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ORGANIC SWEETCORN PRODUCTION

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Introduction

In most of the south, sweet corn (*Zea mays* var. *rugosa*) can be produced from early spring until fall. However, sweet corn does have some specific environmental and cultural needs that must be met for the plant to produce high-marketable yields.

Corn is a warm-season crop that requires high temperatures for optimum germination and rapid growth. Soil temperature should be between 70° and 85°F for best germination. If the soil temperature is too low, the seed will not germinate. If, at the same time, the soil is too wet, the seed may rot before the soil temperatures are adequate for germination. In general, sweet corn does not tolerate cold weather, and frost will injure sweet corn at any stage of growth. Other stressful climatic conditions, such as drought or flooding, can reduce yields and cause small, deformed ears.

Because corn is a short-day plant, some cultivars will not flower when the day length is more than 13 hours. This is rarely a problem with commercially available sweet corn varieties in the Southeast, but a grower should be mindful of day length when planting heirloom or tropical corn varieties.

Corn is wind-pollinated and should be planted in blocks of at least 4 rows for good pollination to occur. Sweet corn can also cross-pollinate with other types of corn. If sweet corn is planted downwind of popcorn or field corn, kernels will be starchy instead of sweet. Cross-pollination between white and yellow cultivars will change the colors of the kernels. Extra-sweet and standard cultivars also should not be planted near each other or at the same time. To prevent cross-pollination problems, sweet corn should be separated from different types of corn by at least 400 yards, different types or cultivars of corn should be planted at least 1 month apart, or cultivars with different maturity dates should be planted.

Overview of an Organic Production System

Organic agriculture employs a combination of the best methods of traditional agriculture and modern technology. Present-day organic growers use tried-and-true practices such as crop rotation, growing a diversity of crops, planting cover crops, and adding organic matter to the soil. At the same time, most organic production systems include use of modern equipment, improved cultivars, and new technologies such as drip-irrigation and plastic mulch.

In contrast to "conventional agriculture," organic farming relies on preventive rather than corrective practices. Instead of depending on synthetic insecticides, fungicides, and herbicides for pest control, organic growers employ an Integrated Pest Management (IPM) approach and use beneficial insects and biological products such as *Bacillus thuringensis* (Bt). Rather than amending the soil with synthetically

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derived fertilizers, organic growers build soil fertility by using natural products such as cover crops, manure, and compost. A successful organic system provides a grower with an income adequate to maintain a good standard of living by producing an abundance of high-quality food, while at the same time nurturing the soil, protecting the environment, and ensuring that the land will be healthy and productive for generations to come.

Organic Certification

The organic industry uses standards to verify that foods labeled "certified organic" are produced without the use of synthetic fertilizers or pesticides. If a grower sells $5000 or more of a product labeled as organic, he or she must be certified by a federally approved certifying agent. To be certified organic, land must not be treated with any prohibited substances for 3 years. During that 3-year period, a farm is considered transitional. In addition, a grower must have and follow an ecological soil management program. Growers in North Carolina can be certified organic by any organization that is approved by the National Organic Program, a division of the USDA. The North Carolina Crop Improvement Association is the organization that certifies many organic growers in North Carolina. More information on organic certification can be found at the author's organic agriculture website: www.ncorganic.org , as well as at the homepage for the National Organic Program: www.ams.usda.gov/nop/ .

Soil Management and Fertility

Sweet corn grows best in a well-drained soil with a pH of 5.5 to 7.0. In choosing a site for corn production, heavy clay soils with poor drainage and areas subject to flooding should be avoided. Dry, sandy sites should only be used if irrigation is available. Soil pH can be raised by incorporating ground limestone. Because the soil reaction with lime is slow, limestone should be incorporated early, preferably in the fall before a spring planting.

Sweet corn is a fairly heavy feeder, and proper soil fertility is critical for high yields and good growth. Once stunted by lack of nutrients, sweet corn may never fully recover. Over the growing season, sweet corn needs approximately 150 lbs of nitrogen (N) per acre. A grower should ensure that 50 to 60 lbs N per acre are available at the time of planting. It will probably be necessary to side-dress with a natural fertilizer source with rapidly available N starting when plants are about 2 ft tall. Additional nutrient needs should be determined from soil tests but usually consist of about 50 lbs per acre of potash and 75 lbs per acre of phosphate.

