CROP PROFILE FOR SWEET CORN IN VIRGINIA

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GENERAL PRODUCTION FACTS

- Virginia ranked 21st out of 26 sweet corn-producing states in the nation based on 2009 production. Virginia produced 0.36% of the total fresh market sweet corn grown in the United States. Within the state, sweet corn ranked 15th among other crops based on the value of production and cash receipts.
- The 2012 Census of Agriculture indicated that 2,869 acres of sweet corn were grown on 587 farms. Fifty-six farms produced 72 acres of corn for processing while 554 farms harvested 2,797 acres of fresh market corn.
- In 2013, Virginia growers planted 3,000 acres of corn destined for the fresh market. Of those acres planted, 2,800 acres were harvested with a total yield of 305,000 cwt. (109 cwt. per acre).
- The total value of fresh market corn produced in 2013 was $8,235,000 with a price per unit rate of $27 per cwt.

PRODUCTION REGIONS

Sweet corn is typically planted between April 1 and May 15 and harvested from June 15 through September 1, with most of the harvesting done between early July and the beginning of August.

Although sweet corn is grown throughout the state, production tends to be greater in the counties of Augusta, Carroll, Charlotte, Halifax, Hanover, King George, and Rockingham; the City of Virginia Beach; and in the Northern Neck region.

CULTURAL PRACTICES

Sweet corn comes in many varieties for both fresh market and processing and in multiple colors, including white, yellow, and bicolor. Supersweet (also called extra sweet) breeds are able to convert sugar into starch at a slower rate than standard breeds. This allows flavor to be maintained for a longer period.

All processing varieties are yellow and include supersweet breeds, such as *Protégé*, *SS Jubilee Plus*, *Overland*, *GSS 2259P*, and *GSS 1453*, as well as standard varieties, such as *GH 6462* and *GH 9597*. All are resistant to common rust (*Puccinia sorghi*) and have variable resistance to diseases including northern corn leaf blight (*Exserohilum turcicum*), Stewart's bacterial wilt (*Pantoea stewartii*), maize dwarf mosaic virus (MDMV), and southern corn leaf blight (*Bipolaris maydis*).

Fresh market sweet corn varieties include yellow, white, and bicolor breeds. Yellow varieties include *Vision*, *GSS 0966*, *Summer Sweet 7210R*, and *Incredible*. White varieties include *Mirai 421W*, *Xtra-Tender 372A*, *Frosty*, *Sugar Pearl*, *Sweet Ice*, *Whiteout*, *Edelweiss*, *Ice Queen*, *Xtra-Tender 378A*, *Munition*, *Mattapoisett*, *WSS 0987*, *Avalon*, *Devotion*, *Silver King*, *Argent*, and *Celestial*. Bicolor varieties include *Xtra-Tender 272A*, *Temptation*, *Temptation II*, *Mirai 366BC*, *Sweet Rhythm*, *Awesome*, *Xtra-Tender 2074*, *Marquette*, *BSS 0977*, *Summer Sweet HiGlow 7932 MR*, *Xtra-Tender 278A*, *Montauk*, *Obsession*, *Obsession II*, *Summer Sweet 7902R*, *Sensor*, *BC 0805*, *Providence*, *Serendipity*, *Delectable*, and *Journey*. Many of these varieties also have resistance or partial resistance to the common diseases mentioned above. For more information on varieties, please refer to the Commercial Vegetable Production Recommendations: Virginia (http://pubs.ext.vt.edu/456/456-420/456-420-pdf.pdf).

Sweet corn grows best in deep, well-drained, loamy soil with a target pH of 6.5. Lime should be applied when the pH falls below 6.0. The most critical periods for rain or irrigation are during silking, tasseling, and ear development. If water is scarce during silking, there may be poor kernel development.

Corn sweetness is determined by the tassel and silk parent variety, while corn tenderness is derived solely from the silk parent. It is important to space out varieties in space and time (at least 500 ft. apart with silking dates at least 12 days apart) to avoid wind-blown cross-pollination by other corn types. Fungicide-treated seed may be sown as early as the last week of March. Late plantings can be made as late as early July. Corn is planted at a rate of 12 to 15 lbs. per acre at a depth of 1 inch. Smaller-eared varieties should be planted in rows spaced 36 inches apart with 8 to 10 inches between plants within the row. Two-eared or larger-eared varieties require 10 to 12 inches between plants in the row. Adequate moisture is critical to ear development, and irrigation lines are laid soon after planting is completed.

A pre-sidedress soil nitrogen test can be used to determine the need for additional nitrogen applications. The test is effective for corn grown on loamy, highly organic soil or

where manure has been applied. Sandy soils with low organic matter are known to have low nitrogen availability without the need for a test. It is important to note, however, that lodging (plants falling over) may occur if nitrogen is excessive.

Clear plastic mulch can be used to improve stands, retain moisture, and heat up the soil, thus producing earlier maturity. Planting can be done 10 to 20 days earlier. Seeds are sown in double rows 14 inches apart and on 5- to 6-ft. centers. Ridges between double rows or wire hoops are used to allow space for the corn seedlings. Thirty days after emergence, the plastic is cut away to allow for normal growth. If using this method, it is important to test for nematodes and treat if necessary. Sweet corn can also be grown through black plastic or infrared transmitting mulch using plastic mulch containers in early plantings.

Plant tissue testing may be conducted by sampling the most recently matured leaf from a growing tip. For corn, this is just above the attachment point to the stalk. Diseased or insect-infested leaves should be avoided. Samples should be collected from random locations throughout the field during the day when plants are actively growing. The total sample should include 25 to 100 leaves.

Harvesting may be done mechanically or by hand, preferably in the early morning hours before field heat intensifies. If done mechanically, all corn is removed at the same time. During the summer, sweet corn is in prime condition for only one or two days; thus, harvesting at the proper stage of development is critical. Sweet corn reaches maturity 17 to 24 days after silking, and ears should be picked daily. If ears are not picked and eaten immediately, the kernels lose their flavor and grow tough as the sugars convert to starch. Extra tender varieties maintain their quality longer, while supersweet varieties remain sweet longer than other varieties.

Harvesting by hand allows corn to achieve peak ripeness for sale. When picked by hand, corn should be grasped near the base and sharply twisted down as the wrist is rotated. Picked corn is then piled on a wagon in the field or put in baskets or bins to be graded and packed. Sweet corn destined for shipping is packaged in wire-bound crates or perforated wax boxes. Burlap bags may be used for local shipping.

