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Development of 'NuMex Odyssey' & Lessons Learned Towards NM Green Chile Mechanization

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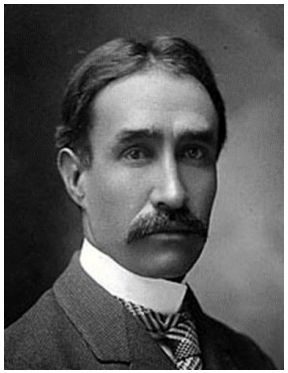
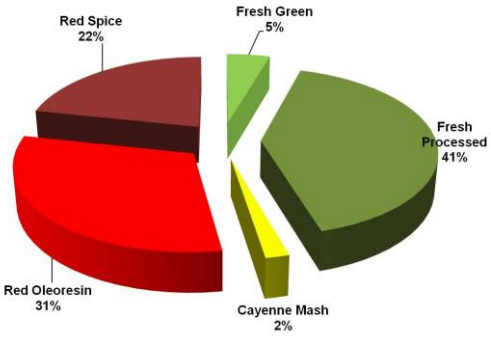
Introduction to New Mexican-type Chile

- Introduction with ‘New Mexico No. 9’ by Fabian Garcia in 1913



- Official New Mexico state question: “Red or Green?”
- **Red** or **Green**
  Two different products; two different approaches to harvest



Source: NM Chile Association

Red Chile in New Mexico

- Vast majority of crop is dehydrated
- Most red chile for commercial production is mechanically harvested
- Once-over harvest late in the season when most fruit are red

NM green chile is 100% hand-harvested

Photo credit: Paul Funk

NM Green Chile

- Harvested fully sized, but physiologically immature
- Minimum of two harvests preferred
- Green chile fruit for commercial processing must be destemmed (removal of pedicel)

Photo credit: Charles Havlik

NM Chile Mechanization

- NM green chile acreage is threatened because of labor challenges (cost and availability)

- Mechanization is critical to sustaining domestic NM green chile production

Challenges to Mechanical Harvest of NM Green Chile

- Fruit damage
- Is a second pick possible?
- Excessive field losses
- Excessive harvested trash (sticks & stems)

Challenges to Mechanical Harvest of NM Green Chile

- Growers need access to the machines

- Destemming is important, but mechanically difficult for whole fruit

- Currently available NM green chile cultivars not optimum for mechanical harvest

Different Mechanical Harvesters/ Different Types of Chile Peppers

- Inclined, double helix picking heads have been widely adopted for harvest of NM red chile; however, other machines have also been used

- Machine needs to work with the particular crop, production system in place

Different Mechanical Harvesters/ Different Types of Chile Peppers

- Some bells and other specialty peppers are currently harvested with ‘tomato-type harvesters’ - Cut plant off at ground and shake fruit off the plants

- Early research indicated that inclined double helix worked better for NM type green chile

NMSU/USDA-ARS/Industry Research Collaboration

1. Evaluate commercially available and experimental mechanical harvesters
2. Evaluate commercially available NM green chile varieties with machines
   -Determine key traits for mechanical harvest efficiency
3. Conduct breeding program to develop new varieties improved for mechanical harvest
4. Determine best field management protocols for mechanical harvest

Previous Research - Evaluation of Commercial and Experimental Chile Harvester Heads

Results

- Conducted many field trials of commercial and experimental harvesters

  -Tore up many NM green chile fields!

- Etgar Moses picking head (manufactured in Israel) provided the highest recovery of undamaged, marketable NM green chile fruit of those tested
  -Counter-rotating, inclined, double helix type head

- NMSU purchased a one-row, tractor powered Etgar Moses for small plot research (received in late 2014)
- Increased our ability to research chile mechanization
- *Allowed us to tear up our own fields*

Previous Research – Evaluation of NM Green Chile Varieties

Results

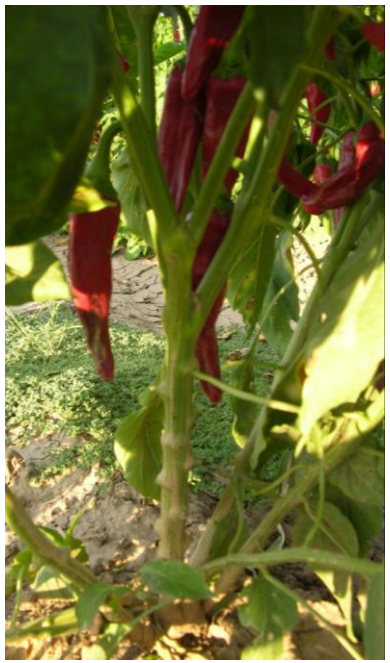
- Evaluated commercially available cultivars and breeding lines from different sources
  - Major differences observed in mechanical harvest efficiency
  - 'NuMex Joe E. Parker' was the overall best
  - Why?