Nitrogen deficiency is fairly common in sweet corn, particularly in cold, wet soils; flooded soils; or dry, sandy soils. Nitrogen deficiency in young plants causes the whole plant to be pale with spindly stalks and yellow leaf tips. In older plants, nitrogen stress is often expressed by shriveling of tip kernels.

Phosphorus-deficient plants are usually dark green with reddish-purple leaf tips and margins. At low pH or in sandy soils, magnesium deficiency may occur. Magnesium deficiency in corn appears as yellow to white striping between veins of leaves. Older leaves become reddish-purple and leaf tips may die.

Commonly used organic sources of nitrogen, phosphorous, and potassium are bloodmeal (~15% N), bonemeal (~4% N and 21% P_2O_5), cottonseed meal (7% N, 2.5% P_2O_5, and 1.5% K_2O), and soybean meal (7% N and 2.3% K_2O). Many local growers use poultry litter or commercially available poultry-litter based products. For example, a 3-2-3 or 3-2-2 poultry litter product can be applied before planting at a rate of 700 to 1000 lbs per acre. A blended fertilizer or cottonseed meal/bonemeal mix (10-10-10) can also be used. Natural sources for micronutrients include rock phosphate, greensand marl, and limestone rock. A liquid fish-emulsion and seaweed product (average analysis of 4-1-1) may then be used for sidedressing.

Adding organic matter such as feedlot manure and compost to the soil increases the level of nutrients, improves soil microbial activity, and increases water-holding and nutrient-holding capacity. Organic matter also improves the physical condition of the soil for cultivation and improves soil structure so the surface of the soil does not crust. Any soil can be improved through the addition of organic matter. A vast array of organic materials are available in the Southeast, including manures from poultry and livestock operations, wood by-products from mills, and crop residues from a wide variety of farming operations. Tobacco stalks, which are readily available in much of the state, are approximately 4% N and 4% K_2O. All of these materials may be used fresh or composted. Cover crops are also an important, inexpensive way to add organic matter to the soil, and much of sweet corn's N needs can be met via cover cropping.

Cover Cropping Systems

Most organic sweet corn growers use cover crops to increase organic matter, improve soil tilth, and reduce erosion. In North Carolina, the most popular cover crops used are rye, rye with hairy vetch, crimson clover, and wheat. Legumes, such as hairy vetch, clover, and alfalfa, fix nitrogen from the atmosphere and can supply more than 100 lbs N per acre. To ensure the nitrogen-fixing capabilities of the legume, a grower should inoculate the legumes with the proper bacteria before seeding. A study on legume cover crops for no-till corn, conducted at the Mountain Horticultural Crops Research Station in Fletcher, NC, by Dr. Greg Hoyt, showed that no one specific legume residue was observed to be superior as a cover crop, though hairy vetch consistently survived Western North Carolina winters. Grasses, such as wheat and rye, produce large amounts of biomass and develop long roots which can bring nitrogen up from deep within the soil.

In North Carolina, winter cover cropping is the most commonly used system in both organic and conventional farming. The cover crop is drilled or broadcast-seeded in the early fall. In spring, the cover crop is disked under for a clean culture system.

In most low-till or no-till systems, the cover crop is sown in the fall, killed in the spring, and left on the surface of the soil as a mulch. For an organic grower, the options for killing the cover crop include mowing or undercutting. In a no-till system, the crop is planted through the cover crop. In a low-till system, a narrow strip is cultivated for planting the crop seed or transplant.

Research on sweet corn production in low-till or no-till systems is still in progress in North Carolina. In Connecticut (DeGregorio et al.), however, sweet corn grew well in a no-till system with hairy vetch. Marketable yields were three or more times higher with hairy vetch than with crimson clover or winter peas. Inoculated vetch seeds were planted in early August and flail-mowed to a stubble-height of 6 inches in mid-June. Corn was then planted in 30-inch rows with a conservation planter. For weed control, the vetch strips were mowed again to about 4 inches tall in late July.

Results may be site-or region-specific, however, because, in Oregon, sweet corn growth and yields were reduced 16% with strip-till and 31% with no-till compared to a conventional tillage system (Peterson, et al. 1986). The reductions were attributed to lower soil temperatures, wetter soils, and more slugs found under the reduced tillage systems. Thus, in our region a low-till or no-till system for sweet corn may work best in the lower elevations of the Piedmont and Coastal Plains where soils warm up early in the spring.

