

Chapter 6 – Insects of Vegetable Crops

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1. Colorado Potato Beetle: *Leptinotarsa decemlineata*

• The Colorado potato beetle (*L. decemlineata* Say) (Coleoptera: Chrysomelidae, Chrysomelinae) is a potato pest that is particularly harmful during severe infestations. It specifically attacks leaves and can completely destroy plants. It has become the most important potato pest in Canada and the United States.

Systematic position

- Class: Insects
- Subclass: Pterygotes
- Group: Neopterans
- Subgroup: Endopterygotes, holometabolous
- Order: Coleoptera
- Suborder: Phytophaga
- Family: Chrysomelidae
- Subfamily: Chrysomelinae
- Genus: *Leptinotarsa*
- Species: *Leptinotarsa decemlineata*

1.1. Morphological characteristics

- Forewings are hardened and have become elytra.
- The sutural margins of the elytra meet without overlapping.
- Mouthparts are chewing type.
- The prothorax is usually free from the meso- and metathorax, which are closely joined to the abdomen.
- Antennae are fairly short and inserted in front of the eyes, which touch the pronotum.
- Adult: 9.5 mm long and 6.4 mm wide.
- Body oval and convex.
- Elytra yellow and striped, bearing 10 characteristic black stripes (Fig. 33).
- Depending on developmental stage, larvae measure 1.5–12 mm; they are orange-yellow, with black head and legs, and two rows of black spots on the abdomen (Fig. 34).

Figure 34. Adult Colorado potato beetle, *Leptinotarsa decemlineata*

Figure 35. Colorado potato beetle larvae completely defoliating a potato plant

1.2. Biological characteristics

- The duration of each stage varies according to temperature.
- Optimal development: 25–33°C.
- Adults and larvae are phytophagous.
- They seek food on host plants, especially Solanaceae.
- Host selection is relatively narrow, particularly potato.

- In North America, several wild Solanaceae species such as *Solanum elaeagnifolium* host some beetle populations.
- These plants provide refuges when the cultivated host plant is rare or absent, but the most suitable host remains cultivated potato, *Solanum tuberosum*.
- However, the Colorado potato beetle can complete its life cycle on flowering tobacco, *Nicotiana glauca*.
- The most compromising species for larval development through to adulthood is tomato.

1.3. Development cycle and voltinism

- Adults overwinter in the soil at a depth of 7.6–12.7 cm.
- After overwintering, when they appear (May–early June), they search for potential hosts.
- After 5–10 days, females begin laying egg masses of 20–60 eggs on the underside of leaves.
- Oviposition continues for several weeks.
- Larvae hatch 4–9 days after oviposition and pass through 4 stages.
- Young larvae eat the leaf on which they were born.
- L2 disperses over the plant; L3 and L4 disperse farther and cause considerable leaf damage.
- The last stages burrow into the soil for pupation.
- Pupation ends 5–7 days later with emergence of the adult.
- During summer, 1 or 2 generations are produced depending on region and environmental conditions.
- The number of generations depends greatly on temperature: up to 4 generations in the warmest regions of the insect's range (30-day cycle), and 1 complete plus 1 partial generation in the coldest areas.

1.4. Damage / harmfulness

- Commercial crops damaged by various Colorado potato beetle populations are mainly eggplant and tomato, but especially potato, for which it is the most important defoliating insect; both larvae and adults feed on leaves.
- It is one of the most widespread and important insect pests of potato.
- It can sometimes cause up to 50% yield and harvest losses, as reported in some EPPO countries.
- After hatching, larvae consume leaves before entering the soil to transform into adults.
- Adults then consume potato plant leaves and completely defoliate them (Fig. 34).
- Severe attacks can cause partial or total destruction of plants, affecting tuber development.
- It can completely defoliate a potato field within a few days.
- Harvest may be severely reduced under heavy infestation.
- Stems and exposed tubers may also be attacked.
- One larva consumes 35–45 cm² of leaves during its cycle.
- Adults may consume up to 10 cm² of leaves per day.
- In addition to foliage loss, toxic glycoalkaloid compounds (solanine and chaconine) are found in greater quantities in infested tubers.
- It is a vector of numerous potato diseases, including *Ralstonia solanacearum* and *Clavibacter michiganensis* subsp. *sepedonicus*.

Control

Regular monitoring

- Regularly inspect potato plants and other Solanaceae for early signs of infestation.
- Intervene as soon as 2 foci per 1,000 m² are observed (1 focus = 1 or 2 plants with at least 20 larvae).
- Since Colorado potato beetles enter fields from the borders, observations are made by inspecting 100 m of field edge over a width of 10 m (1,000 m²).

