http://www.cals.ncsu.edu/course/ent425/pestlist.html

http://www.ces.ncsu.edu/depts/ent/notes/Vegetables/index.html

http://ohioline.osu.edu/hyg-fact/2000/2205.html

Potato Leafhopper

Empoasca fabae (Harris), Cicadellidae, HEMIPTERA)

DESCRIPTION

Adult - Because many species of leafhoppers look alike, entomologists studying these insects must rely heavily on examination of internal genitalia structures, as well as external morphological characters, to distinguish the various species. The mature potato leafhopper is about 3 mm long, wedge-shaped, and winged. Generally greenish, it has very small, yellowish, pale, or dark green spots, and readily jumps when disturbed.

Egg - About 1 mm long, the egg is elongate and whitish.

Nymph - Several nymphal stages exist, all of which are wingless and smaller than the adult. Though paler, the nymph is colored similarly to the adult.

BIOLOGY

Distribution - During the summer, potato leafhoppers are found from the Atlantic coast to the Rocky Mountains. They are absent throughout most of the winter which they spend in the Gulf States. Northeastern and midwestern states suffer the greatest forage loss from this pest due to the concentration of alfalfa and clover in these areas. In North Carolina, these leafhoppers are widely distributed during the growing season on peanuts, hay and pasture crops.

Host Plants - This leafhopper feeds on more than 100 cultivated and wild plants, including bean, potato, alfalfa, soybean, and peanut. In North Carolina, peanuts are more seriously affected by this pest than are forage and pasture crops.

Damage - Nationwide, the potato leafhopper is a very injurious pest of forages, particularly alfalfa and clover. Both nymphs and adults feed on the undersides of the leaves. By extracting the sap, they cause stunting and leaf curl, as well as the condition called "hopperburn." This disease is caused by the injection of a toxic substance. It is characterized by a yellowing of the tissue at the tip and around the leaf margin which increases until the leaf dies. Symptoms are sometimes confused with drought stress.

Life History - Potato leafhoppers winter in the Gulf States and migrate northward in spring. They arrive in North Carolina in early summer. After mating, eggs are laid inside the veins on the underside of leaves. A female leafhopper lives about a month, producing one to six eggs daily. Eggs hatch in about 10 days, and the nymphs mature in about 2 weeks. Mating occurs approximately 48 hours after maturation. Three or four generations are produced each year in North Carolina.

CONTROL

When populations become severe, insecticides are the only practical method of leafhopper control. For specific control information, consult the current *North Carolina Agricultural Chemicals Manual*.

European Corn Borer

Ostrinia nubilalis (Hubner), Pyralidae, LEPIDOPTERA

DESCRIPTION

Adult - The female moth has a robust body and a wingspread of about 25 mm. It is colored pale yellow to light brown. The outer third of the wings is usually crossed by dark zigzag lines. The male moth is smaller, more slender, and darker than the female. The outer third of its wings is usually crossed by two zigzag streaks of pale yellow, and often there are pale yellow areas on the forewings.

Egg - Each white egg is about half the size of a pinhead. The eggs change to pale yellow and darken just before hatching as the brown head of the borer inside becomes visible. Within the egg mass, the eggs overlap each other like fish scales. The masses of 20 to 30 eggs are covered with a shining waxy substance.

Larva - The newly hatched larva, about 1.5 mm long, has a black head, five pairs of prolegs, and a pale yellow body bearing several rows of small black or brown spots. It develops through 5 or 6 instars to become a fully grown larva about 25 mm long.

Pupa - The brown pupa is 13 to 15 mm long with a smooth capsule-like body.

BIOLOGY

Distribution - Introduced into the U.S. from Europea in 1909, the European corn borer has spread throughout the contiguous states and into Canada. In North Carolina, the largest populations of this pest occur in the Coastal Plain where 75% of the stalks in some fields have been attacked. However, 40% lodging of stalks due to borers has been observed in the Piedmont when harvesting has been delayed.