- Traits important for mechanical harvest efficiency were identified
  - Breeding lines were pursued accordingly

NuMex Joe E. Parker

Key Plant Attributes for Optimum NM Green Chile Mechanical Harvest

- Strong single-stemmed plants / less or no basal branches
- Higher bifurcation height (point of first fruit set on plants)
- Somewhat easier fruit detachment from plant



‘NuMex Odyssey’

- New cultivar release in 2021
- Highest marketable green fruit yield with the Etgar harvester

NM Green Chile Mechanical Harvest Trial (2016, 2017, 2018)

Cultivar	Marketable Green Fruit	Damaged Green Fruit	Extraneous Plant Material	Fruit left on Plant	Fruit Dropped on Ground
NuMex Odyssey	8.0 *a*	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

Means followed by the same letter within a column are not significantly different at 0.05 with Tukey's Test.

NM Green Chile Mechanical Harvest Trial (2016, 2017, 2018)

Cultivar	Plant Height (cm)	Plant Width (cm)	Hight to Bifurcation (cm)	Stem Diameter (mm)	# of Basal Branches
NuMex Odyssey	60.5 *a*	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*

Means followed by the same letter within a column are not significantly different at 0.05 with Tukey's Test.

NM Green Chile Mechanical Harvest Trial (2016, 2017, 2018)

Cultivar	Fruit Width (cm)	Fruit Length (cm)	Pericarp Thickness (mm)	Heat (SHU)
NuMex Odyssey	4.16	18.0 *b*	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

Means followed by the same letter within a column are not significantly different at 0.05 with Tukey's Test.

'NuMex Odyssey'

-NM type Green Chile for Mechanical Harvest

- Open-pollinated cultivar with higher mechanically harvested yield of undamaged marketable fruit

- Higher fruit set, strong single stems, and easier fruit removal contributed to efficient mechanical harvest

NuMex Odyssey – Post-Harvest

- Few fruit left on plants
- Low level of damaged fruit
- Stems remain on fruit
  - Mechanical destemming needed
- Minimal damage to plants from harvester
  - Potential for second harvest

Previous Research – Determination of Best Production Protocols

Results

- Production practices in the field also impact plant architecture
  -Irrigation and nutrient management
  -Direct-seed vs. transplants
  -Plant spacing