Manual collection

- At the beginning of an infestation, manually collect Colorado potato beetle larvae and adults: regularly monitor susceptible plants and remove individuals as they appear.
- Eggs can also be found on the underside of leaves: crush them or place them in soapy water for elimination.
- This method can be time-consuming and meticulous depending on field size, but it is the most effective and has the advantage of having no negative environmental impact.

Biological control

- Introduce a natural enemy of the Colorado potato beetle:
- *Steinernema carpocapsae* (nematode), used as a spray on infested vegetation as soon as larvae appear on foliage (therefore it is not a preventive treatment).
- After application, larvae on the soil or plants become parasitized and are eliminated within 24–48 hours.
- *Coccinella septempunctata* (seven-spot ladybird) and *Adalia bipunctata* (two-spot ladybird), particularly their nymphs, feed on beetle eggs, larvae and adults, helping control pest populations.
- The green grasshopper also feeds on caterpillars and Colorado potato beetle larvae.
- Chickens scratch the soil at the end of winter to eliminate dormant larvae.
- Other predators include ground beetles, earwigs, predatory bugs and some bird species such as blackbirds and sparrows.

Natural products

- Colorado potato beetles appear to have developed resistance to chemical control over time.
- Repellent natural products nevertheless exist:
- Sprays made from plant macerations (nettle, tansy, comfrey, etc.), prepared by soaking leaves in water for several days.
- Botanical pyrethrum-based bio-insecticides.
- Bordeaux mixture (copper sulfate).
- These products are not selective, so their use is recommended only occasionally.
- One evening spray will have a lower harmful impact on small pollinators.

Prevention for Colorado potato beetle control

- Crop rotation plays an important role by disrupting the beetle's reproductive cycle. Avoiding cultivation of plants from the same family on the same plot for several consecutive years can limit beetle presence.
- Remove volunteer plants as they appear: adults potentially dormant in the soil will no longer have a food source when they become active.
- Grow early varieties, whose premature drying of foliage also removes a food source.
- Traps: use pheromone traps to attract and trap adult Colorado potato beetles and reduce their numbers.

Use repellent flowers and companion planting

- Combining potatoes and other Colorado potato beetle host plants with repellent plants can give good results.
- Garlic, chives, hemp and castor bean have repellent properties against insect pests.
- Natural decoctions: preparations based on garlic, chili or basil may have repellent effects on adult beetles.
- Establishing a fallow area with an easily cultivated mixture of annual flowers limits beetle presence by making the environment less hospitable: plant blue flax, summer savory and marigold near target vegetables, between rows or along borders.
- The aromatic compounds they release are known to disturb Colorado potato beetles.
- Flowering occurs from June to September, during the beetle's active period.

Among companion plants: chives, marigolds and flax.

Natural and chemical insecticidal and repellent products against Colorado potato beetles

Several natural insecticidal and repellent products can be used to treat infestations.

Neem oil

- Neem oil, extracted from neem tree seeds, acts as a natural repellent against adult Colorado potato beetles and larvae.
- It disrupts feeding and growth, thereby preventing them from damaging plants.
- It can be applied to potato leaves for effective action.

Pyrethrum extract

- Pyrethrum is a natural extract from certain chrysanthemum varieties.
- It acts as an effective insecticide against adult Colorado potato beetles.
- Pyrethrum extract can be sprayed on plant leaves to kill adults present.

Synthetic products

- Success 4 (spinosad) or Coragen (chlorantraniliprole), particularly effective against Colorado potato beetles.

Biopesticides: *Bacillus thuringiensis* (Bt)

- *B. thuringiensis* is a natural bacterium that acts as a specific insecticide against larvae of certain insects, including Colorado potato beetles.
- When larvae ingest Bt, they develop an intestinal infection that kills them.
- It can be applied to plant leaves to control beetle larvae.
- Treatment effectiveness may vary according to factors such as infestation severity, soil temperature and weather conditions.
- Regular plant monitoring is recommended to detect infestation and apply treatments as needed.

Other methods

- Use white vinegar diluted with water at an equal ratio.
- Repeat every 3–4 days.
- Avoid applying vinegar in sunny or hot weather, as it may burn leaves.
- Garlic and chili: solutions based on garlic and chili can be used as natural repellents against Colorado potato beetles. These ingredients contain compounds that repel insects. Mix water with crushed garlic or chili and spray the solution on plants.