Growing a cover crop as a living mulch between rows of corn is an alternative to conventional cultivation and fertilization. A perennial living mulch provides a year-round groundcover which protects against erosion and soil compaction. Growing the corn in narrow rows with wide mulch strips improves access to the corn and facilitates mechanical control of the mulch crop. Even under very wet conditions, with a living mulch in place a grower can still move equipment through the field. A living mulch increases soil nitrogen availability and reduces annual weed populations. Legumes, such as alfalfa, clover, and hairy vetch, add fixed nitrogen and organic matter to the soil. To avoid competition with the corn, a living mulch may need to be suppressed or controlled by mowing or light tilling during the growing season.

Grubinger and Minotti (1990) in New York tested white clover as a living mulch for sweet corn. The clover was broadcast seeded in late April. In early June, a wheel-hoe (a hoe blade on a wheeled frame) was used to open 15-inch strips for sowing the corn. They found the most effective means of clover suppression was partial rototilling with a multivator (multiple-row unit rototiller) when the clover was well established, about 2 weeks after corn emergence. As long as a strip of clover roots passed intact between the tiller tines, regrowth of the clover was extensive providing an effective, yet non-competitive, living mulch. Corn yields were reduced when the clover was mowed rather than tilled. Conversely, in an Oregon study by Fischer and Burrill (1993), mowing the clover did not seriously reduce corn yields. A grower might want to experiment with both methods in this region. An interesting side note from the Oregon study was that when corn smut was present, corn grown with suppressed clover suffered less damage than clean, cultivated corn. Growers should note that a living mulch system for vegetables can be risky if irrigation is not available, because the mulch may out-compete the cash crop for limited soil moisture.

A living mulch system can be difficult to manage during the learning phase. Anyone considering a living-mulch system

should start small. Some problems that may be encountered include increased numbers of rodents and slugs, as well as cooler soils, which may slow germination. According to Burrill et al.(1987), the most predictable and least complex system to start with involves annual seeding of clover after the corn is well established. The clover then has no chance to compete with the corn and makes most of its growth after the corn is harvested. The clover then protects the soil during the winter and grows in the following spring. The clover can then be disked under and another crop planted.

Crop Rotations and Intercropping

Crop rotation is the single most important practice in an organic vegetable production system. Crop rotation is the practice of following one annual crop with another crop that is as different from the first crop as possible in terms of nutrient needs, rooting patterns, disease and insect pests, and growth habit. Many growers have detailed, complicated crop-rotation plans that range from 3 to 7 years before the same crop is replanted on a plot of land. For example, sweet corn may be planted in a 3-year rotation with pumpkins and beans.

Soils deteriorate because of erosion, continuous cropping, deep plowing, and compaction. Rotating fields with soil-improving crops maintains long-term soil fertility. According to Eliot Coleman (1995), a well-thought-out crop rotation is worth 75% of everything else that might be done, including fertilization, tillage, and pest control. Diversity is the key to stability in a biological system.

Intercropping is the practice of planting several crops together in one area. Increasing diversity of crops and reducing the amount of land in a monoculture discourages many pests. To conserve space, sweet corn is often planted at the same time in a field with vine crops, such as cucumbers, pumpkins, and muskmelons. The vines can be trained to grow between the corn plants. In western North Carolina, it is a time-honored tradition for farmers to grow greasy beans in their corn. An alternative to intercropping within the same field is strip-cropping. In this system, two or three different crops are grown in strips, commonly 2 to 6 rows wide.

Variety Selection

Four types of sweet corn are available: standard (su), sugary-enhanced (se), supersweet (sh_2), and synergistic or triplesweet (sy). The su type is the old-fashioned sweet corn with which we are all familiar. It must be consumed quickly after harvest, or the sugars rapidly turn to starch. The se types contain more sugar than the su type and, if cooled, will remain sweet for several days after harvest. The sh_2 type also contains more sugar than the su type but converts very little sugar to starch. If properly cooled, a sh_2 variety will remain sweet for 7 to 10 days after harvest. The sy type is a hybrid comprised of 75% se and 25% sh_2 kernels, resulting in an ear with the sweet and tender characteristics of the se type but with the shelf- life of the sh_2.