Host Plants - The European corn borer infests over 200 plants, but corn is a preferred host. Other vegetable crops likely to be injured include bean, beet, celery, potato, pepper, and tomato.

Damage - On most crops, borers begin feeding on the leaf surface. In corn, feeding first occurs in the whorl. Later the larvae bore down midribs of leaves into the stalk. Frass and silk near entrance holes are evidence of their presence. Borers weaken stalks, or stems, and interfere with the movement of plant nutrients. Consequently, yields are reduced. On infested corn plants, tassels and stalks may break, ears drop, or only small ears develop.

Potatoes and peppers are affected more adversely than corn by borer injuries which allow the entrance of bacterial and fungal pathogens. Reduced yields occur when disease organisms cause stems to collapse and tubers to rot. Potatoes that are produced on infested plants are often of poor quality due to the development of diseases such as black leg. Pepper fruit infested by European corn borers are commercially unacceptable.

Life History - Mature larvae overwinter inside tunnels in stubble, stalks, ears, or other protective plant material. They pupate in spring. During April and May, adult moths emerge and mate. Each female lays 500 to 600 eggs in small masses of 20 to 30 on the undersides of leaves. Eggs hatch in 3 to 12 days, depending upon temperature. Young larvae usually begin feeding on leaf surfaces and, as they mature, begin boring in the midribs of the leaves. Two to 3 days after eggs hatch, stalk or ear boring commences and continues until pupation. In Florence, South Carolina, the European corn borer completes four generations per year and may do so in parts of North Carolina too. If this is the case, eggs of the second generation are laid in mid- to late June, those of the third generation in late July, and those of the fourth generation in September. This last generation is not a threat to corn. First generation European corn borers are a threat to potatoes, and the second and third generations are pests of other vegetables.

CONTROL

Many natural parasites of this corn borer, mainly flies and wasps which have been introduced from Europe, exist in corn-growing areas. Other biological control agents such as ladybird beetles, predaceous mites, and the downy woodpeckers have also been responsible for some borer reduction. The bacterial insecticide, *Bacillus thuringiensis* however, shows some promise for borer control.

Chemical control for the European corn borer is difficult because sprays are effective only during the 2- to 3-day period after eggs hatch and before larvae bore into stems. Therefore, close attention must be paid to the presence of moths and eggs. The emergence of the first moths can be determined by using either light traps or screened cages. Treatments should begin 7 to 10 days after a moth flight or about 5 days after eggs are found. For recommended insecticides and rates, consult the current *North Carolina Agricultural Chemicals Manual*.

Flea Beetles

Palestriped flea beetle, *Systena blanda* Melsheimer; Potato flea beetle, *Epitrix cucumeris (Harris); Tobacco flea beetle*, *Epitrix hirtipennis* (Melsheimer), Chrysomelidae, COLEOPTERA

DESCRIPTION

Adult - The potato flea beetle is about 2.5 mm long and brownish-black to black in color. The equally small tobacco flea beetle is yellowish-brown with a dark band across the wings. Varying from 2.5 to 4.6 mm in length, the palestriped flea beetle has a pale yellow, brown, or black body, a reddish head, and one light-colored stripe along each wing cover.

Egg - The tiny elongate egg is white when first deposited.

Larva - The slender cylindrical grub has a whitish body, a brown head, and 3 pairs of tiny legs near its head. Potato and tobacco flea beetle larvae are 4 to 5 mm long when fully grown. The mature larva of the palestriped species is slightly longer than 6 mm.

Pupa - The white pupa roughly resembles the adult in size and shape. As it matures, it darkens gradually.

BIOLOGY

Distribution - The potato flea beetle occurs from Maine into the Carolinas and westward into Nebraska. Although the tobacco flea beetle is fairly generally distributed, it is primarily a problem in the South. The palestriped flea beetle occurs in most areas of this country, its northern limits lying in Utah, Colorado, Idaho, and New York.