2. Other pests of vegetable crops

2.1. Aphids

- Order: Homoptera (2 pairs of similar wings); Superfamily: Aphidoidea; Family: Aphididae.
- Small, 1–4 mm, with a soft body that may be green, black, brown, pink or almost colorless.
- Antennae consist of 2 short, broad basal segments and up to 4 thin terminal segments.
- Piercing-sucking mouthparts: stylets enclosed in a rostrum formed from modified mandibles and maxillae.
- Long, thin legs with a two-jointed tarsus and 2 claws.
- Most aphids have a pair of cornicles = abdominal tubes located on the dorsal surface of the fifth abdominal segment; role: excretion of honeydew.
- Winged and wingless forms exist.
- One host: monoecious species; two hosts: dioecious species.

Development cycle of aphids

- Winter egg → spring → wingless fundatrix female → summer → virginoparous females, wingless and winged → several generations → autumn → sexual female and adult males → fertilization → winter egg.

Damage characteristics

- Aphids are among the most destructive insect pests of cultivated plants in temperate regions.
- In addition to weakening plants by sucking sap, they act as virus vectors and disfigure plants by depositing honeydew, followed by the development of sooty mold.

Main species

- Black bean aphid: *Aphis fabae*.
- Cotton and melon aphid: *Aphis gossypii*.
- Potato aphid: *Macrosiphum euphorbiae*.
- Cabbage aphid: *Brevicoryne brassicae*.

Control – Mechanical control

- The first means of controlling aphids is mechanical control. It consists of:
- Dislodging aphid colonies with a jet of water (garden hose or sprayer).
- Crushing aphids by hand, which is slow and tedious.
- For fruit trees, a glue band placed around the trunk and tree support is often recommended.

- This device, intended to trap ants mechanically, also captures other useful insects.

Natural anti-aphid treatments

- Spray a black-soap solution at 15–30 g per liter of water at the first attacks.
- Water jets are fairly effective.
- A botanical pyrethrum insecticide as a last resort.
- On fruit trees, apply a white lime-based wash to the trunk and main branches the winter following a year of heavy pest invasion, rather than systematically every year or every two years.
- This destroys a large proportion of overwintering aphid forms, among other pests.

Prevention

- Aphid colony development is often a sign of excessive plant vigor and an imbalance in sap composition.
- Avoid excess nitrogen-rich fertilizer.
- Create good garden balance:
 - Plant ground covers that provide shelter for beneficial larvae, especially ladybirds.
 - Establish a bed of phacelia and borage early in spring; it will flower from early June.
 - These flowers attract hoverflies, which are aphid predators.
- Encourage permanent presence and winter survival of beneficial organisms by installing shelters and nesting boxes so they act as early as possible in spring and stop outbreaks: ladybirds (one ladybird can eat up to 70 aphids/day), lacewings, parasitoid wasps, tits, earwigs, hoverfly larvae, gall-midge larvae, lacewing larvae and entomopathogenic fungi.
- Plant many flowers around and among the vegetable garden and leave “relay” plants infested with aphids (chamomile, nasturtium, foxglove, etc.).

Left: lacewing larva. Right: adult lacewing.

The tit feeds on aphids.

2.2. Thrips (Order: Thysanoptera)

Description

- 1–2 mm.
- Adults are often winged (some species are wingless).
- Wings fringed with setae, giving a feathery appearance.
- Piercing-sucking mouth cone.
- Larvae are wingless, elongated, yellow, red, brown or black, and move slowly.

Biology

- Develop in hot, dry weather.
- When conditions are favorable, development can be very rapid: they are polyvoltine.
- Under unfavorable conditions, larvae leave the aerial parts of the plant and burrow into the soil to overwinter.

Symptoms

- Foliage develops tiny gray spots that become silvery streaks over time.
- Young shoots, flowers and fruits become deformed and then necrotic; leaves eventually dry out.
- Gray-silver spots or mottling.
- Unless the attack is very severe, the plant rarely dies.
- However, thrips can weaken plants and transmit viral diseases, such as tomato spotted wilt disease.

Damage on tomato leaf

Damage on cabbage

Host plants

- Tomato, cucumber, green bean, onion, leek, eggplant, etc.
- About 3,000 more or less harmful species belonging to several genera (Frankliniella, Thrips, Echinothrips,

Gynecothis, etc.).

- Each species has a particular host plant.
- Examples: onion thrips, pea thrips and tobacco thrips.

Control

- Prevention: humidify from May and throughout summer during hot, dry weather by regularly spraying foliage of plants that are not susceptible to fungal diseases.
- Biological control with predators: bugs of the genus Orius, predatory mites Amblyseius cucumeris and the nematode Steinernema feltiae.
- Traps: blue, white or yellow sticky cards to eliminate adults.
- Chemical control: in case of very heavy attack, use natural insecticides (garlic decoction added to a black-soap solution, neem oil, etc.) or pyrethrum.