Field Production of Organic Chile

Guide H-258

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Introduction

New Mexico is renowned for its chile production. Both green and red chile contribute to New Mexico's unique chile-inspired cuisine and culture. Chile production also contributes significantly to New Mexico's economy. The crop is a popular item at farmers' markets, supermarkets, and restaurants throughout New Mexico. At the markets, organic chile commands a premium price and can improve profitability for growers (Figure 1).

Figure 1. **New Mexican landrace chile 'San Juan Pueblo' growing under organic field management in Los Lunas, NM. (NMSU photo)**

Organic chile production poses novel challenges for growers, and must be dealt with in ways other than those used by conventional producers. Chile is subject to a wide variety of pests and diseases that require management for optimal growth and yield. Early growth of chile plants is slow, and weeds can quickly overcome chile fields if not addressed properly throughout the season. In addition, appropriate levels of nutrients must be available in the soil for optimal plant health and productivity. For organically grown chile, dealing with these challenges requires a whole-farm approach that relies on improving soil fertility and health, managing pests and diseases, and controlling weeds for healthy, productive plants (Bosland and Walker, 2014).

Organic Certification

While many farmers and home gardeners may grow chile without using synthetic fertilizers or pesticides, producers that gross more than $5,000 per year in sales cannot legally advertise their chile crop as organic until they are certified through the USDA organic certification process. These producers must comply with the USDA National Organic Program (https://www.ams.usda.gov/about-ams/programs-offices/national-organic-program) requirements in order to make an organic claim. To become certified, a producer may choose any USDA-accredited organic certifier; a list of certifiers is available on the National Organic Program website (https://www.ams.usda.gov/resources/organic-certifying-agents). The only recognized certifier based in New Mexico is the New Mexico Department of Agriculture Organic Program (http://www.nmda.nmsu.edu/marketing/organic-program/).

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Organic farming relies on practices such as crop rotation, green manure/cover crops, composting, and using natural methods for pest control. Organic farming prohibits the use of synthetic fertilizers, pesticides, plant growth regulators, and other synthetic materials. However, organic farmers could possibly use plastic row coverings for frost protection and to extend the harvest season. Plastic for mulch and hoop houses is allowed as long as the material is inspected regularly for signs of degradation. Upon any sign of damage, the material must be removed immediately.

Site Selection

In order for the NMDA Organic Program to certify a chile field, the land must be free of prohibited substances (e.g., synthetic pesticides and fertilizers, seed treated with non-approved materials, and genetically modified [GMO] crops) for three years. Selecting a site that is well-suited to chile is especially important in organic production. For chiles, it is best to select a site with well-drained soil that warms up quickly in the spring. Chile plants are cold-sensitive, so low-lying fields that are subject to late frosts should be avoided. Fields should be chosen that have not grown chile or other solanaceous crops (e.g., tomato, potato, eggplant) within the last three years (Bosland and Walker, 2014). In addition, fields with minimal weed pressure should be selected for organic chile.

Field Preparation

Adding suitable quantities of compost can improve soil by increasing its water-holding capacity, nutrient retention, and aeration. Ensuring proper drainage of the field, through laser leveling at a grade of 0.01–0.03% in one or both directions away from the irrigation head, using raised beds, or other methods depending on the size of the production plot, is beneficial in draining the field of extra water and reducing the risk of root diseases (Bosland and Walker, 2014). Cover crops, such as cereal grains and legumes, should be worked into the soil at least three weeks before planting or transplanting. A long-term crop rotation strategy is critical for productive soil and for organic management of weeds, insect pests, and diseases. A three- to five-year rotation schedule, in which chile is planted once and a grain (monocot) crop is planted at least once, is recommended (Bosland and Walker, 2014).

Soil Fertility

Building soil fertility is one of the most important elements of successful organic crop production. Most soils in New Mexico have very low levels of organic matter. Regularly incorporating composted manure will increase soil fertility. However, chile seedlings are sensitive to salinity (Flynn et al., 2002), and the salt content of the manure must be considered. Using a legume crop as a green manure is an excellent method to increase the nitrogen content of the soil. The legume crop should show nodule formation on the roots, indicating nitrogen fixation, and should be worked into the soil before going to seed. For more on nitrogen fixation, see NMSU Extension Guide A-129, *Nitrogen Fixation by Legumes* (http://aces.nmsu.edu/pubs/_a/A129.pdf).

