Red Chile and Paprika Production in New Mexico

Revised by Stephanie J. Walker[1]

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New Mexico is the leading state in chile acreage (non-bell pepper, *Capsicum annuum*), and red chile and paprika represent approximately 40% of the state's overall production. Red chile is derived from New Mexican-type chile varieties that are harvested when fruit have turned red or when they have reached physiological maturity. Paprika is a type of red chile and is the designation used for low (or no) heat, red *Capsicum annuum* varieties (Wall, 1994). Paprika varieties are also distinguished by their high levels of red pigments (capsanthin and capsorubin) in the pericarp (walls) of the fruit. The majority of the red chile and paprika crop is dehydrated and crushed into flakes or powder for use in a wide variety of products. Approximately 15% of the paprika crop is further processed into oleoresin paprika, a natural red food colorant (Walker, 2007).

CULTIVAR SELECTION

The larger red chile processing operations in the Southwest maintain in-house breeding programs, and all preferentially process their own proprietary cultivars (Bosland and Walker, 2004). Cultivars specifically bred to display attributes such as superior drying are preferred. For smaller operations and home gardeners, many of the commercially available New Mexican-type green chile cultivars also provide an excellent red, ripe, dry product. 'New Mexico 6-4' is a mild cultivar that works well as either a green or red chile. 'Sandia' is a hot

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variety that can be used for either green or red chile, and is commonly used in the manufacture of red chile ristras because of its excellent drying characteristics.

LAND PREPARATION

A well-balanced crop rotation plan is essential for optimum red chile production. Chile, as well as other crops in the Solanaceae family (e.g., tomatoes, potatoes, eggplant), should not be planted in the same field more than once every three years. Rotation with a monocot (e.g., corn, wheat, oats, sudangrass) aids in reducing many of the disease and pest pressures associated with chile production (Pennock, 2003).

Water accumulation or pooling in any part of the field encourages rapid reproduction and spread of chile wilt caused by the soilborne pathogen *Phytophthora capsici*. To reduce potential disease incidence, fields should be prepared for thorough drainage. Laser leveling fields at a grade of 0.01 to 0.03%, in one or both directions, is optimal (Bosland and Walker, 2004). In addition, digging drainage holes at the low end of the field is a best management practice to quickly drain large amounts of water from a field at times of high rainfall.

Virtually all paprika grown in the Southwest for commercial processing is direct seeded and irrigated by furrow or overhead pivot. Because of the long growing period for red chile and paprika (approximately 165 days) and the desire to begin processing as early as possible, the crop is usually direct seeded early in the season (Bosland and Walker, 2004). Red chile and paprika fields are planted beginning in early March, and the majority of the crop has been seeded by mid-April.

Seed should be obtained from a trusted source to ensure that it is clean and free from pathogens, such as bacterial leaf spot (*Xanthomonas campestris*), that can be spread via seed. Many early season diseases and pests impact chile seedlings, and many producers will therefore plant a high rate of seed (4 lb/ac or greater) to ensure strong stand establishment. Red chile and paprika fields are thinned or blocked to clumps of 1 to 3 plants, with the clumps spaced approximately 4 to 6 inches apart. A final stand of 40,000 plants per acre is optimal, but up to 80,000 plants per acre will not adversely affect quality or yield (Paroissien and Flynn, 2004).

FERTILIZATION

Nitrogen and phosphorus are the two nutrients routinely added to the soil of red chile and paprika in New Mexico. A soil test prior to planting is recommended to determine nutritional needs. Phosphorus is relatively immobile in the soil, and so is typically applied pre-plant or banded into the soil at planting. Approximately 50 to 100 lb/ac of P_2O_5 are incorporated, depending on existing levels. Approximately 200 lb/ac of nitrogen are used by a chile crop over the course of the season. The optimal application window for nitrogen begins when plants reach the reproductive period (first bloom) and continues through early fruit development. Fertilization is usually stopped in mid-August to limit new growth and encourage ripening of fruit in anticipation of a red chile harvest.

HARVEST

Harvest begins in late September and continues until the harvest quota is completed or all red chile is harvested. Mechanical harvest of the red chile and paprika crops has been widely adopted, with more than 85% of the commercial crop currently harvested by machine (Bosland and Walker, 2004).

There are several different types of mechanical harvesters currently being used for red chile and paprika in the Southwest. Their performance is greatly affected by field and crop conditions. The three most common picking heads are the finger-type, the belt-type, and the double helix. The finger-type head is based on a design incorporating a series of counter-rotating bars with fingers. The fingers comb the plants to strip the pods off the plants and onto conveyor belts. The mechanism is very aggressive with the plants and can result in an excessive amount of harvested trash, especially after a freeze. The belt-type harvester has two sets of counter-rotating vertical belts embedded with fingers that comb either side of the plant from the bottom to the top. If the belts are set low enough, fruit can be harvested off the ground with this machine. This machine also tends to be very aggressive with the plants and can pick up an excessive amount of dirt and debris if set to sweep the ground. The most widely used picking head, and most consistent for picking over the entire red chile harvest season, is the double helix model (Marshall, 1997). The helices may be vertical or oriented at an angle. The helices rotate in opposite directions to each other, snapping pods off of the plants and flipping them onto conveyor belts on either side of the helices.