Host Plants - Potato and tobacco flea beetles infest solanaceous plants such as tomato, potato, tobacco, pepper, horsenettle, etc. The palestriped flea beetle, however, is a more general feeder. Its hosts include potato, corn, eggplant, tomato, pea, bean, watermelon, pumpkin, sweet potato, peanut, oat, cotton, grape, pear, and strawberry.

Damge - Flea beetles attack the foliage leaving small round holes. Most serious early in the growing season, this injury eventually kills infested leaves. In addition, potato flea beetles may transmit early blight. As a general rule, flea beetles are much less of a problem on potato than on other solanaceous crops.

Life History - Flea beetles overwinter as adults among debris in or near fields of host plants. They resume activity in spring and feed on weedy hosts until crop hosts are available. Eggs, deposited in soil near the bases of host plants, may require a week or more to hatch. Grubs feed on or in roots, tubers, and lower stems for 3 to 4 weeks before pupating. After a pupal period of 7 to 10 days, a new generation of beetles emerges. The palestriped flea beetle completes only one generation each year. Potato and tobacco flea beetles produce three to four annual generations in North Carolina.

CONTROL

Cultural methods are primary sources of defense against flea beetle infestations. First, it is important to keep fields free of weeds. Destruction of plant residues, especially piles of cull potatoes and trash where beetles hibernate, prevents the buildup of high populations. Late planting favors growth of the host plant over establishment of flea beetles. Lastly, covering beds of seedlings with a gauze-like material prevents beetle entry.

A number of insecticides (granular and foliar) are available to control adult flea beetles. On potatoes, an in-furrow insecticide application at planting can prevent flea beetle damage early in the season. For control throughout the season on all vegetable crops, spray plants when adults appear and repeat as needed. For recommended insecticides and rates, consult the current *North Carolina Agricultural Chemicals Manual*.

Potato Aphid

Macrosiphum euphorbiae (Thomas), Aphididae, HEMIPTERA

DESCRIPTION

Adult - This soft-bodied, pear-shaped insect may be solid pink, green and pink mottled, or light green with a dark stripe. Usually wingless, it is about 2.5 to 3.5 mm long and has a pair of long, slender tailpipe-like appendages known as cornicles.

Egg - The egg stage does not occur in North Carolina.

Nymph - Although slightly smaller than the adult, the nymph is similar in color and shape.

BIOLOGY

Distribution - Potato aphids occur throughout North America.

Host Plants - Potato aphids infest a wide range of host plants. Some important cultivated hosts include potato, tomato, eggplant, sunflower, pepper, pea, bean, apple, turnip, corn, sweet potato, asparagus, clover, and rose. Weeds such as ragweed, lambsquarters, jimsonweed, pigweed, shepherdspurse, and wild lettuce are also common food plants.

Damage - Sporadic in occurrence, potato aphid infestations are rarely severe enough to kill plants. Aphids pierce veins, stems, growing tips, and blossoms with their needle-like mouthparts. As a result, blossoms are shed and yield is reduced. New growth becomes stunted and curled. Heavily infested plants turn brown and die from the top down. Aphids tend to spread rapidly from field to field transmitting a number of viral diseases. These include various mosaics, leaf roll, spindle tuber, and unmottled curly dwarf.

Life History - In North Carolina, female potato aphids feed and reproduce year round. No eggs or males are produced. Without mating, wingless females give birth to about 50 live nymphs. During warm weather, each of these nymphs matures in 2 or 3 weeks. The life cycle continues in this manner until overcrowding occurs or food becomes scarce. At these times nymphs develop into winged adults and migrate to new host plants. Once settled down, these aphids begin reproducing and the life cycle continues as before. During winter, however, feeding and reproduction occur at a much slower rate. Many generations are produced each year.

CONTROL

Lady beetles and their larvae, lacewing larvae, syrphid larvae, and stilt bugs all feed on aphids. Fungus diseases, high temperatures, damp weather, and hard rains also limit aphid populations.