Before planting a crop, a soil test should be conducted on the soil where the chile will be grown. A soil test will provide a scientific basis for the addition of plant nutrients. The soil test will give recommendations on the types and amounts of fertilizer to apply to the field. In organic production, only approved fertilizers can be used. Often, conventional recommendations will be for inputs that are prohibited in organic production, such as urea. Before application, organic producers are required to obtain consent from their certifier for any product they wish to apply. Each approved fertilizer or amendment has different nitrogen-phosphorus-potassium (N-P-K) ratios. The soil test results will be a guide for the appropriate amendments (Flynn, 2015). For more information on soil tests, see NMSU Extension Circular 676, *Interpreting Soil Tests: Unlock the Secrets of Your Soil* (http://aces.nmsu.edu/pubs/_circulars/CR676.pdf).

Planting

Chile is a warm-season crop, meaning it is sensitive to frost. Direct seeding or transplanting chile outside should be delayed until soil temperatures warm to 60°F. In general, the optimal period for direct-seed planting of chile is between March 1 and May 1 in southern New Mexico, and four to six weeks later in central and northern New Mexico. Transplanting should be delayed until after the last frost in spring. In direct seeding, producers should plant a minimum of 2 pounds of high-quality seed per acre. Some growers plant up to 10 pounds of seed per acre to compensate for plant losses due to curly top virus, early season pests and diseases, or poor germination. Using transplants, or seeding at a high rate (up to 10 pounds of seed/acre), may provide insurance against seedling loss due to early season fungal diseases and insect pests (Bosland and Walker, 2014) in an organic system. Transplants and seed must be certified organic unless the desired cultivar is unavailable and a search has been documented. There must also be documentation that the conventional seed is untreated and non-GMO. Producers should check with their certifier. If producers choose to save seed, it can be certified for the following year, but it must appear on the product list and records must be kept of harvest quantities.

NMSU Extension Guide H-230, *Growing Chiles in New Mexico* (http://aces.nmsu.edu/pubs/_h/H230.pdf), provides additional planting details.

Harvest

The days to harvest for the green chile crop depends on the pod type: bell (50–90 days), jalapeño (60–90 days), or New Mexican (65–120 days). A red chile crop requires more time to mature and will be ready about 165 days after planting. However, areas with shorter growing seasons may have little to no red chile for harvest unless an early maturing cultivar is planted. Producers should consult with their county Extension agent (http://aces.nmsu.edu/county/) or NMSU Extension Vegetable Specialist for additional information on appropriate cultivars for their area.

Green chile should be harvested when the fruit are fully sized and firm when squeezed. Fruit may also be harvested in the "pinto" stage when fruit are green with a slight amount of red color. For a red chile harvest, fruit should be allowed to turn completely red and left on the plant until partially to fully dry. After harvest, fruit are often tied into a ristra or left to air dry in a sunny location until completely dry (Walker, 2010; Coon and Walker, 2015). Emptied hoop houses can also be good places to finish drying red chile. If chile is dried in a dehydrator, the producer must be certified as an organic processor as well as an organic crop producer.

Irrigation

Optimal watering will increase overall yields and the quality of the chile pods. A visual assessment of the leaves on the chile plants is one of the best indicators of water stress. Generally, during hot summer days, plants that wilt in the morning hours are in immediate need of water as opposed to plants that wilt in the afternoon. During the season, the frequency of irrigation applications must be adjusted for rainfall, wind, and temperature. Decreasing the frequency of irrigation at the end of the season promotes fruit ripening and improves the quality of the red fruit color.

There are a number of techniques used in irrigating chile, including drip and furrow. Drip irrigation, which employs plastic tubes that provide a small and steady amount of water directly to the plant's root zone, is a more efficient use of water. Disadvantages of drip irrigation include the expense, additional maintenance compared to furrow irrigation, and disposal of the plastic drip lines. Furrow irrigation is a method commonly used by growers in New Mexico, and is achieved by growing the plants on rows and partially filling the furrows with water. Furrow irrigation of chile fields can employ an alternate row irrigation to move salts in the soil away from seedlings. NMSU Extension Guide H-230, *Growing Chiles in New Mexico* (http://aces.nmsu.edu/pubs/_h/H230.pdf), provides more information on irrigation.

Weed Management

Healthy, fast-growing plants can better tolerate or outgrow pest and weed problems (Bosland and Walker, 2014). Managing weeds organically starts with good crop rotations. Watering before planting and then tilling in the first flush of weeds can help reduce the weed seed bank. Other methods include mulching, cultivation, flame weeding, and using corn gluten meal, citrus oil, or vinegar (acetic acid).

Mulches made of organic material, applied on the soil around the chile plants, can nourish the soil as they decompose and are also effective weed barriers. Growers should be careful not to cover the chile plants when applying the mulch to the field. The mulches must be sourced from materials approved by the certifier prior to application. Mulching materials include compost, straw, and paper. Although a thick layer of mulch is better for inhibiting weed growth, excessive mulch can harbor insect pests.

