Chile Seed Quality

College of Agriculture and Home Economics
Cooperative Extension Service
Agricultural Experiment Station

In November 1998, the New Mexico Chile Task Force was formed to identify and implement ways to keep chile pepper production profitable in New Mexico and to maintain and enhance the research and development partnership between the New Mexico chile industry and New Mexico State University.

Chile Task Force reports will be issued periodically to consider issues of concern to the industry and to document the Task Force's progress in developing techniques and technologies to improve industry competitiveness in the 21st century global trade environment.

♦ ♦ ♦

For more information, contact:
New Mexico Chile Task Force
Rich Phillips, Manager
New Mexico State University
Cooperative Extension Service
College of Agriculture and Home Economics
Box 30003, MSC 3AE
Las Cruces, NM 88003-8003
Phone: 505-646-2353
Fax: 505-646-8085
E-mail: rphillip@nmsu.edu

♦ ♦ ♦

This publication also is available on the Web at: **www.chiletaskforce.org** and **cahe.nmsu.edu/pubs/research/**

Chile Seed Quality[1]

by Arthur D. Wall[2], Richard Kochevar[3] and Richard Phillips[4]

"It Doesn't Cost, It Pays"

The greatest potential for good chile crop yield is in the seed, assuming that crop management and environment are optimal. Seed quality refers to both genetic quality and the quality of the seed that carries the genes. A chile cultivar's genetic purity is important for maintaining many crop attributes, including yield, pungency (heat), fruit shape, size and color. Seed quality also greatly affects germination and vigor of chile seedlings. Buying genetically pure and high-quality chile seed can help increase grower profits. The motto of certified seed is: "It doesn't cost, it pays." Many chile growers find that the modest increase in price for higher quality seed is one of their best investments.

Growers who plant chile seed that has been selected continually for superior plant characteristics will have the best potential for crop profits. Chile cultivars that are not selected continually, grown in isolation to prevent cross-pollination and rogued of off-type plants throughout the growing season will revert to land-race populations with a higher proportion of off-type and low-yielding plants. A cultivar's highly uniform crop population is considered to be "true-to-type" and that uniformity is passed from generation to generation through the seed by constant reselection and isolation.

High-quality seed is a chile grower's best investment.

Growers who invest in high-quality chile seed have better potential to maximize chile yields, quality and profits.

- Assume high-quality chile seed costs as much as $10/lb more than lower quality seed.
- Planting 5 lbs of seed/acre would add $50/acre more to production costs.
- In round terms, breakeven on the investment would occur with a 333 lbs/acre yield increase, assuming a green chile price of $300/ton ($300/ton=$.15/lb x 333 lbs/acre =$49.95)
- If high-quality seed improves green chile yield by 500 lbs/acre, a $25/acre profit would be recovered at $300/ton (500 lbs/acre x $.15/lb = $75-$50 extra seed cost = $25 profit/acre).
- If high-quality seed increases green chile yield by 1,000 lbs/acre, profit = $100/acre, at $300/ton.
- If high-quality seed increases yield by 1,500 lbs/acre, profit = $175/acre, at $300/ton.
- Red chile growers who invest $50/acre in top-grade seed would get $100/acre profit, if yield increases by 250 dry lbs/acre and the crop sells for $0.60/lb.

These are very conservative estimates. Return on investment will be greater if green chile sells for more than $300/ton or red chile for more than $0.60/lb or if high-quality seed costs less than $10/lb extra.

[1]This article was reviewed by Joe N. Corgan, professor emeritus, and Paul Bosland, professor, NMSU's Department of Agronomy and Horticulture, Las Cruces; Charles Glover, New Mexico Crop Improvement Association, Las Cruces; Robert Flynn, associate professor and Extension agronomy and soils specialist, NMSU's Cooperative Extension Service, Artesia; and Marisa Wall, research postharvest physiologist, U.S. Pacific Basin Agricultural Research Center, USDA, ARS, Hilo, Hawaii.

[2]Research associate, Department of Tropical Plant and Soil Sciences, University of Hawaii, Honolulu, and former crop production scientist, New Mexico Chile Task Force, NMSU's Extension Plant Sciences Department, Las Cruces. E-mail: arthurdwall@hotmail.com

[3]Director, N.M. Department of Agriculture Seed Laboratory, Las Cruces. E-mail: rkocheva@nmda-bubba.nmsu.edu

[4]Project manager, New Mexico Chile Task Force, NMSU's Extension Plant Sciences Department, Las Cruces. E-mail: rphillip@nmsu.edu

Why maintain genetic purity of chile cultivars?