Due to its fragility, sweet corn should be cooled down immediately after harvest and kept close to 32°F to maintain freshness. Corn that is marketed locally is often picked and sold the same day. If being shipped long distances, corn should be hydrocooled or packed on ice. Hydrocooling involves immersing the corn in ice water, although smaller growers may be able to get away with adding ice to the crates before shipping. This should be done with 1 lb. of ice for every 5 lbs. of sweet corn. Ice can also be blown on top of crates once in a cooler or refrigerated truck. If not precooled, refrigerated corn will not retain freshness nearly as long as hydrocooled or iced corn.

Sweet corn growers using pesticides during the flowering stage that are labeled as being toxic to bees must notify beekeepers within a 3-mile range of the site at least 24

hours before application. The notice (phone call, regular mail, or certified mail) must include the approximate date and time of application, the target site, brand name, pesticide active ingredient, and name and registration number of the certified pesticide applicator.

WORKER ACTIVITIES

Before planting, fields are typically disked by a grower driving an enclosed cab tractor in order to prepare for seeding. Likewise, corn seed is planted mechanically using a tractor. Fertilizer is usually applied at the same time. Irrigation lines are placed soon after planting. Cultivation and additional fertilizer applications may be accomplished using an enclosed cab tractor. Scouting for diseases and pests is done weekly, at minimum. If necessary, pesticide applications may be made by ground or by air, depending on the number of acres planted. Normally, the only time when agricultural workers could be directly exposed to treated corn is if plant tissue samples are taken or during harvest, when corn is removed by hand. If the corn is harvested mechanically, there is virtually no exposure risk to workers. If harvesting by hand, field workers typically wear long-sleeved shirts, long pants, and gloves to prevent injury.

ARTHROPOD PESTS

INSECTS

Corn Earworm, *Helicoverpa zea*

The corn earworm (CEW) will consume hundreds of different plants but prefers and is a serious pest of corn. Other hosts include field crops and vegetables. Adult moths are nocturnal, tan, and have a 1-1/2-inch wingspan. They are active in the summer and early fall. Females lay greenish yellow eggs on fresh corn silk, buds, and the growing corn tips. Corn earworm caterpillars first eat silk but will later move to the ears, where they consume kernels. They also feed on shoots, leaves, and tassels. They will also occasionally become cannibalistic. Only one or two caterpillars are typically found per ear. Mature caterpillars are 1 inch long and may be brown, green, or tan with both light and dark stripes. The head capsule is brownish orange, and the ventral side is lighter than the dorsal side. Caterpillars pupate in the soil beneath corn plants and overwinter in the pupal stage. However, the pupae usually do not survive unless there is a mild winter. New moths will fly in from the South to reinfest the field. The most damaging generations occur in mid-July.

MONITORING: Black light and pheromone traps may be used to monitor flight. If more than 20 moths are caught per night, treatment should be considered. Applications are made when early silking begins.
CHEMICAL CONTROL: See the *Chemical Arthropod Control* section for more information.

BIOLOGICAL/ORGANIC CONTROL: Numerous natural enemies have been identified, but none are currently effective at controlling CEW or preventing crop damage. However, genetically modified *Bt* corn is less susceptible to CEW injury. Mineral oil may be applied to the silks three to seven days after silks appear to control CEW.
CULTURAL CONTROL: Growers should plant resistant varieties when possible, such as *BSS 0977*, *BC 0805*, *GSS 0966*, *Temptation II*, *Obsession II*, and *WSS 0987*. Varieties harvested before mid-July will usually escape significant damage.

Corn Flea Beetles, *Chaetocnema pulicaria*

There are many species of corn flea beetles. The adults are black, brown, or striped and are about 1/16 inch long. They are very active and will hop away when disturbed. Although generalists, they consume mostly grasses. Adults damage the leaves, creating round holes and bleached-out spots or stripes, while larvae are root feeders. Feeding damage is not the main problem, however—these beetles are more concerning because they transmit bacterial wilt (Stewart's bacterial wilt). Flea beetles are most troublesome when mild winters are followed by cold springs. Small corn plants (< 6 inches tall), early-maturing varieties, and stressed plants are most likely to be severely affected by flea beetle feeding. Infested plants may exhibit retarded growth, small ears, wilted leaves, greatly reduced yield, or plant death. Flea beetle adults overwinter in weeds, litter, and trash around fields.

MONITORING: Flea beetle monitoring involves selecting 20 plants from each of five areas within the field. Growers should examine both the upper and lower leaf surfaces while looking for beetles and damage. Growers should note the number of injured plants and the severity of the damage in order to calculate the percentage of infested plants. Susceptible plants should be treated during the spike stage when 5% of plants are infested. Monitoring is only necessary up to and including the V4 stage because once plants reach the V5 stage, they are no longer vulnerable to flea beetle feeding damage.
CHEMICAL CONTROL: Treated seed provides early-season protection from flea beetle damage. See the *Chemical Arthropod Control* section for more information. Growers should be especially cautious if applying carbaryl to the tassel of corn plants during the pollen-shedding period to prevent widespread bee death.
BIOLOGICAL/ORGANIC CONTROL: Diatomaceous earth and/or rotenone are sometimes used for serious flea beetle infestations.
CULTURAL CONTROL: Growers should control weeds and plow under crop residue in the fall to keep beetles from overwintering. Growers can also plant corn late and use wilt-resistant hybrids to reduce loss from Stewart's bacterial wilt.

Corn Leaf Aphid, *Rhopalosiphum maidis*

Corn leaf aphids (CLA) are small, dark bluish gray, pear-shaped insects with a pair of tailpipe-like cornicles on the ends of their abdomens. Corn leaf aphids prefer barley, sorghum, and corn but will also infest other field crops and grasses. Feeding results in mottled, discolored leaves and stunted, deformed tassels. If the infestation is heavy, the

leaves may turn yellowish red, shrivel, and die. Damage is most serious when plants are flowering. The population peaks soon after tassel formation. Aphids will also feed on corn tassels and silks. Further damage is caused by the presence of black mold that grows on honeydew exuded by the aphids. When tassels and silks are covered by honeydew, pollination, photosynthesis, and grain development may all be impacted. Additionally, female CEW moths are thought to be attracted to and lay their eggs on honeydew-covered corn. Corn leaf aphids are vectors of MDMV and other viruses. Some corn varieties are more susceptible to MDMV than others.

MONITORING: To sample, growers should examine all plants in a linear foot of row in at least five locations and estimate the number of aphids per row foot. The field should also be examined for the presence of small yellowing patches of stunted plants. When sampling for aphids, growers should be careful not to take samples from the field edges where populations are usually highest. The side of a field that is downwind of a tree line often has more aphids than other parts of the field. Fall insecticide applications are generally needed only when average populations approach 15 to 25 aphids per row foot.