Typically, whether by hand or machine, the crop will undergo a once-over, destructive harvest. Maintaining fruit on the plants in the field until they are ready to be processed keeps post-harvest deterioration to a minimum; this has been the most cost-effective “storage” method for red chile (Cotter and Dickerson, 1984), and allows for some natural drying to occur. Following harvest from the plants, fruit must soon be dried to between 8 and 12% moisture to prevent decomposition while maximizing quality (Wall, 1994).

Maximum yield and quality for a paprika crop are obtained from material harvested from October through November, before the season's first freeze (<28°F) (Kahn, 1992b; Palevitch et al., 1975; Wall, 1994). While paprika continues to be harvested after the first freeze, quality and yields decline significantly (Walker, 2007). Red chile experiences a 0.5% yield loss for every day that harvest is delayed past the optimal harvest window. Yield losses are attributed to pre-harvest fruit abscission as well as fruit deterioration (Cotter and Dickerson, 1984; Kahn, 1992a).

PROCESSING

Historically, red chile and paprika were dehydrated through sun drying. Ripe, red chile fruit were laid on rooftops, canal banks, or the ground and left in place until adequate drying was achieved. Although this technique is still commonly practiced in many chile-producing countries, only the smallest operations in the United States still utilize this method. Larger, commercial operations employ either tunnel or belt dryers. Both systems are more reliable and sanitary than sun drying (Wall, 1994). These methods also use a lot of energy, especially early in the harvest season when very succulent pods are dried. Another drawback to tunnel and belt dryers is their fixed capacity. Because of the finite capacity of the dehydration equipment, only a limited amount of chile fruit can be processed through a dehydration facility over a set period of time.

Early in the season, when chile pods are more succulent, less material can be processed. Later in the season, throughput increases because drier raw material is entering the processing stream. While it would therefore seem that it is in the best interest of processors to harvest late in the season and take advantage of the rapid throughput, advantages are outweighed by disadvantages. As the plants begin to senesce, yield per plant dramatically declines and brittleness increases. Harvested trash tends to increase with increasing brittleness (Cotter and Dickerson, 1984; Walker, 2007).

Harvest timing and efficiency can affect the profitability of both red chile growers and processors. Red chile grower reimbursements are based on the amount of dried, processed product. Processors measure weight lost during dehydration by dividing the incoming fresh weight by the dry, processed weight to obtain what is termed "shrink." Because of the critical relationship between pod succulence and throughput efficiency for red chile dehydrators, shrink is carefully monitored during the course of the harvest season. Typically, shrink is much greater early in the harvest season and decreases steadily as the chile plants continue to mature and senesce. Early in the season, the very succulent fruit have a shrink ratio of 7:1 or 8:1 (Wall, 1994). Late in the season, when fruit and plants are very dry, shrink ratio drops to around 1:1. In addition to date of harvest, chile cultivars have a large impact on shrink values. The development of cultivars with increased dry yield and lower shrink is an ongoing priority of paprika breeding programs (Walker et al., 2004).

HARVEST AIDS

Virtually all red chile and paprika grown for processing plants and harvested in the succulent stage undergoes application of salt in the form of sodium chlorate before harvest (Wall, 1994). The main purpose of "salting" the plants is defoliation to provide a cleaner harvest. The removal of leaves from the plants also hastens senescence, and therefore encourages ripening of the fruit. A maximum rate of 10 lb/ac of salt is applied, with reduced rates for less succulent material. The chile is harvested between 10 to 14 days after the application of the salt. The treatment is relatively inexpensive and effective at removing much of the foliage that would otherwise interfere with a clean harvest of the material. Fields harvested in the last half of the season are not sprayed because the fruit dry too fast, and by late in the season, adequate natural defoliation and ripening have occurred (Walker, 2007).

Ethylene is sometimes applied along with the salt (Wall, 1994). Ethylene is a naturally occurring hormone that induces ripening in fruit and can also assist in defoliation of the plants. The use of ethylene products for paprika production has been limited because fruit drop is often an unintended consequence of application. The treatment's effectiveness is greatly affected by environmental conditions (Conrad and Sundstrom, 1987; Kahn, 1992a; Wall et al., 2003), so it is difficult to gauge the proper timing or concentration of ethylene needed to obtain the desired effect.

Red chile and paprika are used extensively in a wide variety of food products, and New Mexico's crop is known for its consistent quality. Through careful cultivar selection and use of best production practices, growers can continue to profitably produce this crop that is a critical component of New Mexico's chile industry.

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