A chile cultivar should be improved and maintained by continual selection for the following important criteria:

- Yield
- Pungency (heat)
- Fruit size, shape and thickness
- Red chile color or oleoresin content
- Skin thickness (and corking for jalapeños)
- Stem size and detachment force
- Fruit seediness
- Plant growth habit for different row and plant spacings for mechanical or hand-harvested crops
- Earliness, fruit set during heat and concentric (more determinant) fruiting
- Disease and pest tolerance or resistance

Commercial seed producers keep a chile cultivar true-to-type for best crop yield and quality potential through the following careful management and seed handling practices:

- Rogueing seed fields of off-types and diseased plants throughout season
- Keeping weeds out of seed fields
- Isolating seed fields from out-crossing by at least 1/4 mile, ideally by 1 mile
- Cleaning seed harvesting and processing equipment and facilities and handling seed carefully to avoid mixing seed of different chile types
- Using proper seed treatment and storage temperatures, containers and environment
- Sanitizing and disinfecting the seed to control seedborne diseases

To obtain optimal crop performance potential, growers should not save seed from crop to crop or buy seed extracted from red chile crops. An inferior crop usually is produced from unselected, "saved" seed. Likewise, inexpensive seed extracted from red chile crops during normal crop processing will produce inferior crops. This is especially true of seed extracted after chile dehydration because heat damages seeds. Seed crops must be processed separately. The fruit pericarp (rind) can be processed only as a seed-extraction by-product. Growers can compare different cultivars and seed sources in on-farm yield tests to determine the best yielding types and seed sources for their farm management practices and environment. County Extension agents can provide information about how to set up on-farm yield trials.

Chile Breeding, Cultivar Development and Genetic Purity

Plant breeders continually improve existing chile cultivars by selecting and recombining the best plants in isolation every year. Breeders develop new cultivars by crossing different chile types. The best plants in these new populations are reselected and recombined every year. Genetic purity implies that plants within a cultivar seed-lot are high yielding, with very uniform pod shape, pungency, color and fruiting habit. Genetic purity influences other factors, such as early maturity or ability to set pods in heat.

After a new cultivar is released, it must be maintained and improved through recurrent selection. A chile cultivar must be constantly maintained by aggressive rogueing (removing) of off-type plants throughout the growing season and by growing the crop in isolation to prevent out-crossing with pollen from other chile fields. Without strict isolation, rogueing and recurrent selection during every generation, chile cultivars will degenerate into a mixed land-race population with variable yield, quality and plant uniformity. Pungent (hot) cultivars like 'Sandia' can become mild; nonpungent cultivars like 'NuMex Sweet' can become hot. Also, fruit shape, size, heat level and fruit-wall thickness become more variable, increasing processor culls. Most importantly, yield declines and plant variability increases.

Crop uniformity is important to chile processors. They must be assured that heat levels are uniform within each harvested lot and that size, shape and fruit-wall thickness are within acceptable ranges for the intended product. Many processors will not contract for chile crops for which a high level of uniformity cannot be guaranteed.

Seed Quality for Germination and Vigor

Germination tests give growers the best indication of how well seed will germinate in the field. The certified seed label states the expected germination percentage of a chile seed-lot, as well as the percentage of pure seed (compared with broken, shriveled or otherwise damaged seed). To maximize germination in the field, growers can adjust planting rates based on the certified germination rate and pure seed percentage. Pure live seed is calculated by multiplying (seed weight) x (% germination) x (% pure seed). For example, (5 lbs seed) x (80% germination) x (98% pure seed) = (5 x 0.80 x 0.98) = 3.92 lbs pure live seed in 5 lbs total. A germination test is valid only for six months, assuming the seed has been stored in a cool, dry environment. It is best to use seed grown the previous season, because seed that has been stored for more than one season is likely to germinate at a lower rate. If it is necessary to use older seed, retest the germination after seed has been stored for six months.

Improving Seed Germination and Emergence

Chile seed germinates best in warm soil, with temperatures of 75º-85ºF (24º-30ºC). Planting in cooler soils will delay germination and emergence. However, growers often plant in cooler soils (a 50º-68ºF temperature range typical in March), despite lower germination rates, to try to establish the crop before it is subjected to heat-related disorders later in the planting season. There are many factors in addition to seed quality and soil temperature that affect chile germination and stand establishment. Some of these factors include water fluctuations, soil crusting, seedling diseases, soil fertility, soil biology and organic matter, irrigation method, planting method, decapping method (if used), wind damage, salinity cycles concurrent with watering cycles and interactions among planting date, soil temperature and seedling heat stress. Further research is required to better understand these additional factors that affect chile seed germination rate, emergence and stand establishment.

Planting chile seed in warm soil and avoiding overwatering will minimize seedling diseases. In addition, chile seed can be treated with a registered seed fungicide just prior to planting to help avoid many seedling diseases. However, some seedling diseases that commonly occur in cool, wet soils, such as damping-off, are not controlled easily even with fungicides. A list of registered seed fungicides is available from agricultural supply companies or from the plant pathologist with NMSU's Extension Plant Sciences Department at (505) 646-2875.

There are some experimental treatments that may improve seed germination and emergence in cooler soils or when seeds exhibit dormancy. Several methods of seed priming have been demonstrated to improve germination, seedling emergence and crop yields in chile. However, results have been variable and these technologies have yet to be developed for New Mexico chile crops (Bosland and Votava, 1999).