CHEMICAL CONTROL: Aphids rarely reach damaging levels, and pesticide treatments may actually worsen aphid problems by inadvertently eradicating natural enemies. See the *Chemical Arthropod Control* section for more information.

BIOLOGICAL/ORGANIC CONTROL: There are a number of aphid predators and parasites that, if left unharmed, can effectively keep aphid populations below economic thresholds. Among the most common are lady beetles (adults and larvae), syrphid fly (hover fly) larvae, common lacewing larvae, and various small parasitic wasps. Oil and soap sprays may also be used to control aphids.

CULTURAL CONTROL: Early planting and cultural practices designed to hasten development can prevent late-season aphid problems. Johnsongrass is a reservoir for MDMV, so weed control may help prevent the spread of disease.

European Corn Borer, *Ostrinia nubilalis*

European corn borer (ECB) is a major pest of corn grown in Virginia. This moth is found throughout the commonwealth, but its population density fluctuates from year to year in any given locality. There are three to four generations per year in Virginia. Weather is known to impact ECB survival. Heavy rains and strong winds harm or kill borer adults. Additionally, eggs are vulnerable to both drought and excessive moisture. Corn borer larvae initially feed in the whorl and the tassel but later burrow into the stalk and the ear. When infested with ECB, corn plants show reduced vigor, which leads to eardrop and stalk lodging. Although one or two ECBs in the stalk will not affect yield and lodging is not as great a concern in sweet corn, infestation of the ear is ruinous to the crop. Corn borer infestation also makes the corn plant more vulnerable to fungal or bacterial infection.

European corn borer eggs are flat, white, and scalelike. Mature ECB larvae are ¾ inch to 1 inch in length and creamy white to pink. The larval head capsule is dark brown, and

there are several small dark brown or black spots on top of each abdominal segment. Pupae are torpedo-shaped, vary from ½ inch to ¾ inch in length, and may be reddish brown or dark brown. The adult moth has a wingspan of about 1 inch, with the female being slightly larger than the male. The wings are dusky yellow and bear transverse, irregular, olive-green bands.

European corn borers overwinter as larvae in old corn stalks or in weeds. Pupation takes place in spring, and first-generation adults usually emerge anytime between mid-May and early June. Adult female moths will lay eggs on the most developed corn stalks, as well as many other kinds of crops. The second generation tends to create the most damage, with larvae hatching from late June to early July.

MONITORING: Moth monitoring can be conducted by using black light or pheromone traps. To assess the potential for economic damage, growers should begin checking for egg masses when second-generation moths emerge and begin laying eggs. The presence of ECB moths in areas bordering a field may also indicate a likely infestation.
CHEMICAL CONTROL: Treatment should begin when 50% of plants show tiny pinholes in leaves. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Commercially available controls include *Trichogramma* (parasitic) wasps and the bacterium *Bacillus thuringiensis* (*Bt*), which have proven moderately effective in controlling ECB. Corn borers also have several natural enemies, including flower bugs, green lacewings, and lady beetles. Birds such as woodpeckers and flickers prey on overwintering larvae. The fungal organisms *Beauveria bassiana* and *Metarhizium anisopliae* are known to attack ECB. Corn borers are also vulnerable to infection by the microsporidian *Nosema pyrausta*.
CULTURAL CONTROL: The best cultural control method is planting resistant corn varieties, such as *BSS 0977*, *BC 0805*, *GSS 0966*, *Temptation II*, *Obsession II,* and *WSS 0987*. Spring plowing may also help by interring the previous season's corn stalks and weed residues. Planting time is also important. Corn that has been planted very early can serve as an unintended "trap crop" for newly emerged first-generation moths, resulting in heavy infestations and greater subsequent damage. Similarly, late-planted corn can be subject to greater ECB damage because younger plants are less able to withstand the higher population pressure of the second generation.

Fall Armyworm, *Spodoptera frugiperda*

Fall armyworms (FAW) do not overwinter in states as far north as Virginia but instead move in from warmer regions in the South in late summer. Their populations are greatest in the fall, especially when the season is cool and damp. Adult moths are light brown or gray with a 1-1/2-inch wingspan and are nocturnal. Females lay eggs in cottony ovisacs, each containing up to several hundred eggs. Fall armyworm larvae vary in color from light tan or green to dark brown (nearly black) with three yellowish white lines down the sides and back from head to tail and four dark circular spots on the upper portion of each abdominal segment. The front of the head is marked with a

prominent inverted white “Y,” but this characteristic is not always a reliable identifier. Caterpillars cause damage by chewing holes in foliage.

MONITORING: Adults may be monitored using black-light traps, though pheromone traps are more effective. Catches of 10 to 20 FAW moths per night indicate that treatment is necessary. If moths are found, growers should also look for egg masses in order to determine the proportion of crop affected. A survey of 20 plants in five locations or 10 plants in 10 locations is generally considered to be adequate to assess the proportion of plants infested.
CHEMICAL CONTROL: Thresholds for treatment applications depend on plant age. Seedlings and plants pushing tassel are more vulnerable than plants in other stages and may be treated at lower infestation rates. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: No commercial controls are currently recommended. Parasitoids and natural enemies of FAW include wasps and flies. Birds are also natural enemies, but they themselves are pests of corn.
CULTURAL CONTROL: Since FAW does not overwinter in Virginia, there are few cultural control methods to interrupt their life cycle. Fall armyworm-resistant varieties include *Temptation II* and *Obsession II*. Early planting of corn may offer some protection from FAW.

Grasshoppers, Order Orthoptera

Grasshoppers will eat any available vegetation and can be devastating when they occur in large numbers. Grasshoppers can grow up to 2 inches long. Adults and nymphs look the same with long bodies and strong back legs. They can be brown, gray, black, or yellow. Female grasshoppers lay eggs in grassy areas toward the end of summer. Nymphs emerge from these overwintering eggs in early summer and will feed on young plants. As the grasshopper nymphs mature, they migrate to other areas, including cropland, and will consume a large variety of plants. Nymphs mature into adults in about one and a half to two months. Adults continue feeding until killed by cold temperatures.