Cultivation can be done by hand hoeing or with a cultivator implement on a tractor. This method effectively severs the stems of weeds from the roots just below the soil surface and kills most weeds.

Flame weeding is another allowed method used to destroy weeds in the field, and uses a propane-fueled torch to direct a flame at the targeted weeds.

Corn gluten meal is a byproduct of corn processing that is often used to feed livestock, but it can also be used as an organic herbicide. It is known to inhibit the germination of seeds and can be used as an organically approved pre-emergent weed treatment. This material may also inhibit germination of chile seeds, so it must be used in established chile fields or in conjunction with transplants.

There are also a few commercial herbicides that are approved for organic systems; the main ingredients in these products are vinegar (acetic acid), clove oil (eugenol), or soap (fatty acids). These are usually nonselective contact herbicides and are not effective on perennial weeds (Ozores-Hampton et al., 2012). Contact your certifier for approval before applying anything that has not been noted in the organic plan.

Common Diseases of Chile in New Mexico and their Management

Phytophthora capsici is a fungal pathogen that causes root rot, foliar blight, and fruit rot in chile. Infection of chile peppers commonly starts in the root zone, but the first observable symptoms are often at the soil line where dark, water-soaked areas on the stem are visible. Crop rotation with non-host plants reduces the inoculum in the soil. Irrigation management is the most effective way to control this disease in both organic and conventional production. Areas of standing water in and around the field should be eliminated, and fields should be allowed to dry before the next irrigation.

Verticillium wilt, caused by *Verticillium dahliae* and *V. albo-atrum*, is another devastating fungal disease in chile. Typically, symptoms are first manifested on the lower or outer parts of the plant. This disease invades the vascular system within the plant. *Verticillium* is long-lasting in the soil and easily spread through infected soil. For organic systems, plant disease-free plants or seeds into uncontaminated fields. There are no resistant chile cultivars, but some management can be achieved through crop rotation with non-hosts, biofumigation (which utilizes the toxicity of *Brassica* crop residues in order to control soil-borne plant pathogens), and soil solarization (Goldberg, 2010).

The most serious virus disease affecting chile production is beet curly top virus (BCTV). Beet curly top virus is a pathogenic plant virus that is spread by one insect vector, the beet leafhopper (*Circulifer tenellus*). Disease symptoms may include vein swelling, leaf curling, yellowing of leaves with purple veins, and stunting. Management strategies include destroying the weeds that host the beet leafhoppers, including kochia (*Neokochia americana*) and London rocket (*Sisymbrium irio*). Also, placing insect netting material or a row cover over the chile plants while leafhoppers are active in the area can reduce BCTV infection. NMSU Extension Guide H-106, *Curly Top Virus* (Goldberg, 2001a; http://aces.nmsu.edu/pubs/_h/H106.pdf), provides additional details on this disease. Another possible control for BCTV is the use of kaolin, which is a colloidal clay material that is sprayed on the plants to discourage the insects from biting and infecting the crop. A study published by the New Mexico Chile Task Force entitled *Use of Kaolin to Suppress Beet Curly Top Virus in Chile Peppers* is available at http://aces.nmsu.edu/pubs/research/horticulture/CTF19.pdf. Again, seek approval from your certifier before applying kaolin products.

Pest Management

Most economic infestations of insect pests in chile are limited to young plants (Goldberg, 2001b). Early season insect pests include thrips (Thripidae spp.), fall armyworms (*Spodoptera frugiperda*), root-knot nematodes (*Meloidogyne incognita*), and beet leafhoppers (*Circulifer tenellus*). Smaller infestations of false chinch bugs (*Nysius raphanus*) and cutworms (Noctuidae spp.) have been reported. Pepper weevil (*Anthonomus eugenii*) is the pest most likely to reach economically damaging populations in post-bloom chile fields (English and Lewis, 1999). Additional information on insect pests of chile can be found in NMSU Extension Guide H-243, *Economic Insects of Chile* (http://aces.nmsu.edu/pubs/_h/H243.pdf).

In order to monitor the pests that are in the field, growers may use sticky traps, which must be approved by the certifier before use. These traps catch insects attracted to the color of the trap. Traps do not necessarily provide control, but are an excellent tool for monitoring the presence of insect pests in the field. To be effective, the traps must be clean and sticky. Insect pheromone placed on the sticky traps increases their efficiency.