Precision planters help ensure good seed germination and emergence by controlling seeding rate, spacing, depth and bed firmness. There also are new technologies that can improve chile seed emergence and stands, such as fluid-drilled and plug-mix seeders or gel seeding. These delivery systems can use raw, primed or pregerminated seed to promote rapid crop emergence and uniform stands (Bosland and Votava, 1999). Consult a farm equipment dealer or the World Wide Web to learn more about precision planters and new seeder types.

What Seed Certification Tells a Chile Grower

When a cultivar is released, high-quality seed must be produced every generation to maintain the cultivar's purity. Seed certification provides chile growers with a measure of seed quality control but does not certify the seed's genetic uniformity or field performance. Genetic uniformity and field performance are the seed producer's

Test chile seed germination to determine percent live seed.

Obtain a representative sample of a seed-lot by taking subsamples from different containers of the same seed or from different areas in a seed bin. Mix the bulk sample thoroughly. Take out 20-30 grams of seed to make a composite sample for the germination test.

To calculate average seed germination:

- Randomly select three samples of 100 seeds each (three groups of 100 seeds). Count broken, shriveled or brown seeds for the germination test if % pure seed is unknown. Otherwise, do not count damaged seed and factor in % pure seed, as described below.
- Work in a clean area with clean hands.
- Moisten a paper towel with clean water. Allow the excess water to drain, so the towel is wet but not soaking in water.
- Put first 100 seeds in rows on the paper towel with 2 inches between seeds and at least 3 inches between rows.
- Cover the towel with another moist towel and fold the towels in half several times to form a 2-3 inch wide strip.
- Repeat for each of the two remaining 100-seed samples. Place all three folded-towel packets in a clean plastic bag.
- Place the seeds where the temperature remains at 75º-80º F. Ideally, the temperature should be controlled so that the seeds are at 68º F for 16 hours at night and at 86º F for 8 hours during the day, which is the standard test for chile seed germination. Use a minimum-maximum thermometer to determine actual temperatures.
- Count the number of germinated seeds 6, 10 and 14 days after sowing. Remove germinated seeds and moldy seeds at each counting.
- Write down the number of seeds germinated at each count and average the three replications at 14 days to calculate average germination. For example, if 80, 84 and 82 seeds germinated in each sample, respectively, then 80+84+82=246/3 = 82% germination.
- Seeds that germinate faster with a higher germination percentage at 6 and 10 days are more vigorous. Seeds that do not germinate in 14 days may be dormant or not viable.
- Germination at lower temperatures may require 21 days or longer.
- If one towel is ruined by mold, take the average of the other two. If more than one towel is moldy, start again with a cleaner preparation. Seeds not treated with bleach are more likely to grow mold.

responsibility (Wall, Kochevar and Phillips, in press). Seed certification provides assurance, first, of high germination rates and cleanliness. Second, it offers assurance that the seed crop was grown in isolation and was relatively free of plant off-types (for example, jalapeño in a cayenne seed crop). Third, certification provides assurance that crop disease levels were tolerable. The New Mexico Crop Improvement Association (NMCIA) is a public agency that supports the New Mexico seed industry by managing seed certification programs. To obtain information about the New Mexico Chile Seed Certification Program or to obtain The Official Seed Certification Handbook, call NMCIA at (505) 646-4125 or write to NMCIA, MSC 3CI/Box 30003, NMSU, Las Cruces, NM 88003.

Further Information

For information about producing chile seed crops, please refer to Guidelines for Chile Seed Crop Production, New Mexico Chile Task Force Report 5, in press.

For a list of suppliers of New Mexico certified chile seed or seed processors and cleaners, please contact the New Mexico Crop Improvement Association, MSC 3CI, Box 30003, New Mexico State University, Las Cruces, NM 88003-0003; phone: (505) 646-4125 or on the Internet at http://www.nmsu.edu/~nmcia

NMSU Cooperative Extension Service publications mentioned in this report are available from the Agricultural Communications Department, Box 30003, MSC 3AI, NMSU, Las Cruces, NM 88003; phone: (505) 646-1075; E-mail: bulletin@nmsu.edu or on the Internet at http://www.cahe.nmsu.edu

References

Bosland, P.W. and E.J. Votava. 1999. Peppers: vegetable and spice capsicums. London: CAB International.

Wall, A.D., R. Kochevar and R. Phillips. Guidelines for chile seed production. New Mexico Chile Task Force Report 5. Las Cruces, N.M.: NMSU College of Agriculture and Home Economics, in press.

New Mexico Chile Task Force Publication List

Report 1: An Industry-University Response to Global Competition

Report 2: Chile Seed Germination as Affected by Temperature and Salinity

Report 3: Yield and Quality of Machine-Harvested Red Chile Peppers

Report 4: Chile Seed Quality

Printed December 2002
Electronic Distribution December 2002