MONITORING: Growers should scout for grasshoppers in any surrounding untilled grassy areas using the square-foot method. The monitor should randomly select a 1-square-foot area that is several feet away. While watching the chosen site closely, the monitor approaches on foot and counts the number of grasshoppers within or jumping out of the area. A total of 18 samples are made at randomly chosen sites. The total grasshopper count is then divided by 2. This yields the number of grasshoppers per square yard. Within fields, grasshopper densities tend to be lower so the sampling method is a little different. Grasshopper counts are made in 18 different, randomly selected square-yard-sized areas. Numbers are averaged to determine the approximate density per square yard. Control may be warranted if grasshopper densities within the fields are eight to 14 per square yard or greater, or if 20 to 40 grasshoppers or more are found in the field borders.

CHEMICAL CONTROL: Grasshoppers are easier to control when they are still immature. Border treatments are often made at field edges to protect crops, but it is difficult to find chemicals that are labeled for use on both crops and noncrop areas. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Natural enemies include birds (e.g., crows, catbirds, bluebirds, mockingbirds, and sparrows) and spiders.
CULTURAL CONTROL: Growers should avoid planting crops next to hayfields and ditch banks that tend to harbor high grasshopper populations. Crop debris should be removed, and the soil can be turned to help expose grasshopper eggs to predators and the weather. Small-scale farmers can protect seedlings by covering the plants with netting or cheesecloth.

Sap Beetles, *Carpophilus spp.*

Corn sap beetle adults are rarely a problem in sweet corn. The larval stage causes the most harm by damaging the kernels after the husk is loosened. The small (3/16-inch) beetle is black with clubbed antennae. The white larvae have a brown head capsule and are up to ¼ inch long. They are photophobic and will scatter when exposed to light. Adults overwinter under logs or near dead trees and reemerge in spring. Adult beetles feed on tassels and fallen pollen grains. Female beetles are attracted to and lay eggs on or near decomposing plant material, such as corn ears or other debris. Sap beetles prefer to lay eggs where corn earworm infestations occur. Larvae feed on decaying vegetation and later pupate in the soil.

MONITORING: Growers should begin sampling during pollen shed by inspecting 20 plants at five different locations on a weekly basis. Treatment is necessary when 5% of ears contain adults and/or eggs.
CHEMICAL CONTROL: Corn earworm control methods also help manage this pest. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: No commercial controls are currently recommended. Natural enemies include nematodes and parasitic wasps.
CULTURAL CONTROL: Corn varieties with long, tight husks are resistant to corn sap beetles. Varieties with long, tight silk tubes demonstrate 50% less damage than looser breeds. Growers should clean up plant refuse after harvest to destroy potential pest overwintering sites. Sweet corn should be harvested immediately upon ripening.

Seedcorn Maggot, *Delia platura*

Corn seedlings will fail to emerge due to seedcorn maggots boring into kernels and killing the germ. Adult flies emerge in April, and the females lay their eggs in the soil or at the base of stems. Once the eggs hatch, the 1/3-inch-long maggots move down to feed on the roots for three to four weeks. After pupating for a week, adults emerge. The first generation is most damaging. Flies prefer to lay eggs in recently tilled soil high in moisture and organic matter, especially where animal manure has been spread. Overwintering pupae emerge as adults the following spring. Flies may be observed in

early spring on sunny days flying around or resting near fields. They are small (1/4 inch) and resemble house flies. Damage is worse in wet, cold seasons and in fields with lots of organic matter in the soil.

MONITORING: There is no particular monitoring protocol for seedcorn maggots. Therefore, preventive chemical controls are typically used.
CHEMICAL CONTROL: Planting insecticide-treated seed or using granular insecticides at planting gives the most effective control. Post-planting rescue treatments are not effective. Treatment is particularly warranted in fields with a history of seedcorn maggot infestations or when a cool, wet spring is predicted. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Ground beetles and other predators may provide some degree of control, but serious damage can still occur if postplanting weather conditions are cool and wet. If infected with a certain type of fungus (*Entomophthora* spp.), flies may become "zombies" whereupon they climb to the top of a high branch of a dogwood tree or crape myrtle and die. Reproductive fungal spores are then released from the fly's body.
CULTURAL CONTROL: Growers may avoid injury to their crop by planting late to allow quick germination of seed. If damage occurs or seedlings fail to sprout, replanting may be necessary.

Stalk Borer, *Papaipema nebris*

Young stalk borer larvae are creamy white with a dark purple band around the body and several brown or purple stripes running lengthwise down the body. Mature larvae are creamy white to light purple but lack the band and stripes. The stalk borer can grow up to 1-1/4 inches long when mature. Stalk borers are typically found in border rows of conventionally planted corn and no-till planting systems. These insects bore into almost any large-stemmed plant, including – but not limited to – corn, potato, tomato, cotton, pepper, and alfalfa. Larvae either enter the plant at the base and tunnel upward or enter from the top, where they consume buds and rolled leaves. Once corn is past the whorl stage, plants are relatively immune to stalk borer attacks and are better able to overcome damage. Stalk borer eggs overwinter on weeds. Larvae emerge in spring and mine leaves or bore into grass stems. They either kill or outgrow their primary host and will emerge at night to move to their secondary host, where they complete larval development in midsummer. In July, they drop to the soil to pupate. Adult moths emerge in late summer and lay the eggs of the next generation.

MONITORING: Signs of infestation include destroyed tassels, sucker (side shoot) production, deformation of the upper plant, and stem breakage. Frass (insect feces) may be observed at the base of the plant. If monitoring indicates one in three plants appears to be infected, spot treatment should be considered.
CHEMICAL CONTROL: Chemical controls are only effective when applied preventively because larvae are protected once inside the plant. No chemical controls are currently recommended.

BIOLOGICAL/ORGANIC CONTROL: No commercial biological or organic controls are currently recommended.
CULTURAL CONTROL: To prevent borer problems, growers should practice good sanitation by removing and destroying weeds in fields and along fencerows to eliminate the primary plant host. If a plant is already infected, the borer may be punctured to save the plant. Borers can be located by splitting the stems lengthwise above the tunnel opening. The split stem should be bound and the plant watered. Corn plant debris should be destroyed after harvest.

Japanese Beetle, *Popillia japonica*

Japanese beetle adults are 1/3 to ½ inch long and are metallic green with copper wing covers. The larvae (grubs) have off-white or gray bodies with orange-brown head capsules. The larvae feed on germinating plants and developing roots, overwinter in the soil, and emerge as adults from June to July. After mating, female beetles lay eggs in July and August within burrows in the soil. Larvae overwinter and resume feeding in the spring. The adult beetles feed on and clip corn silks, thus inhibiting pollination. Adults survive until September. Drought conditions in late summer will reduce the beetle population the following year.

