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Colorado potato beetle LIFE STAGES



Adult Colorado potato beetle,
Leptinotarsa decemlineata (Say)

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Introduction

The Colorado potato beetle, *Leptinotarsa decemlineata* (Say), has become the most significant pest on potato across Canada and in many potato-growing areas of the United States. Managing the pest successfully, using either a traditional or a sustainable method, depends on being able to reliably monitor populations at each life stage. Specific descriptions of the different life stages are scattered in the scientific literature and originated mostly in European publications more than 20 years ago (Wegorek, 1959; Niezgodzinski and Koroluk 1976). The new North American data on larval instars provided here are presented in a manner to make the information more accessible to a variety of users ranging from the home gardener to the research scientist. The adults are relatively easy to recognize, although they can be confused with some other insects by less-informed growers or gardeners. Some larval stages of the beneficial Coccinellidae (lady beetles) are, however, often confused with those of the Colorado potato beetle. This guide is designed to help scientists, commercial growers, and gardeners to identify, both in the

laboratory and in the field, the life stages of the Colorado potato beetle. An easy-to-use key to the stages is complemented by photographs of each stage along with highlighted descriptive characters. Identification is based on characteristics that are visible either to the naked eye or with the use of a 6-10 X hand lens. It reviews and assembles the information available on the life stages of the Colorado potato beetle, so that growers and gardeners can take full advantage of new trends in the control of this pest. For example, the recently registered biological agent *Bacillus thuringiensis* is significantly more effective against the first and second instars than against the third and fourth; therefore it has become important to identify the characteristics of each larval instar. This insecticide is not effective for controlling adult beetles.

Life cycle

The complete life cycle of the Colorado potato beetle in Canada involves seven life stages. The adult beetle overwinters buried in the soil at depths of up to 50 cm. During the spring, the beetles respond to rising temperatures and generally first appear during the last week of May or in early June. They seek host plants from the family Solanaceae, which include crop plants such as potato, tomato, and eggplant. Weeds such as nightshade and horse nettle can also support populations of Colorado potato beetles. The females then lay eggs in masses on the leaves. Each egg mass contains about 30 eggs. Oviposition continues for several weeks during which time females may move from older to younger plants. During this period adult beetles feed voraciously on potato leaves. Larvae (Fig. 1) also feed mostly on the leaves of their host plants and, except when they are molting, feeding is almost continuous. There are four larval instars. When the fourth instar larva ceases feeding, it burrows into the soil to pupate. Adult beetles emerge 1-2 weeks later.

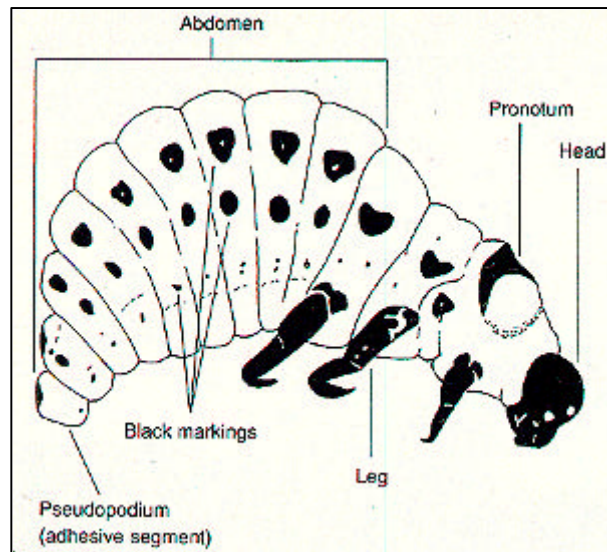


Fig. 1. Morphological characteristics useful for identifying and recognizing the four larval instars of the Colorado potato beetle (adapted from Bounhiol 1927).

In Canada, depending on the region, adults emerging from pupation may either feed briefly and then enter an overwintering diapause or produce immediately a second generation. The factors that can induce diapause are short photoperiod and poor-quality host plants. Low temperatures also bring on diapause. In most areas of the country only one generation normally occurs; there may occasionally be a full or partial second generation, however, this usually is late in the season and does not significantly affect potato yields. Such a second generation normally occurs in southern Ontario and southern Quebec.