Replicated organic sweet corn variety trials have not been conducted in North Carolina. Many North Carolina organic growers, however, prefer the following cultivars. 'Platinum Lady' (se) and 'Bodacious' (se) are good early-season sweet corn varieties. 'Silvarado' (se), 'Kandy Corn' (sh_2), 'Argent' (se), and 'Snowbelle' (se) are excellent mid-season varieties, and 'Delectable' (se), 'Pegasus' (sh_2), and 'Silver Queen'(su) are good late-season white corns. In a crop-rotation study (J.M. Davis, unpublished), 'Silver Queen' exhibited very little earworm damage, probably because of the tight tips on the husks. All of these varieties are among those recommended for all North Carolina commercial vegetable growers.

During the early 1990s, an organic growers network in New Jersey, Connecticut, Massachusetts, and Vermont recommended 'Silver Queen' (su) (because of consumer name recognition and earworm resistance) and 'Snowbelle' (se) as good white corn varieties for organic growers. For an early-season yellow corn, they suggested 'Sugar Buns' (se). 'Bodacious' (se) is a favorite early to mid-season yellow, and 'Clockwork' (se) is an excellent mid-season bicolor in that part of the country. For wholesale shipping of sh_2 varieties, the Northeastern group recommends the varieties 'Aloha', 'Skyline', 'Diablo', 'Starstruck', and 'Escalade'. They caution that results in another location or market might be different. Varieties for the new sy type include 'Renaissance' and 'Nantasket (early season), 'Montauk' and Bojangles' (midseason), and 'Providence', 'Cameo' and 'Charmed' (late season). In addition, improved sweet corn hybrids are being introduced every year, especially se, sh_2, and sy varieties, with improved disease resistance and seed germination.

Please note that you should be careful to avoid Genetically Modified varieties of sweet corn. These varieties are

transgenetic, for example, containing the Bt gene. The use of GMO corn is not approved for organic production.

Planting

Fresh corn seed should always be used, especially for supersweet cultivars. Standard and sugary-enhanced corn seeds should be planted about 1 inch deep in moist, heavy soil; 1 to 2 inches deep in very light, sandy soils. Supersweets need to be planted shallow -only about 1 inch deep. Minimum soil temperatures for germination are 50°F for su varieties and 60°F for se and sh_2 varieties. Seed planted in moist soil below these temperatures will often rot. The optimum, but rarely obtained, soil temperature for sweet-corn germination is 85°F.

When planting small acreages of sweet corn, be sure to plant the corn in blocks of at least 4 rows to insure good pollination. If large acreages of sweet corn are being planted, especially se and sh_2 varieties, purchase of a precision seeder might be cost worthy to reduce seed costs and labor costs for thinning. No-till systems require no-till planters such as those used for field corn. Depending on the cultivation equipment available, seeds are usually planted 5 to 6 inches apart in rows 30 to 42 inches apart. Once the plants are well established, they should be thinned to stand 8 to 12 inches apart in the row.

Because sweet corn is wind pollinated, quality is best if the stands are isolated from field corn, popcorn, and ornamental corn, as well as from other types of sweet corn. Isolation, in this sense, means either planting the crops at least 250 feet apart, or staggering your plantings so that there is a 10 to 14 day difference in maturity between crops. If possible, sweet corn should be planted upwind of field corn.

Successive plantings can be made to provide a continuous supply of sweet corn. A second planting can be made when the first plants contain 3 or 4 leaves. Early and late-season cultivars may be planted at the same time for a longer harvest. Many growers, however, try to time their harvests before August when armyworm and earworm populations are highest.

Weed Control

Weed control is one of the most difficult management problems facing organic vegetable growers. Before planting, weed populations can be reduced through use of crop rotations and cover crops. Try to rotate crops with different growth habits, warm and cool season crops, and crops grown in wide and narrow rows. On small plantings, organic mulches, such as straw or grass clippings, can help shade out weeds between the rows. Growing corn in strip-till, no-till, or living mulch systems can also reduce weed problems.