MONITORING: To determine the presence of grubs, growers can use baited wire traps or direct soil sampling before planting. Growers can check for the presence of adults in the corn ears or determine the percentage of plants with silk clipping.
CHEMICAL CONTROL: See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Nematodes and milky spore disease are two biological control options. Milky spore disease is not always effective, but *Heterorhabditis* nematodes typically provide very good control of white grubs when administered in August. Pheromone traps are another option, although they may unintentionally draw in beetles from outside the treatment area.
CULTURAL CONTROL: Growers can plant corn late to prevent grub damage or plant corn early to prevent adult damage. Crops can also be covered with loose netting to avoid beetle damage.

Lesser Cornstalk Borer, *Elasmopalpus lignosellus*

The lesser cornstalk borer (LCB) prefers corn but may feed on many other crops, including beans, peanuts, weeds, and grains. It is most damaging in the southern states. Larvae cause the most damage by boring into the plant stalk and interfering with growth. Damage caused by LCB may be minor or fatal to the plant, although it is most injurious during droughts in plants grown on sandy soil. Lesser cornstalk borers overwinter as larvae or pupae and emerge as adult moths in early spring. Adult female moths are small (1/2 to 5/8 inch long) and grayish or reddish brown. Males are yellowish brown. The females lay green eggs on the leaves and/or stems of host plants. Eggs turn pinkish red and hatch one week later. The larvae feed on leaves or roots, later building

silk tubes underground, where they bore into plants at the soil line. They pupate in the soil and emerge as adults four to six weeks later.

MONITORING: Pheromone and black light traps are used to monitor adults.
CHEMICAL CONTROL: When planting in fields with a history of LCB infestation, preventive treatments that occur at planting are more effective than applying chemicals once damage appears. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Natural enemies likely do not significantly affect lesser cornstalk borers due to the latter's protective feeding tubes and underground lifestyle.
CULTURAL CONTROL: Growers seeking to control LCB should destroy weeds along fencerows and practice no-tillage cropping if possible or, if using a conventional cropping system, plow in late fall to kill overwintering stages. It may also help to avoid planting corn immediately following corn, sorghum, small grains, sugar cane, beans, or peanuts. Growers should also refrain from planting corn too quickly in recently turned weedy fields.

Southern Corn Rootworm, *Diabrotica undecimpunctata*

Also known as the spotted cucumber beetle, the southern corn rootworm (SCR) is a generalist in diet, feeding on cucurbits, melons, peanuts, and corn. These beetles cause the most significant damage on corn and peanuts. Mature larvae are yellowish white, wrinkly, and a little over ½ inch long. Adult beetles are about ¼ inch long with a bright yellowish green body. The head, legs, and antennae are black, and twelve black spots are present on the elytra.

The SCR prefers moist soil and is most injurious to corn during cold, wet springs. Corn is most likely to be injured if it is under no-till culture, in a continuous rotation, or following turned-under winter legumes. In the spring, larvae chew round holes through the growing points, killing the terminal blades. Stands may be reduced 50% to 90% or more. Extensive root feeding may occur late in the season. Plants with severe root damage lodge during wind- and rainstorms, often causing the stalks to "goose neck," which makes harvest more difficult. In addition to direct injury, rootworms vector bacterial wilt disease and create wounds that allow the entry of rot-causing organisms. The adults feed on aboveground plant parts but cause the most damage by eating unpollinated silks, which results in sparsely filled ears.

MONITORING: Growers should sample cornfields with suspected insecticide failures or fields in which a high adult rootworm population was observed during the previous summer.
CHEMICAL CONTROL: Applications of soil insecticide during egg hatch is effective for SCR larval control. Caterpillar-targeting chemicals applied at silking will help control SCR adults. See the *Chemical Arthropod Control* section for more information.

BIOLOGICAL/ORGANIC CONTROL: No commercially available controls are currently recommended.
CULTURAL CONTROL: For larval control, crop rotation is most effective. Corn should not be planted in the same exact spot where corn or cucurbit crops were just grown. Early plowing and/or disking at least 30 days before planting corn removes vegetation and discourages further oviposition. Other options to improve production include planting corn early and using near-maximum seeding rates.

Stink Bugs, Pentatomidae family

Various species of stink bugs, including the notorious brown marmorated stink bug, may attack and damage sweet corn causing kernel loss and deformed cobs. Stink bugs resemble shields and come in many colors ranging from green to brown to red and black. Not all stink bug species are pests and some actually prey on economically harmful insects.

MONITORING: Scouting is critical to identifying damage before it becomes too serious. Monitoring should begin early and be repeated regularly. Stink bug feeding on stalks is indicated by brown spots. Sometimes a white stylet sheath is present in the center of the feeding spot. Detection tools include beat-sheets, black light traps, and pheromone traps.
CHEMICAL CONTROL: Many common insecticides will control stink bugs, so growers using caterpillar-targeting pesticides will likely not have stink bug issues. However, Bt corn is not protected from stink bugs and chemical applications may be necessary. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Stink bugs have many natural enemies, including parasitoids, flies, and predators (e.g., insects, spiders, and birds). Organic options include kaolin clay, neem oil, and others.
CULTURAL CONTROL: Cultural control methods include trap cropping (e.g., planting preferred host plants near cash crops in order to lure in and destroy pests), controlling weeds, and removing wild fruit trees adjacent to planted fields.

Wireworms, Family Elateridae

Wireworms are the larval form of click beetles. They are pests of many different crops and are notoriously damaging, widespread, and difficult to control. Female beetles prefer to lay their eggs on grasses in June and July. Weedy fields, turf areas, and fields with cover crops are attractive oviposition sites. After hatching, larvae feed on roots. Larvae are reddish brown and ½ to 1 inch long. There can be up to seven to 10 larval stages per year in Virginia. Wireworms overwinter in the larval stage. Spring-planted sweet corn is subject to feeding by larvae, causing failed germination or stunted, sickly plants. Wireworms may attack corn kernels or roots of established plants, depending on the species of the pest. Damage is variable from year to year. Mature larvae pupate in the soil in May and adults emerge in early summer. They take refuge in the terminal buds of weeds and crops or in the whorls of young corn.