Root-knot nematodes (*Meloidogyne incognita*) are a serious problem for New Mexico chile production, especially in sandy soils. Root-knot nematodes infect plant roots, causing the development of root-knot galls that drain the plant's photosynthate and nutrients. Infection of young plants may be lethal, while infection of mature plants causes decreased yield. Root-knot nematode damage results in poor growth, a decline in quality and yield of the crop, and reduced resistance to other stresses. Crop rotation with cereals, such as wheat (*Triticum* spp.), rye (*Secale cereale*), or barley (*Hordeum vulgare*), for a year and interplanting marigolds (*Tagetes* spp.) are strategies used against nematodes (Goldberg, 2010).

Many thrips (Thripidae spp.) species are pests of chile due to the damage caused by feeding on developing flowers or pods, causing discoloration and deformities and reducing marketability of the crop. Thrips may also serve as vectors for plant diseases. Due to their small size and high rates of reproduction, thrips are difficult to control using classical biological control methods. Effective strategies for controlling thrips are biological agents, such as *Beauveria bassiana*. This fungus has been effective in some circumstances, such as moist and humid environments (Gillman, 2008).

The fall armyworm (*Spodoptera frugiperda*; Figure 2) will eat many plants in an area, and once the food supply is exhausted, the entire "army" will move to the next available food source. The armyworm's diet consists mainly of grasses and small grain crops. An infestation is hard to detect since the caterpillars migrate to new feeding areas in the cool of the night. An effective strategy for controlling armyworms is the use of biological insecticides, including *Bacillus thuringiensis* (Bt), when the larvae are still small. As a last resort, neem oil may be applied; however, it may have some adverse effects on humans, such as allergic reactions, and is known to be toxic to some aquatic organisms (Boeke et al., 2004).

Figure 2. **Fall armyworm damage to chile plants. (NMSU photo by Stephanie Walker)**

Methods for Pest Control in Organic Production

Row Covers

Row covers are translucent, porous, polyester fabric that act as an insect barrier while allowing up to 80% of the available light to penetrate to the plant canopy. Heavier weights of row covers are also used for frost protection; however, the lighter type of cover should be used for controlling pests in summer because it will keep out insects without overheating the plants. Growers can use row covers as temporary barriers to get plants past critical growth stages, such as seedlings or when a pest is most active. Also, to prevent access by some pests, growers may want to seal the bottom of the row covers securely to the soil.

Insecticidal Soap

Insecticidal soap contains unsaturated, long-chain fatty acids that dissolve the cuticle of insects. These soap sprays are commercially formulated products sold specifically for insect control. To be effective, the insecticidal soap must come in contact with the insects while it is still liquid. Spray only on pests and avoid beneficial insects. Be aware that not all insecticidal soaps are allowed in organic production. Certifier approval is required before using insecticidal soap.

Bacillus thuringiensis

Bacillus thuringiensis (Bt) is a naturally occurring bacterium found in the soil. Approximately 150 species of moths and butterflies are susceptible to Bt and can be killed in their larval stage with this material. When an insect takes a bite of a plant sprayed with Bt, the insect gets infected and stops feeding. Inside the insect, the bacterium releases a protein that causes the pest to die within a few days. Certifier approval is required before using Bt.

Beneficial Insects

Beneficial insects are any of a number of species that perform pollination and/or pest management. The concept of beneficial use is subjective and only arises in light of desired outcomes from a human perspective. In farming and agriculture, where the goal is to raise selected crops, insects that hinder the production process are classified as pests, while insects that assist production are considered beneficial. In gardening, pest control and habitat integration are the desired outcome with beneficial insects. In order to encourage beneficial insects as a pest control strategy, it is important to provide suitable living conditions for the beneficial insects. See NMSU Extension Guide H-169, *Using Insectary Plants to Attract and Sustain Beneficial Insects for Biological Pest Control* (http://aces.nmsu.edu/pubs/_h/H169.pdf), for more information. Some species of bees are beneficial as pollinators to facilitate propagation and fruit production. Also, some beneficial insects are predatory and will kill pest insects.

Companion Planting

Companion planting is the planting of different crops in close proximity for pest control and to increase pollination by creating habitat for beneficial organisms. Companion planting is a form of polyculture. Diversity on the whole is an important aspect of organic production. Companion planting is used for many reasons, including pest suppression, predator recruitment, positive hosting, and pattern disruption.

Additional Resources

The Organic Materials Review Institute (OMRI; http://www.omri.org) is a national nonprofit organization that reviews materials for suitability in organic production and processing. OMRI listed or approved products may be used on operations that are certified organic under the USDA National Organic Program with prior approval from the certifier. All restrictions on use must be complied with.

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