In a clean-culture system, cultivation is a common and effective method used to control weeds before and after the crop is planted. Prior to planting, till the soil several times to expose weed seeds and stimulate their germination. Conduct the last tillage just before sowing the crop. After the crop has emerged, cultivate frequently, getting as close to the corn plants as possible without damaging the roots. Spring-tooth harrows and finger weeders work especially well for this purpose. When the corn is 12 to 18 inches tall, till for the final time, throwing soil against the base of the plant. Commonly used equipment to cultivate between rows include multi-row rototillers, coil-tine harrows, and rolling cultivators. For small-scale production, a grower may walk the field frequently with a hand-held hoe.

Soil solarization is a relatively new method for weed control that is still being tested. Solarization kills weed seeds, perennial weeds, soil pathogens, and nematodes by heat treating the soil. Solarization requires long-range planning because a field must be solarized the summer prior to planting the corn. The system involves laying clear plastic over tilled, moist soil and sealing around the edges with ridges of soil. The plastic is left in place, usually during mid-summer, for 6 to 8 weeks. After the plastic is removed the soil surface should be disturbed as little as possible to prevent bringing weed seeds to the surface. It is better to plant a fall vegetable crop or winter cover crop than to leave the solarized soil fallow for the winter.

Flame weeding by propane torches is another method used by some farmers. Small, inexpensive, hand-held propane units and large, tractor-mounted units are available. Weeds are best controlled by flame weeding when the weeds are 1 to 2 inches tall or at the 3- to 5-leaf stage. Flame weeding can be used before a cash crop emerges or as a directed flame after the crop is 2 inches tall.

Pest Management

Pest management in an organic system is based on prevention. The goal is to have a healthy, balanced plant

and soil system in which pest populations will ~~be~~ stay within tolerable limits. In a conventional system, synthetic pesticides may help a grower save the current crop from an immediate pest problem; however, in many cases, the problem recurs or another develops. The organic approach is based on the theory that major pest problems usually occur when something is out of balance in the system. Are the plants undernourished or stressed from growing too quickly? Is there a nutrient imbalance? Is the soil too wet or too dry? Has a good crop rotation been followed? Is there a diversity of plants to support beneficial insects? Thus, studying the problem and trying to determine why it occurred should help prevent similar problems in the future. This will, of course, take time to learn and develop. Unless growers refuse to use any pesticides, they may at times choose to apply some organic pesticides to save a specific crop.

An integrated pest management (IPM) approach is well-suited for organic production. IPM is a system in which insects, diseases, and weeds are closely monitored, and different methods are used to keep pest populations at levels that are not economically damaging with minimal adverse environmental effects. IPM encompasses use of cultural and biological control methods, use of resistant varieties, and judicious use of pesticides. When pesticides must be used, an effort is made to select ones with low toxicity, non-persistent residues, narrow spectrum of control, and low environmental impact. There is not enough room here to cover IPM thoroughly. Several good books are available and should be consulted, such as *Vegetable Insect Management* (1995).

There is no guarantee that once an organic system is established, there will never be a disease, weed, or insect problem. Stressful conditions that a grower cannot control will occur, such as weeks of endless rains, droughts, periods of extremely high temperatures, hurricanes, plagues of grasshoppers, or hail. Likewise, if an airborne disease invades your area, your plants will probably be infected. However, with careful observation and preparation, an organic system should progressively have fewer pest problems as years go by.

Disease Management

Although there are several corn diseases of concern in the Southeast, there are many sweet-corn cultivars available with resistance to the major diseases. Whenever possible, a grower should select marketable cultivars with disease resistance to fit specific needs and conditions.

Corn smut, which appears particularly on white cultivars, is characterized by large, fleshy, grey-black galls on the stalks, tassels, or ears. It is important to remove and destroy the first galls before they open. To control smut, avoid injuring plantings and avoid areas where smut occurred before. Root rot frequently occurs on seedlings planted in cool, moist soil. Planting should be delayed until soil temperatures are adequate to allow for rapid germination.

Stewart's bacterial wilt is sometimes a problem in the mid-South. Early-infected plants wilt and die. Later-infected plants are stunted and contain yellow streaks on the leaves. The disease is spread by the corn flea beetle, especially after mild winters. New cultivars resistant to Stewart's wilt should be used if early sweet corn is to be planted where flea beetle populations were high the previous year.

Rust and leaf blights can be a problem in extended periods of warm, moist weather or areas of heavy dew. Rust blown from field corn planted upwind nearby can threaten sweet-corn crops. Cultivars resistant to rust are recommended in threatening conditions.