MONITORING: No specific monitoring protocol is recommended in Virginia due to post-planting treatments being largely ineffective. However, if desired, growers can monitor for wireworms when fields are plowed or disked. Wireworms are attracted to germinating seeds so baits consisting of a 1:1 ratio of untreated wheat to corn seed may be used. A handful of bait should be buried 4 to 6 inches under the soil surface at random locations throughout a field in spring or fall to determine if wireworms are present. There should be at least one bait site per acre. Soil should be mounded over the bait, and sites can be marked with flags. Baits usually need to remain in fields for at least one week. Black plastic laid on the soil surface over the bait site can help warm the soil in early spring to expedite seed germination and wireworm activity. Soil temperatures need to be above 45°F. Bait sites should be dug up in seven to 10 days.
CHEMICAL CONTROL: Wireworm control is typically applied at planting in order to prevent damage. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Entomopathogenic fungi, such as *Metarhizium anisopliae*, have potential as control agents. These organisms are naturally active in the soil and are lethal to many different kinds of insects.
CULTURAL CONTROL: Potatoes may be used as a trap crop to control wireworms. Other options include crop rotation and plowing/cultivating infested soil in late summer and autumn to kill and/or expose pests to predators.

ARACHNIDS

Two-Spotted Spider Mites, *Tetranychus urticae*

Two-spotted spider mites are minute, pale green arachnids that bear two dark spots on their bodies. Adults overwinter in the soil. The full life cycle (egg to adult) is completed in five to 21 days. Many generations can occur in a year and, with proper conditions, populations will grow rapidly. These mites flourish in hot, dry weather.

MONITORING: Mite feeding often results in a stippling or fine flecking on the upper surface of leaves, giving the foliage a “sandblasted” appearance. On heavily infested plants, the foliage will appear bronzed, bleached, yellow, or gray. When mites are numerous, fine webbing is often visible where the leaves join the stems.
CHEMICAL CONTROL: Dormant oil may be used during the winter and early spring. In the summer, miticides and insecticidal soaps are often used for mite control. However, mites are often resistant to chemicals applied to control them. Chemicals used to control other pests cause mite populations to build rapidly due to the elimination of natural enemies. See the *Chemical Arthropod Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: Commercial biological control agents are not effective so it is critical to conserve natural enemies. These may keep mites at low levels when conditions are unfavorable to mites. Lady beetles, thrips, pirate bugs, lacewing larvae, predaceous mites, and fungi provide some degree of spider mite control, but usually only after mite infestations have become destructive. When conditions are favorable to mites, biological controls are not as effective.

CULTURAL CONTROL: To prevent mite infestations, growers should be sure to provide adequate irrigation and employ other tactics to avoid drought stress.

CHEMICAL ARTHROPOD CONTROL

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http://pubs.ext.vt.edu/456/456-420/456-420-pdf.pdf. For noncommercial recommendations, please refer to the Virginia Pest Management Guide: Home Grounds and Animals, which is updated and published annually. A current PDF version can be downloaded from the following URL: http://pubs.ext.vt.edu/456/456-018/456-018.html

DISEASES and NEMATODES

Common Rust of Sweet Corn, *Puccinia sorghi*

Corn rust is not an issue most years, although some hybrids are susceptible. Common rust is more likely to occur when temperatures are moderate and conditions are humid. Pustules (initially brown but later turning black) form on the upper and lower leaf surfaces, which may turn yellow and rot.

MONITORING: Growers should look for oval or circular pustules after corn silking. They will be red or brown and may be found on either surface of the leaf as well as on sheaths. If infection occurs in the whorl, pustules may appear in a band. Under severe conditions, leaf chlorosis or death may occur.
CHEMICAL CONTROL: If infection/pustules occur before whorl stage, then treatment is necessary. See the *Chemical Disease Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: None are currently recommended.
CULTURAL CONTROL: Growers should plant resistant hybrids, such as *Summer Sweet 7210R*, *Incredible*, *Obsession*, *Providence*, *Delectable*, *Protégé*, and *Overland*.

Common Smut of Corn, *Ustilago maydis*

Although common smut is not usually a severe problem, if plants are infected with it before they are a foot high, they are usually either killed or stunted in growth. The smut fungus survives from year to year in old, smutty cornstalks. Sweet corn is more susceptible than field corn to smut infection. Spores may be windblown over considerable distances to new plants. The fungus often enters plants through wounds made by hail, insect feeding, cultivation, or detasseling. Infection may also occur through the silks or even in seedlings if conditions are right.

MONITORING: The easiest way to determine infection is to look for smut galls. Galls are most obvious on the ears, but they may also form on leaves, tassels, and stalks.

The galls are at first enclosed in a silvery white membrane. As they mature, the membrane breaks and a black, powdery mass of spores is released. Smut on the leaves and tassels usually appears as very small galls or pustules (generally less than an inch in diameter) that eventually become hard and dry. On all other parts of the corn plant, the galls are frequently several inches in diameter.
CHEMICAL CONTROL: Seed treatment does not help. Control the insects whose feeding makes plants susceptible to smut.
BIOLOGICAL/ORGANIC CONTROL: None are currently recommended.
CULTURAL CONTROL: Most recommended species are fairly resistant to common smut, but no variety is completely resistant. White sugar-enhanced varieties tend to have a better chance against smut than bicolor or white supersweet varieties. Collecting and destroying galls before the dark fungal spores form will help reduce severity in small plantings. Crop rotation, in which corn is not grown more than once in three years, will help reduce fungal inoculum in the soil. Efforts to minimize plant damage will also help.

Dwarf Viruses
Maize Dwarf Mosaic Virus
Maize Chlorotic Dwarf Virus

Maize chlorotic dwarf virus (MCDV) and MDMV may be spread through either seed or mechanical means (e.g., through leaf rubbing by an infected plant). As for insect vectors, aphids are known to spread MDMV while black-faced leafhoppers transmit MCDV. Johnsongrass is a frequent weed host of both viruses. The diseases flourish in average to warm temperatures. Mosaic virus may slow ear formation and development, causing stunted growth and reduced yield. MDMV infections may result in unproductive stalks and root rot.

MONITORING: If corn is infected with MDMV, growers may see chlorotic spots and streaks on young green leaves, which later develop into a mottled or mosaic pattern. After cool nights, leaves may also develop red spots or streaks. In MCDV infections, the upper internodes of corn may be shortened and excessive tillering may occur. The youngest leaves in the whorl turn yellow with fine yellow stripes (veinbanding) along the smallest leaf veins. This symptom is most clearly visible on the underside of infected leaves.
CHEMICAL CONTROL: No commercial controls are currently recommended.
BIOLOGICAL/ORGANIC CONTROL: No commercial controls are currently recommended.
CULTURAL CONTROL: Growers should plant early since this virus is most common in corn planted after July 1. Aphids transmit viruses from weeds, especially johnsongrass, so growers should keep fields as weed-free as possible, control aphids, and plant resistant varieties (e.g., *Incredible* or *Delectable*) for fall harvest.