Cultural practices are helpful in avoiding aphid populations. Crops should be planted in well-prepared, fertile seedbeds to promote vigorous growth. When possible, avoid

planting sites near infested fields or from which an aphid-infested crop has been removed.

A number of insecticides are available to control aphids on a wide variety of crops. However, repeated applications of certain carbamate insecticides within intervals of a week or less are frequently conducive to aphid buildups. For specific chemical recommendations, consult the current *North Carolina Agricultural Chemical Manual.*

Green Peach Aphid

Myzus persicae (Sulzer), Aphididae, HEMIPTERA

DESCRIPTION

Adult - This soft-bodied, pear shaped insect is usually wingless and ranges from 1.6 to 2.4 mm long. The wingless female is pale yellow to green. The winged midgrant form has a yellowish-green abdomen with a dark dorsal blotch. Both forms have a pair of tailpipe-like appendages known as cornicles.

Egg - No egg stage occurs in North Carolina.

Nymph - Slightly smaller than the adult but similar in shape, the nymph is pale yellow-green with three dark lines on the abdomen.

BIOLOGY

Distribution - The green peach aphid is a cosmopolitan species.

Host Plants - The green peach aphid infests a wide range of plants. Some important hosts include cabbage and related cole crops, dandelion, endive, mustard greens, parsley, turnip, tomato, tobacco, potato, spinach, pepper, beet, celery, lettuce, and chard.

Damage - Green peach aphids extract sap from plants and excrete a sweet sticky substance known as honeydew. Black sooty mold grows on honeydew and, though not directly harming the plants, may block out sufficient light to reduce yield. Weakened plants become susceptible to secondary disease and may be inoculated with viruses carried by aphids. Among the virus diseases transmitted by green peach aphids are potato leaf roll, potato virus Y, beet mosaic, beet yellows, and lettuce mosaic.

Life History - Adults pass the winter on greens and wild hosts such as cabbage, collards, turnip, wild mustard, and dock. Winged forms migrate to other hosts in late spring. During these migratory flights, aphids may spread virus diseases from infected volunteer

plants and weeds to healthy crop plants. Movement between host plants continues through summer and fall.

In southern states, the aphids are nearly all females. Successive generations of females, mainly wingless, are produced throughout the year. Winged migrants develop whenever overcrowding occurs or food becomes scarce. This type of development (all females, no males or eggs) occur as far north as Tennessee and Maryland. Many generations are produced each year.

CONTROL

Lady beetles and their larvae, lacewing larvae, syrphid fly larvae, and stilt bugs all feed on aphids. Fungus diseases, high temperatures, damp weather, and hard rains also reduce aphid populations.

Cultural practices are helpful in avoiding aphid infestations. Winter host plants (collards, mustard, dock, turnip) in the vicinity of seed beds should be destroyed before plants begin to come up. The purchase of certified seed from areas free of virus is also a good preventative measure.

A number of insecticides are available to control aphids on a wide variety of crops. However, repeated applications of certain carbamate insecticides within intervals of a week or less are frequently conducive to aphid buildups. For specific chemical recommendations, consult the current *North Carolina Agricultural Chemicals Manual*.

Return

Southern Potato Wireworm

Conoderus falli Lane, Elateridae, COLEOPTERA

DESCRIPTION

Adult - The adult, 6 mm to 8.5 mm long, is a brownish, oblong click beetle. Its legs are light tan.

Egg - The spherical egg is smooth and translucent white with an average diameter of 0.5 mm.

Larva - The newly hatched larva is white and later becomes cream colored or yellowish-gray with a reddish-orange head. The fully grown larva is about 17 mm long. The last abdominal segment of this larva, unlike that of the tobacco wireworm, terminates in a closed oval notch rather than a V-shaped notch.

Pupa - Slightly larger than the adult, the pupa is white when first formed but soon changes to a creamy yellow.

BIOLOGY

Distribution - The southern potato wireworm was apparently introduced into the U.S. from South America. In this country, it has been reported on coasts from North Carolina to Louisiana. Within North Carolina, it occurs mainly in the southeastern counties of the Coastal Plain.

