‘NuMex Odyssey’ is the higher number of plants with single stems, as shown by the significantly reduced number of plants with basal branches compared with ‘NuMex Joe E. Parker’ and ‘AZ-1904’. A greater distance to first fruit set (bifurcation) was also measured, although the difference was not significant compared with ‘NuMex Joe E. Parker’ (Table 2). Other traits improved on with ‘NuMex Odyssey’ included a reduced amount of fruit breakage compared with ‘AZ-1904’ and a lower field loss component due to fruit remaining on the plant compared with both control cultivars. Extraneous plant material generated during mechanical harvest was higher in ‘NuMex Odyssey’ plots relative to the other two cultivars and denotes the importance of mechanical removal of such debris in a mechanized system.

‘NuMex Odyssey’ fruit width was similar to ‘NuMex Joe E. Parker’ and ‘AZ-1904’,

whereas its fruit length was shorter than ‘AZ-1904’ and longer than ‘NuMex Joe E. Parker’ (Table 3). Pericarp thickness of the fruit was similar to ‘NuMex Joe E. Parker’, but thinner than ‘AZ-1904’. Favorable flavor evaluation reported for ‘NuMex Odyssey’ was determined by taste tests of the fresh fruit by knowledgeable program personnel and chile pepper industry representatives. Although ‘NuMex Odyssey’ has not been screened for specific pathogen tolerance, diseased and off-type plants were rogued from the populations during the selection process so that only vigorous plants adapted to growing conditions in New Mexico were advanced during the breeding process.

Availability

‘NuMex Odyssey’ is being offered for exclusive release. Breeder seed of ‘NuMex Odyssey’ will be available for research

purposes. Contact Stephanie J. Walker, Department of Extension Plant Sciences, MSC 3AE, Box 30003, New Mexico State University, Las Cruces, NM 88003 with requests.

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