Leaf Spots and Blights

Southern Corn Leaf Blight, *Bipolaris maydis*
Gray Leaf Spot, *Cercospora zeae-maydis*
Northern Corn Leaf Blight, *Exserohilum turcicum*

Northern leaf blight, southern leaf blight, and gray leaf spot are all fungal diseases of foliage. These diseases overwinter in corn stubble and thrive during periods of warm, wet weather. Foliar diseases can and often do cause leaf death and may prematurely kill the plant. The diseases reduce the photosynthetic area and limit the carbohydrate available for kernel fill. They can also predispose the plant to stalk rotting and lodging. All three of these fungal diseases are characterized by brown, tan, or grayish lesions. The lower leaves are often the first to show infection. Gray leaf spot first produces yellowish brown lesions with a faint halo. These spots later become sharply rectangular, running parallel to the veins, which are 1-1/2 to 2-1/2 inches long and 1/8 to ¼ inch wide. Lesions do not extend beyond the leaf veins. Northern leaf blight lesions are long (2- to 6-inch), ovular spots that are 1 to 1-1/2 inches wide. Southern leaf blight symptoms are variable, except that infection is usually indicated by small (< 1-inch), tan foliar lesions that are rectangular or oblong-shaped. Unlike gray leaf spot, southern leaf blight lesions may extend beyond the leaf veins. Lesions usually form first on the lower leaves and gradually move to the upper leaves.

MONITORING: Gray leaf spot tends to first affect corn plants just before tasseling.
CHEMICAL CONTROL: For optimal control, spraying should begin before symptoms appear. Corn should be treated if symptoms appear before silking. Likewise, if early plantings become infested, later plantings should be treated preventively. See the *Chemical Disease Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: None are currently recommended.
CULTURAL CONTROL: Planting of resistant or tolerant varieties is the best control. Varieties resistant to northern corn leaf blight include *Summer Sweet 7902R*, *Summer Sweet 7210R*, *Protégé*, *Overland*, and *GSS 1453*. Varieties resistant to southern corn leaf blight include *Protégé* and *Summer Sweet 7201R*. Rotating crops and burying plant residues can minimize blights and spots from season to season.

Nematodes

There are many nematode species that affect corn crops. Sting, stubby-root, stunt, awl, root-knot, lesion, and lance nematodes are important pests of sweet corn in sandy soils. Stubby-root, stunt, and root-knot nematodes are most important in muck soils.

Typical symptoms of nematode injury can affect both aboveground and belowground plant parts. Foliar symptoms of nematode infestation of roots include stunting and general unthriftiness, premature wilting, slow recovery to improved soil moisture conditions, leaf chlorosis, and other symptoms characteristic of nutrient deficiency. Plants exhibiting stunting or decline symptoms usually occur in patches of non-uniform growth instead of an overall decline of plants within an entire field. Root symptoms

induced by sting or root-knot nematodes can often be as specific as aboveground symptoms. The sting nematode can be very injurious, causing infected plants to form a tight mat of short roots and frequently causing a swollen appearance. New root initials (tiny nubs or nodules) generally are killed by heavy infestations of the sting nematode, a symptom reminiscent of fertilizer salt burn. Root symptoms induced by root-knot nematodes cause swollen areas (galls) on the roots of infected plants.

MONITORING: Base the need for a nematicide on the results of a soil test for the presence and level of plant pathogenic nematodes and on the site history. The best time to collect samples for nematode testing is fall, immediately after harvest. Before deciding to use a nematicide, growers should consult their county Extension office for information on proper soil sampling procedures for nematode testing and for information on threshold levels. Nematode testing is available for a fee through Virginia Cooperative Extension and some commercial soil testing laboratories.

CHEMICAL CONTROL: Seed treatments or fumigation may be necessary to control nematodes in sweet corn plantings. See the *Chemical Disease Control* section for more information.

BIOLOGICAL/ORGANIC CONTROL: None are currently recommended.

CULTURAL CONTROL: Cultural practices, particularly rotation with nonhost crops or letting fields lie fallow, are the most effective cultural management tactics. The length of rotation needed depends on nematode population level and species.

Stewart's Bacterial Wilt, *Pantoea stewartii*

Stewart's bacterial wilt is spread by corn flea beetles. Bacterial wilt is more likely to develop after mild winters (average temperatures over 30°F) due to a spike in flea beetle populations. The disease has two stages: (1) seedling wilt, which affects young plants systemically, and (2) leaf blight, which appears when tissues are wounded via insect feeding. Initial symptoms are water-soaked lesions at feeding sites, which later turn necrotic. Yellow-green striations appear parallel to leaf veins. If the plant is infected systemically, disease symptoms will appear on new leaves emerging from the whorl and cavities may appear in the stalk near the soil line. Resistant cultivars demonstrate greatly reduced reactions to feeding wounds and rarely show systemic reactions. Leaf rot may lead to stalk rot and reduced yields. Other diseases and cultural problems may cause similar symptoms, but a definitive diagnosis may be obtained by submitting a plant sample to a local Extension office.

MONITORING: Growers should watch for foliar symptoms, as well as for beetles. For more information on beetles, refer to the *Arthropod Pests* section above.
CHEMICAL CONTROL: Early-season insecticidal sprays may be applied to control beetle vectors. Growers may use treated seed or in-furrow chemical applications to control flea beetles. After planting, susceptible varieties should be treated at the spike stage when 5% of the plants are infested. See the *Chemical Disease Control* section for more information.

BIOLOGICAL/ORGANIC CONTROL: No commercially available controls are currently recommended.
CULTURAL CONTROL: Growers should consider planting corn varieties such as *Argent*, *Celestial*, and *Summer Sweet 7210R* that are resistant to bacterial wilt. Flea beetles should be controlled to prevent infection. Growers can also use disease forecasts (e.g., the Stevens-Boewe Index) to help determine when diseases may occur.

CHEMICAL DISEASE CONTROL

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WEED PESTS

Many different species of annual grasses, perennial grasses, and broadleaf weeds invade cropland in Virginia. If left unchecked, weeds can harm crop roots and impact harvest yields. Proper weed management is essential to corn production. Weeds compete with crops for light, space, nutrients, and water. Weeds also provide refuge for pests and diseases and make it difficult to harvest crops.

Herbicide control options vary depending on if conventional tillage or no-till/conservation tillage is used. In no-till/conservation tillage systems, weeds are controlled after they emerge. With conventional tillage, weeds may be controlled at planting, before emergence, at early emergence, postemergence, or postharvest.