Host Plants - The southern potato wireworm appears to prefer potato tubers. Newly transplanted tobacco seedlings, roots of sweet potatoes, carrots, corn seedlings, and stems of tomato transplants are also frequently attacked. Less frequently damaged hosts are melons, the roots of beets, and the fruits of strawberries, cantaloupes, watermelons, and tomatoes that touch the soul surface.

Damage - Wireworms chew ragged holes on the roots. Oftentimes a single root may have 10 or more small holes. Early feeding appears as shallow but large cavities. Late or most recent feeding appears as ragged, deep holes. This wireworm usually attacks sweet potatoes late in the season.

Life History - While the biology of this insect pest has not been studied in North Carolina, in South Carolina adults are found in fields throughout the year. There are two generations annually. Adults from overwintering larvae begin to appear in large numbers during May, reaching their peak abundance in June. Each first-generation female lays an average of 36 eggs. They hatch into the "short-cycle" brood, which requires 42 to 109 days to mature. Adults of this "short-cycle" brood are abundant in late August and in September. They mate and lay eggs of the "long-cycle" brood, or the overwintering generation, which requires 239 to 318 days for the eggs to reach adulthood.

CONTROL

No insect parasites or predators of this wireworm have been discovered. Three disease-causing agents - a fungus, a protozoan, and a parasitic nematode - have been isolated, but their usefulness in the control of this wireworm has not been determined.

As a cultural control, susceptible crops should not be planted in fields that were planted with a winter crop, those not plowed during the fall and winter, or those not recently in row crops. No resistance to this pest has been found in Irish potatoes. However, the sweet potato varieties Nugget and All Gold do possess some resistance.

Insecticides for the control of wireworms can be applied in furrow at planting, broadcast and incorporated into the soil, or broadcast later over the top of sweet potato foliage. A problem has been this wireworm's development of resistance to chlorinated hydrocarbons and organophosphate insecticides. Therefore, for specific information or insecticides and rates, consult the current *North Carolina Agricultural Chemicals Manual*.

Tobacco Wireworm

Conoderus vespertinus (Fabricius), Elateridae, COLEOPTERA

DESCRIPTION

Adult - The adult, called a click beetle, is reddish-brown with yellow markings, oblong, and about 8.5 mm in length, though the size varies considerably.

Egg - The newly laid egg is spherical, white and about 0.5 mm in diameter.

Larva - The newly hatched larva is approximately 1.5 mm long and grows to a length of 14 to 19 mm. Except for the head, which is tinged iron brown, the larva is white. Its last abdominal segment terminates in a V-shaped notch.

Pupa - The brown pupa is slightly larger than the adult; it occurs in the soil near the food source.

BIOLOGY

Distribution - The tobacco wireworm is common in the southeastern states. In North Carolina it occurs throughout most of the Coastal Plain. It is much more prevalent in areas where tobacco, cotton or corn are the main crops than in areas planted chiefly with truck crops.

Host Plants - The tobacco wireworm apparently prefers tobacco, but it feeds on a variety of other plants including cotton, corn, potatoes, sweet potatoes, and various truck crops.

Damage - Damage occurs as ragged holes in the roots. Oftentimes a single root may have 10 or more small holes. Early feeding appears as shallow but large cavities. Late or most

recent feeding appears as ragged, deep holes. Damaged roots are downgraded or discarded.

Life History - Eggs, averaging 240 per female, are laid singly on, or slightly beneath, the soil surface in summer. Larvae hatch and feed on roots of corn, tobacco, potato and other plants. Winter is passed in the larval stage. Pupation in June occurs in the soil. Adults emerge during early summer with greatest activity from late June through July. There is only one generation per year. The typical life cycle requires about 348 days in North Carolina: egg, 10 days; larva, 315 days; pupa, 10 days; and preoviposition period, 13 days.