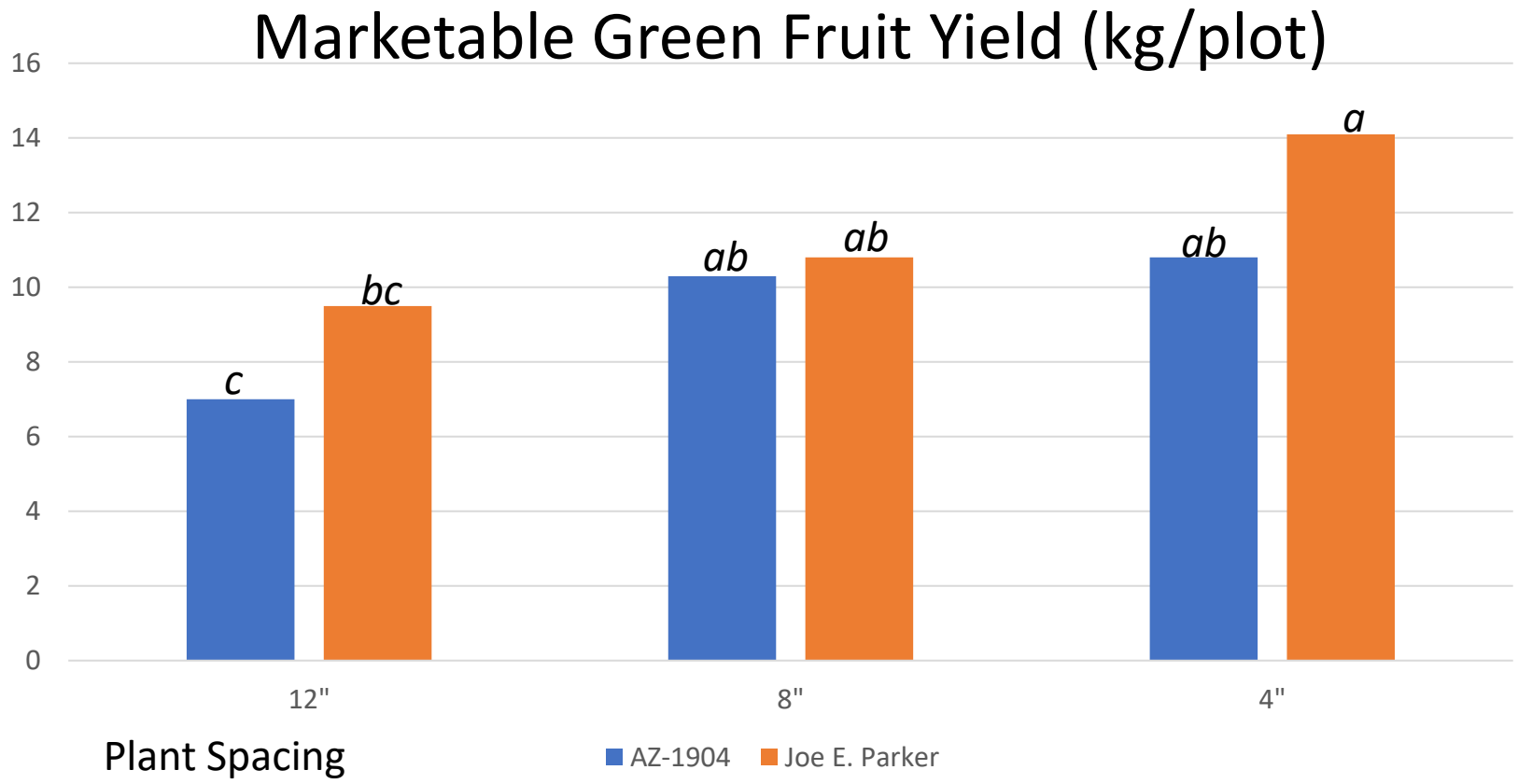
Direct-Seed vs. Transplants

- Most NM type chile fields are established by directly planting seed in field (unlike the vast majority of bell and other specialty chile pepper fields that are transplanted from hybrid seed)
- Direct-seeded chile plants provide improved plant architecture for mechanical harvest
  - Increases height to first bifurcation (fruit set)
  - Reduces basal branching
  - Tends to reduce plant uprooting

Plant Spacing

- Stand establishment is always critical to achieving optimum yields; however, it's especially important for mechanical harvest
- Large gaps between plants cause uprooting
- Closer plant spacing improves plant architecture for mechanical harvest
  -Increases plant height
  & distance to first bifurcation
  -Reduces basal branching

Impact of Plant Spacing on Mechanical Harvest Efficiency
2015 & 2016 combined data (Havlik, 2021)



Impact of Closer Plant Spacing (up to 4”)

- Significantly increased the distance to the plant bifurcation (first fruit set)
- Provided significantly higher marketable fruit
- Tended to increase the amount of damaged fruit
- Tended to decrease the amount of field loss from fruit dropped on ground during harvest
- Did not impact the fruit size, quality

Summary – Steps to Best Mechanical Harvest of NM Green Chile

Equipment:

- Use best machine for the type of chile peppers you're growing
- Inclined, double helix picking head worked best for us
- Double helix picking heads are ***not*** all the same

Summary – Steps to Best Mechanical Harvest of NM Green Chile

Varieties:

- Use best varieties for your operation
- Plant architecture with single stems, minimal basal branching, fruit set off ground, fruit easier to remove from plant
- 'NuMex Odyssey' best in our trials
  - Seed will be available from Mesilla Valley Chile Co.

Summary – Steps to Best Mechanical Harvest of NM Green Chile

Field Management:

- Irrigation, fertilization should encourage deep, robust root growth
- Direct seeding produces plant architecture better for mechanical harvest
  -Transplants tend to grow into shorter, bushy plants
- Plant spacing; when thinning direct seeded fields, leave less space between plants (avg. 4”)
  - Closer plant spacing provides higher yield of marketable green chile fruit without reducing fruit quality

Acknowledgements

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Thank you…
…Questions?