Insect Management

Insects which attack sweet corn during its early growth include southern corn rootworm, cutworm, white grub, wireworm, and flea beetle.

Wireworms and white grubs are often abundant in soils previously planted in alfalfa or sod. After the soil has been worked, large numbers of birds feeding in the field indicate a high pest problem. To avoid pest damage to the crop, a farmer can delay planting to let exposed worms and grubs starve or be eaten by birds. Another strategy is to till the field and plant it with another legume cover crop, such as crimson clover or Austrian winter peas, for a season before planting a crop susceptible to wireworm or grub damage.

Corn earworms are a major pest on corn. The night-flying, light brown- or buff-colored moth lays eggs on the corn silks. In North Carolina, the moth can emerge as early as late March. These tiny, dome-shaped eggs hatch in 1 to 2 days in warm weather or 10 days in cool weather. The small caterpillars move down the silk into the ear, where they feed on the tip. After 12 to 13 days, the caterpillars leave the ears by boring out the side or crawling out the tip. They burrow 3 to 5 inches into the soil to pupate. After

about 12 more days, they can emerge to start the cycle again. There can be at least three generations per year, and the pupal stage can also overwinter.

Once earworm caterpillars have worked their way inside the ear, they cannot be controlled. Early plantings often are not affected by earworms, but late plantings can be under serious pressure. Low infestations are often handled by simply removing the damaged ear tip of the corn after harvest. Some growers provide a free "de-silking" of the ears at sale, so the consumer never sees the worms.

Earworm adult moths should be monitored by pheromone traps placed near the corn field. In Oklahoma, Kuepper and colleagues (1991) used oils and oil-pesticide blends to control corn earworm on small acreages. They injected oil into the neck of the ear (where the silk emerges from the husk), with a standard oiling can. To be effective, oil must be applied 2 to 3 days past the full-brush stage (when silks are at maximum extension from the eartip). Addition of Bt or pyrethrum is more effective than the oils alone. Be aware that using Bt with oil is difficult, time consuming, and not always effective. Estimates obtained for costs of these methods, however, are competitive with the conventional pesticide methods.

Fall armyworms can also be a major pest in North Carolina. They overwinter further south and migrate north each year. The female moths are about 1.5 inches across the wings with grayish-white hind wings and dark gray forewings with splotches and white spots near the tips. They deposit clumps of up to 150 pinkish-white eggs on the leaves. In warm weather, these eggs hatch in 3 to 4 days. In 2 to 3 weeks, the armyworms are about 1.5 inches long, light tan or green to almost black with yellow and dark stripes running the length of the body. Their distinctive characteristic is an inverted Y on the front of the head. Fall armyworms will feed on just about any plant, but damage is especially severe in late sweet corn and field corn. They will eat all above-ground parts of the plant and are very messy eaters. The best defense is to plant early so that corn matures in mid-August before armyworms peak in the fall.

Pheromone traps have not been very reliable, so blacklight traps are recommended for monitoring armyworms. Traps should be checked daily and both male and female moths counted. Less than 10 moths per night do not indicate an immediate problem. More than 10 moths per night for 3 consecutive nights indicate that moths are laying eggs.

Mature European corn borer larvae overwinter in stalks and ears left in the field. The larvae are .75 to 1 inch long, cream colored with small, round, brown spots on the back. Early in the spring the larvae pupate, and in June adults emerge and lay eggs. The adult female moth is pale yellowish-brown, with wavy bands running across the wings. The males are darker, with olive brown markings on the wings. Both have a wing span of about one inch. The females lay white eggs in masses of five to fifty, usually on leaf undersides. In less than a week, the eggs hatch and the young larvae feed on, but not through, the leaf surface. They move into the whorl and within 2 to 5 days enter the midribs of leaves and continue boring into the stalk or ear. The stalks become weakened and may fall over. Nutrient movement in the corn plant is also disrupted. European corn borers usually have two generations per year.

Corn is vulnerable to corn borers when tassels, silk, and pollen are present; preventative action is required or damage will occur. The size of any year's European corn borer population is greatly dependent upon the synchrony of the pest population and the development stage of field corn in the region. If field corn is planted early and provides the first generation moths with plenty of corn to lay their eggs on, large populations will probably be available to attack sweet corn later. Field corn planted nearby is the source of most European corn borer problems for sweet corn.