CONTROL

Crop rotation is an effective management tool for control and should be practiced where possible. Fields planted to a winter cover crop, those not plowed during fall and winter, and those not recently in row crops are not suitable sites to plant wireworm-susceptible crops. Low soil moisture, high summer temperatures, disease, predation and cannibalism are helpful in reducing wireworm populations.

Insecticides for the control of wireworms can be applied in furrow at planting, broadcast, and incorporated into the soil or broadcast later over the top of sweet potato foliage. For specific information on insecticides and rates, consult the current *North Carolina Agricultural Chemicals Manual*.

Pepper Maggot

Zonosemata electa (Say), Tephritidae, DIPTERA

DESCRIPTION

Adult - The adult pepper maggot is a yellow fly about 8 mm long. It has one pair of brown-banded, clear wings. A small black dot is located on each side of the last segment of the abdomen.

Egg - The white, crooknecked-shaped egg is roughly 2 mm long and about 0.3 mm wide.

Larva - White and translucent when newly hatched, the maggot has a pointed head and turns yellow as it develops. When fully grown, it is 10 to 12 mm long and about 3 mm in diameter at its widest point.

Pupa - The pupa is enclosed in a hard covering known as the puparium. This protective case is about 8 mm long and 4 mm wide.

BIOLOGY

Distribution - From New Jersey, this introduced pest has spread throughout the eastern half of the U.S. It now occurs from Massachusetts south to Florida and westward to Indiana, Oklahoma, and Texas.

Host Plants - Pepper maggots feed within the fruiting structures of weeds such as horsenettle and ground cherry. Economically important hosts include hot cherry pepper, eggplant, and tomato fruit. Bell and sweet peppers are not subject to infestation.

Damage - The first sign of pepper maggot infestation is the appearance of egg punctures in small peppers 1 to 4 cm in diameter. These punctures are elliptical holes 0.4 by 0.3 millimeters. As infested peppers enlarge, the egg punctures become shallow depressions in the fruit. Maggots feed within the fruit but usually have emerged by the time the peppers are sold in the market. If peppers are picked when green, infested fruit cannot be distinguished from good fruit. Eventually however, maggot-damaged peppers will turn red prematurely and begin to rot. Such peppers are worthless for marketing. As they rot, peppers attract many kinds of flies, and maggots may develop in the decaying fruit. These maggots should not be confused with the pepper maggots which initiated the damage. The pepper maggots are no longer present.

Life History - Pepper maggots overwinter as pupae 5 to 10 cm below the soil surface. Flies emerge from late June through August and mate. Soon afterwards, females insert eggs just beneath the skin of young peppers. Eggs hatch about 10 days later depending on the growth rate of host peppers. At this time the peppers are usually 2/3 to fully grown. Larvae feed within the peppers for about 18 days. When fully grown, each larva cuts an exit hole, emerges, and drops to the soil to pupate. Only one generation occurs each year.

CONTROL

The use of insecticides is the only reliable method of pepper maggot control. A dust or spray should be applied to the foliage when flies appear and repeated as necessary. For chemical control recommendations, consult the current *North Carolina Agricultural Chemical Manual*.

Fall Armyworm

Spodoptera frugiperda (Smith), Noctuidae, LEPIDOPTERA

DESCRIPTION

Adult - The adult moth has a wingspan of about 38.5 mm. The hind wings are grayish-white; the front wings are dark gray mottled with lighter and darker splotches. Each forewing has a noticeable whitish spot near the extreme tip.

Egg - Minute, light gray eggs are laid in clusters and covered with grayish fuzzy scales from the body of the female moth. Each egg becomes very dark just before hatching.

Larva - About 30 to 40 mm long, the fully grown larva varies in color from light tan or green to nearly black. Along each side of its body is a longitudinal black stripe. Down the middle of its back is a wider yellowish-gray stripe with four black dots on each segment. The head of the fall armyworm often is marked with a pale but distinct inverted "Y."