Identification

Adult stage

The Colorado potato beetle belongs to the family Chrysomelidae, the leaf beetles, and the subfamily Chrysomelinae. Adult beetles are oval and robust and are convexly rounded (Fig. 2a). They are easily differentiated from other chrysomelid adults, because only they have the head inserted deep in the thorax. They vary somewhat in size but average 6-11 mm in length and about 3 mm in width. The orange-yellow beetles have black markings, the size and number of which vary in different individuals. The elytra (hardened forewings) on the dorsum of the thorax and abdomen display ten characteristic black stripes; hence the species name, *decemlineata*, meaning ten lines. The posterior end of the last ventral abdominal segment is depressed in the male, whereas in the female this depression is absent. Rivnay (1928) has described the external morphology of the adult in more detail. In Canada, the Colorado potato beetle is the only species representing the genus *Leptinotarsa*. Other hardshell beetles found on solanaceous plants differ considerably in appearance, generally having spots instead of stripes. The adult Coccinellidae (lady beetles) are usually smaller, more brightly colored, and not leaf feeders. Some coccinellid species can eat eggs and young larvae of the Colorado potato beetle.

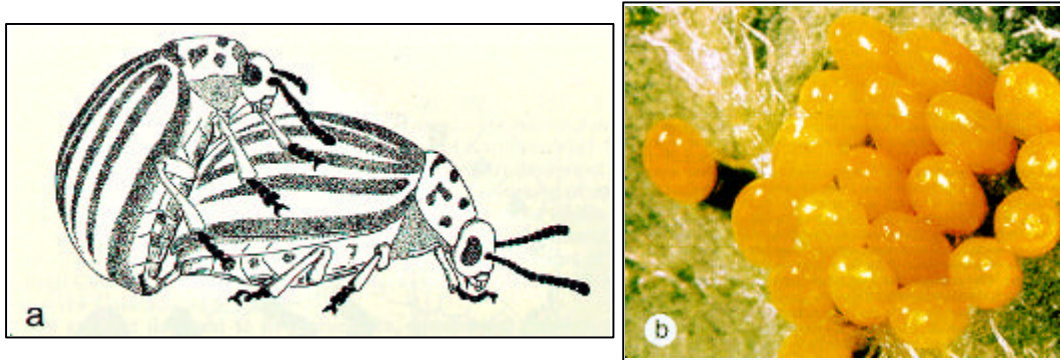


Fig. 2. Colorado potato beetle: **a** - mating pair, and **b** - egg mass.

Egg stage

Yellow-orange oblong eggs are laid on end during daylight, usually on the underside of the leaves, in clusters of 20-30 (Fig. 2b). Eggs hatch producing larvae within 4-9 days of oviposition. Lady beetle eggs (Coccinellidae) are also laid in clusters and are similar in appearance; however, they are smaller than those of the Colorado potato beetle.

Larval instars

The four larval instars are characterized by their large abdomen and arched back (Fig. 1). The orange pink larvae have black spots and are up to 15 mm in length in their last instar (Fig. 3, 4).