In most cases, a grower should plow under corn debris at the end of the season to help destroy overwintering stages of some pests. Tilling, however, will also destroy many beneficial insects.

Growers in North Carolina are experimenting with beneficial insects, although to date there are few true success stories. Trichogramma wasps may provide some control of European corn borers, beneficial nematodes sprayed on the corn plant and silk may reduce earworm damage, and ladybugs will help control aphid populations.

Bird Management

Young corn seedlings are vulnerable to bird damage. A large flock of crows can quickly devastate a new corn planting. There are several methods to reduce bird

problems. The most common, inexpensive, and easy methods are designed to frighten birds away. A method that is sometimes effective in western North Carolina is a bird-scare balloon with shiny, mylar "eyes," or inflatable owls. These should be suspended about 5 ft above the ground and moved every few days. Reflective bird tape that is silver on one side and red on the other can be twisted and suspended about 6 inches above the newly seeded rows. A field full of this shiny tape will disorient bird and grower alike. Noise making cannons are used by some large producers, but will not make you popular if you have neighbors close by.

Irrigation and General Cultural Practices

Sweet corn needs a continuous supply of moisture to ensure pollination and growth of kernels in the ear. After the tassels are produced, sweet corn requires 1 to 1.5 inches of water each week. Overhead irrigation is the most common method. Small-scale growers may use soaker hoses laid on the soil surface and covered with an organic mulch. Whatever method is used, a grower should never allow the soil to dry out. It takes consistent, adequate moisture from silking through kernel fill to ensure high yields of high quality ears.

Common recommendations are that suckers should not be removed from the base of the corn plant. It has been reported in many vegetable production publications that their removal does not increase yield or ear size and that removal may actually reduce yield and consume valuable time. Reports from both Clemson University (2002) and Colorado State University (2004) support this recommendation. Many growers who feel that sucker removal is beneficial still continue this practice.

Harvest and Post-harvest Handling

Each sweet-corn plant will produce at least one large ear that should be harvested at prime maturity, when the silks are dry and brown and the ear has enlarged to the point that the husks are tight. This stage is usually 17 to 18 days after silking under warm day and night conditions, or 22 to 24 days after silking during cool weather conditions. At harvest, kernels should be plump and exude a milky liquid when punctured (except for most supersweets with the sh_2 gene where the liquid is clear). This stage only lasts 4 to 5 days, so the corn must be checked and harvested frequently. Sweet corn is removed from the plant by simultaneously snapping and twisting the ear away from the stalk.

To retain peak quality, sweet corn should be picked in the early morning and cooled immediately to 32°F preferably, or at least 40°F. The longer the delay between harvest and cooling, the more conversion of sugar to starch and subsequent loss of quality. Prompt cooling is critical for standard varieties, but also helps maintain quality in supersweets and sugary-enhanced varieties. Hydrocooling involves immersing the corn in cold water, or less commonly, drenching with ice-cold water. Crushed ice can be added to the crate or box. Corn must be stored close to 32°F, with high relative humidity, and transported with ice in a refrigerated truck.

Mesh cabbage bags are frequently used to package corn for local sales. For marketing to wholesalers and supermarket chains, corn must be properly cooled and packaged. For sales to chain stores, corn is usually packaged in wirebound wooden crates or waxed cartons which hold 4 to 6 dozen ears.

Yields, Marketing, and Economics of Production

With a final plant population of 12,400 plants per acre and an average yield of one ear per plant, total yield will be 248 crates per acre. In western North Carolina in 2004, direct sales of organic sweet corn brought around $0.50 per ear. This translates to a gross return of $6,200 per acre. In western North Carolina, where most organic farm acreages are small, this is low compared to gross returns for many other organic vegetable crops. However, many growers who sell directly to the consumer at farmers' markets, tailgate markets, roadside stands, or have a CSA (Community Supported Agriculture) subscription farm, report that their customers expect sweet corn and that sweet corn is necessary for sales of other produce. In contrast, in the Piedmont of North Carolina, growers with larger acreages report that sweet corn is a profitable part of the vegetable mix that they grow.

Near urban areas, fresh, organic sweet corn is usually sold directly to the consumer at tailgate and farmers markets. Wholesalers of organic produce, however, report a need for more locally grown organic sweet corn.

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