Pupa - The pupa, approximately 13 mm long, is originally reddish-brown and darkens to black as it matures.

BIOLOGY

Distribution - The fall armyworm is a continuous resident of the Gulf states, the tropics of North, Central, and South America, and some of the West Indies. Each year it migrates as far northward as Montana, Michigan, and New Hampshire.

Host Plants - Field corn, sweet corn, sorghum, and grasses are preferred foods. However, the fall armyworm may also infest alfalfa, bean, peanut, potato, soybean, sweet potato, turnip, spinach, tomato, cabbage, cucumber, cotton, tobacco, all grain crops, and clover.

Damage - The fall armyworm is the second most important pest of sweet corn. It most frequently causes damage to the whorl of late pretassel corn. Larvae feed throughout the tightly coiled blades causing what is known as "shatterworm" injury. When the blades unfurl, the new leaves are riddled with numerous ragged holes. As with the corn earworm, wet tan excrement lodges in the remaining blades and blade axils.

In addition to defoliation, damage to corn may be three-fold. First, larvae feed on the undeveloped tassels of young plants. Secondly, immature ears are attacked near the shank. Lastly, large larvae may bore into maturing ears and stalks.

Life History - Fall armyworms overwinter in Florida and along the Gulf Coast in several life stages, but usually as pupae. Egg-laying moths appear in North Carolina about the middle of July. Each female lays about 1000 eggs in masses of 50 to several hundred. Two to 10 days later, the small larvae emerge, feed gregariously on the remains of the egg mass, and then scatter in search of food. They usually are unnoticed until they are about 25.5 to 38.5 mm long, by which time, if abundant, they have consumed so much foliage that they create alarm. Larvae are most active early in the morning or late in the evening. When abundant, these caterpillars eat all the food at hand and then crawl in great armies to adjoining fields. After feeding for 2 or 3 weeks, the larvae dig about 20

mm into the ground to pupate. Within 2 weeks, a new swarm of moths emerges, usually flying several miles before laying eggs. Several generations may occur each year.

CONTROL

During favorable seasons, a number of parasitic enemies keep fall armyworm larvae down to moderate numbers. Cold, wet springs seem to reduce the effectiveness of these parasites and a population explosion often results.

Early planting is the most effective cultural control method in our state. For recommended chemical controls, consult the current *North Carolina Agricultural Chemicals Manual*.

R

Hornworms

Tobacco hornworm, *Manduca sexta* (Linnaeus); Tomato hornworm, *Manduca quinquemaculata* (Haworth), Sphingidae, LEPIDOPTERA

DESCRIPTION

Adult - Adult tobacco hornworm moths have a wingspan of about 112 to 127 mm and are slate brown compared to the ash gray color of tomato hornworms. Tobacco hornworms have 6 orange spots on each side of the abdomen, whereas tomato hornworms have 5 similar, but less distinct, spots on each side. Wavy lines on the hind wings of the tomato hornworm are more distinct and jagged than the lines on the hind wings of the tobacco hornworm moth.

Egg - Hornworm eggs are smooth, spherical, and about 1.3 mm in diameter. Light green at first, they turn white before hatching.

Larva - Mature tobacco hornworm larvae usually have green bodies with fine white pubescence and seven diagonal stripes on each side; the posterior horn is usually curved and red. Tomato hornworm larvae have 8 V-shared markings on each side; the horn is straight and black. Both species are about 75 to 85 mm long when fully grown.

Pupa - Pupae are brown, hard, spindle-shaped, and about 5 cm long. They have a curved, projecting, pitcher-handle-like tongue case. The tongue case of the tomato hornworm is longer and more curved than the tongue case of the tobacco hornworm.

BIOLOGY

Distribution - The tobacco hornworm ranges from southern Canada to Argentina. The range of the tomato hornworm, however, extends only from southern Canada through the southern U.S.

Host Plants - Hornworms feed primarily on solanaceous plants. These hosts include tobacco, tomato, eggplant, pepper, and some weedy plants. Tobacco and tomato plants are preferred for oviposition.