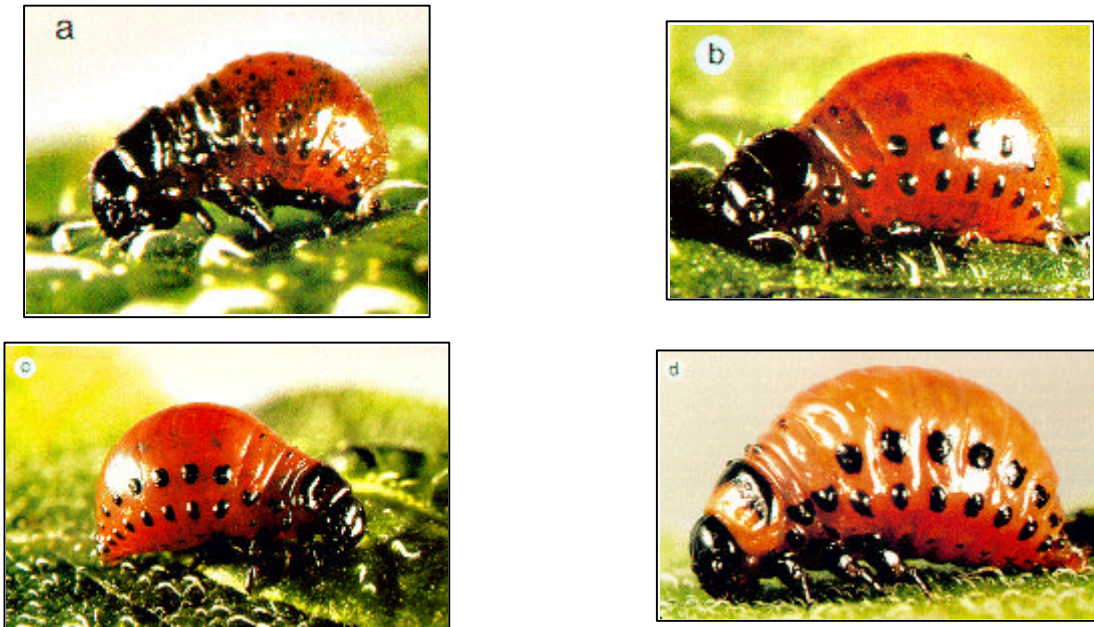


Fig 3. Larval instars of the Colorado potato beetle: **a** - first, **b** - second, **c** - third, and **d** - fourth.








Character \ Larval instar	(top view) 	(top view) 	(side view) 
	Head width (mm)	Pronotum	Average body length (mm)
1	0.6		1.5
2	1.0		3.0
3	1.6		5.0
4	2.4		8.0

Fig. 4 Identification key to the four larval instars of the Colorado potato beetle; head width and color of the pronotum are the most reliable characters (drawings adapted from Bounhiol 1927).

The head is small and black. Behind the head, above the first pair of legs is another sclerotized (hard) structure: the pronotum. This structure is entirely black in first- and second-instar larvae. In third-instar larvae, the anterior margin of the pronotum appears orange-brown. In fourth-instar larvae, about half the pronotum is light brown anteriorly. The abdomen has nine segments (Fig. 1); and at its posterior end is a tubelike structure that has some adhesive properties. Bounhiol (1927) has described the external and internal morphology of the last larval instar in more detail. Larvae of Coccinellidae (lady beetles) may be found on the same host plants but they are elongated, more flattened, and often dark in color with

bright-colored spots. The size and color of the four larval instars are variable and, therefore, are not valid discriminating characters. The size of the head is more reliable. The greatest width of the head changes at each molt when the larvae pass from one stage to the next. The head capsules of about 250 larvae taken from the field were measured. Heads measured $0.63 + 0.09$, $1.03 + 0.09$, $1.60 + 0.10$, and $2.36 + 0.16$ mm for larval stages 1,2,3, and 4, respectively. Although these represent small dimensions, given a little practice most people can become proficient at differentiating each stage. The stadium or the time spent in each larval instar varies with temperature. In Canada, the first three stadia each occupy about 2.5-4.0 days. The fourth instar takes 6.0-9.0 days to develop. Therefore the total time Colorado potato beetles spend as larvae varies from 13.5 to 21.0 days. First-instar larvae remain clustered as in the egg mass, eating first the egg shells and then the leaf. During the second instar, they begin to disperse over the plant. Together the first- and second-instar larvae eat about one-quarter of the plant surface eaten by all instars. The leaves are eaten at the edge in irregular patterns. The third- and fourth-instar larvae disperse further and do significant damage to the leaves.

Pupa

The large, fully stretched fourth-instar larvae burrow a few centimetres into the ground. There, in a prepupal stage, they spend at least as much time as they have already spent on the plant in their fourth instar. A molt then occurs disclosing the pupa (Fig. 5). After another 5-7 days, the pupae transform into adults, completing the metamorphosis.

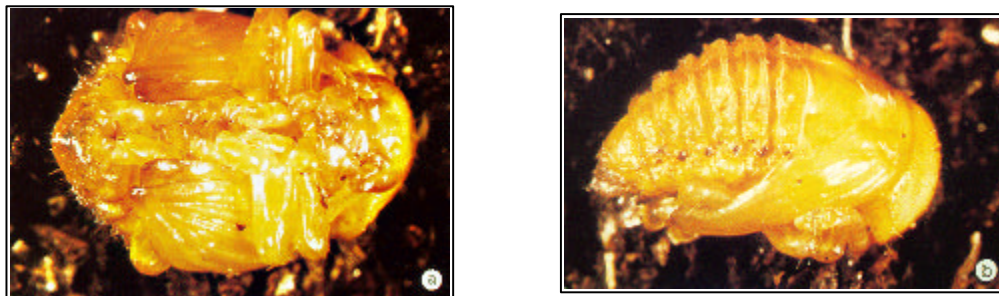


Fig. 5 Pupae of the Colorado potato beetle; **a** - ventral view, and **b** - lateral view.

The sex of the beetle can also be determined at the pupal stage. The seventh abdominal segment on the ventral side is complete and depressed in its centre in the males. This segment is divided in its Centre by a dark line in the females (Pelletier 1990).

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