Common weed pests that can be treated both preventively and after emergence include barnyardgrass, large crabgrass, fall panicum, foxtail spp., goosegrass, johnsongrass, yellow nutsedge, carpetweed, common cocklebur, hairy galinsoga, jimsonweed, common lambsquarters, morningglory spp., shepherd's purse, pigweed spp., common purslane, common ragweed, Pennsylvania smartweed, eastern black nightshade, and velvetleaf.

Weed species that should be treated postharvest but before the first frost include bitter nightshade, Canada thistle, field bindweed, hemp dogbane, horsenettle, pokeweed, brambles, horseradish, poison ivy, sow thistle, quackgrass, johnsongrass, bermudagrass, and yellow nutsedge.

MONITORING: No specific monitoring protocol is recommended.

CHEMICAL CONTROL: Herbicides are necessary for adequate control of weeds in commercial production. See the *Chemical Weed Control* section for more information.
BIOLOGICAL/ORGANIC CONTROL: No biological control is recommended.
CULTURAL CONTROL: Fields with a history of severe weed infestations should be avoided. Crop rotation can help prevent domination by any particular weed species from year to year. Mechanical cultivation works well to remove or cover small weeds.

CHEMICAL WEED CONTROL

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VERTEBRATE PESTS

Birds

Birds become pests when they eat planted seed or damage ears of corn. Before attempting to use control measures on any pest birds, birds should be sure to note the species and review any current legislation on how those birds are to be treated. Many species are protected due their endangered status or because they are migratory. Blackbirds, for example, are protected under the federal Migratory Bird Treaty Act.

Blackbirds are a major pest of corn. These birds initially feed on insects and weed seeds in cornfields but will later include developing corn in their diet because it is growing in their desired feeding location. Blackbirds will form large flocks that retreat to cattail marshes or woods at night and feed in cornfields during the day.

MONITORING: Male blackbirds will shred cornhusks from the tip to the stalk. Once the husks are opened, females and young birds will consume kernels and cause more damage.
CHEMICAL CONTROL: Nonlethal methods should always be attempted before using lethal measures. See the *Chemical Vertebrate Control* section for more information.

BIOLOGICAL/MECHANICAL CONTROL: In general, frightening devices (either visual or sound), exclusion (netting), trapping, and shooting are all methods used to control birds. The most effective way to deter blackbird feeding is to use several types of harassment devices, including pyrotechnic devices (e.g., firecrackers, whistlers, and cracker shells); blackbird distress-call-emitting devices; and bird-scaring cannons that

are fired every five minutes. Protective equipment should be worn when dealing with explosives and precautions should be taken during dry periods to avoid starting a fire. Distress-call devices have a limited range and batteries wear out relatively quickly. Cannons can be annoying to neighbors and should only be used during the day, when birds gather in the field. Cannons should be moved frequently to prevent birds from acclimating to the sound. One cannon protects between 10 and 20 acres if used in tandem with other startling devices.

CULTURAL CONTROL: To manage blackbirds, growers should avoid planting corn near marshes or woodlots. Bird-resistant hybrids may be an option, particularly those varieties with good tip cover to foil ear opening by the male birds. Insects should be controlled because they are an attractive food source to blackbirds. In large fields, growers should leave access trails every 200 to 300 feet to scare birds from the center of the field. Corn should be planted on the same schedule as corn-growing neighbors because early- or late-planted corn plants suffer more damage. To control other avian pests, growers may – where legal – remove nesting sites, practice habitat modification, or time the harvest to occur before bird predation becomes a problem.

Mammals

Mammals – raccoons and deer in particular – may cause damage by eating mature corn. Deer consume corn at nearly every stage of its development, but plants are most vulnerable during silking and tasseling. If silks are eaten, the ears will be smaller and kernel fill will be poor. Corn plants can recover if fed upon by deer earlier in the season. Like birds, many mammal species are protected, and it is necessary to keep up with current legislation to ensure control practices are legal. Often, it is best to hire a professional for vertebrate control.

MONITORING: Deer feeding damage appears ragged and torn, not cleanly cut like rodent and most insect feeding damage. Hoofmarks, deer droppings, and ragged/torn foliage are fairly reliable deer indicators. Raccoon feeding damage consists of pulled-back husks, partially eaten ears, and broken stalks.

CHEMICAL CONTROL: There are species-specific chemical treatments. See the *Chemical Vertebrate Control* section for more information.

BIOLOGICAL/MECHANICAL CONTROL: Frightening devices, exclusion (netting or fences), trapping, shooting, and legal harvest are all methods of mechanical control. Deer may only be shot during hunting season by individuals holding valid hunting licenses. Some municipalities will allow landowners a permit to shoot deer on their property if the deer become nuisances. Some growers may employ noise devices, but these are largely ineffective because deer rapidly grow accustomed to the sound. Repellents work in small home garden plots but are cost-prohibitive in large fields. Electric fences are an option but need to be installed before feeding begins, then inspected and maintained on a weekly basis. To deter deer, one strand should be placed at a height of 30 inches. Electric fences can be made more effective by applying attractants such as peanut butter to ensure deer make contact and are shocked in order

to learn to avoid the crop. Deterrents (e.g., rotten egg-based repellents) can also be applied to electric fencing to keep deer at bay.

Electric fences may be useful to control raccoons and other small mammalian pests. Strands should be placed at 5 and 10 inches off the ground. Fencing should be installed at least two weeks before raccoons would likely begin feeding. Where permitted, raccoons may be trapped or shot. Pests caught in live traps should not be released off the property without permission.

CULTURAL CONTROL: Sanitation is very important. Vertebrates such as raccoons are attracted to loose trash.

CHEMICAL VERTEBRATE CONTROL

Always read the label before applying any chemicals, and be sure to follow the rates specified for the crop of interest. For chemical control recommendations specific to sweet corn, please refer to the Commercial Vegetable Production Recommendations: Virginia, which is updated and published annually. A current PDF version can be found online at: http://pubs.ext.vt.edu/456/456-420/456-420-pdf.pdf. For noncommercial recommendations, please refer to the Virginia Pest Management Guide: Home Grounds and Animals, which is updated and published annually. A current PDF version can be downloaded from the following URL: http://pubs.ext.vt.edu/456/456-018/456-018.html

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ONLINE RESOURCES

Commercial Vegetable Production Recommendations: Virginia
http://pubs.ext.vt.edu/456/456-420/456-420-pdf.pdf

Southeastern U.S. Vegetable Crop Handbook
http://www.thepacker.com/sites/produce/files/2015_SEVG_FEB6_web.pdf

Virginia Cooperative Extension
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Virginia Pest Management Guide: Home Grounds and Animals
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