Damage - Hornworms strip leaves from tomato vines. If a heavy infestation develops, caterpillars also feed on developing fruit. Rather than bore into fruit, they feed superficially leaving large open scars. Fruit damage, however, is much less common than defoliation. Hornworm damage usually begins to occur in midsummer and continues throughout the remainder of the growing season.

Life History - Hornworms overwinter in the soil as pupae. Moths of this overwintering generation begin to emerge in early June and may continue to emerge as late as August. Nocturnal in habit, hornworm moths frequently can be seen hovering over plants at dusk. At night, eggs are deposited on the underside of leaves. Each moth deposits one to 5 eggs per plant visit and may lay up to 2,000 eggs.

Hornworms emerge from the eggs about 4 days later, depending upon temperature. After feeding for 3 weeks, hornworms burrow into the soil and spend 4 days as prepupae. In summer, the pupal period lasts 3 weeks after which a new generation of moths emerges. Heavy egg deposition is common in August and early September. At least two generations occur each year in North Carolina.

CONTROL

In small gardens, hornworms can be controlled simply by picking the larvae off the plants. Most seasons, however, hornworms are kept at subeconomic levels by a wasp parasite. Parasitized hornworms are easily recognized by the small white oblong cocoons attached to their backs. Such worms should be left in the garden so the emerging wasps can parasitize other hornworms.

Colorado Potato Beetle

Leptinotarsa decemlineata (Say), Chrysomelidae, COLEOPTERA

DESCRIPTION

Adult - This oval, convex beetle is yellowish-brown and about 9 to 14 mm long. It has five longitudinal black stripes on each wing cover and a variable number of black spots on the pronotum (area just behind the head).

Egg - The yellow or orange elongated eggs are deposited on end and grouped into rows. Each egg is about 1.8 mm long.

Larva - Red at first, this soft grub has a black head and black legs. As it matures, the larva turns yellowish-red or orange and develops two rows of black spots along each side of the body. It reaches a length of about 10 mm.

Pupa - Generally resembling the adult in shape, the pupa is approximately 13 mm long.

BIOLOGY

Distribution - The Colorado potato beetle can be found throughout most of North America.

Host Plants - Colorado potato beetles infest a wide variety of plants including tomato, potato, eggplant, pepper, tobacco, ground cherry, nightshade, and other solanaceous plants.

Damage - Adult beetles and larvae feed on leaves and terminal growth of their host plants. The loss of foliage hinders development of tubers or fruit thereby reducing yield. In cases of heavy infestation, entire plants may be killed. Colorado potato beetle damage often occurs in isolated spots throughout the field.

Life History - Colorado potato beetles overwinter as adults in the soil. After emerging in spring, beetles feed for a short period before mating and laying eggs. Females each deposit 300 to 500 eggs in clusters of 20 or more on the undersides of leaves. Four to 9 days later, larvae emerge and feed for the next 3 weeks. Once mature, larvae drop to the ground and pupate in the soil. Five to 10 days later, a new generation of beetles emerge. In North Carolina, at least two full generations and a partial third occur each year.

CONTROL

Many cultural enemies help keep Colorado potato beetle populations low. Birds feed upon adults and larvae while predatory bugs attack eggs and larvae. These predatory bugs may be gray, brown, or brightly colored and are often shield-shaped. Two kinds of gray and black tachinid flies also parasitize larvae.

Katahdin potatoes show some resistance to Colorado potato beetles. Early treatment of commercially grown potatoes with systemic insecticides normally control overwintering beetles and early hatching larvae. However, some insect activity may persist around the field. The application of a foliar insecticide is not recommended until the first eggs have hatched. As soon as damage is noticed, treatment should begin. Chemical control is directed toward the first generation since the buildup of subsequent generations may cause severe damage and defoliation. In some cases, spot treatments may be effective. For recommended insecticides and rates, consult the current *North Carolina Agricultural Chemicals Manual*.