

EPPO DATA SHEETS ON QUARANTINE PESTS

Diabrotica undecimpunctata

IDENTITY

Name: *Diabrotica undecimpunctata* Mannerheim

Synonyms: *Diabrotica soror* Le Conte

Taxonomic position: Insecta: Coleoptera: *Chrysomelidae*

Common names: spotted cucumber beetle (English)
chrysomèle maculée du concombre (French)

Notes on taxonomy and nomenclature: the nominate subspecies *D. u. undecimpunctata* (known as the western spotted cucumber beetle) can be distinguished from the more widely distributed and generally more important subspecies *D. u. howardi* Barber (synonyms *D. duodecimpunctata* Fabricius, *Chrysomela duodecimpunctata* Fabricius, *Crioceris sexpunctata* Fabricius), known as the 12-spotted cucumber beetle or, in the larval stage, southern corn rootworm (Bayer computer code DIABUH). In addition to these two subspecies, Barber (1947) provided information about *D. u. duodecimnotata* Harold and *D. u. tenella* LeConte. *D. undecimpunctata* is closely related to the major pests *Diabrotica barberi* and *Diabrotica virgifera* (northern and western corn rootworms) (EPPO/CABI, 1997a).

Bayer computer code:DIABUN

EPPO A1 list: no. 292

EU Annex designation: I/A1

HOSTS

D. undecimpunctata howardi is polyphagous. Adults attack many cultivated plants including most characteristically *Cucurbitaceae* (e.g. *Cucumis sativus*, *Cucumis melo*, *Cucurbita pepo*, *Citrullus vulgaris*) but also groundnut (*Arachis hypogea*), soybean (*Glycine max*), *Phaseolus vulgaris* and other legumes, maize (*Zea mays*), sweet potato (*Ipomoea batatas*). If flowers are available, adults will feed on them rather than leaves causing reductions in fruit yield. If flowers are not available, adults prefer the foliage of cucurbits to other crops. The larvae feed mainly on the roots of maize, but can also feed on various other plants (cucurbits, legumes, sweet potato, weeds). They differ in this from the larvae of the closely associated striped cucumber beetle *Acalymma vittata*, which feed exclusively on the same cucurbit hosts as the adults. *D. undecimpunctata undecimpunctata* has a more restricted host range, the adults feeding mainly on cucurbits and the larvae on maize (like *D. virgifera*).

GEOGRAPHICAL DISTRIBUTION

The older literature did not distinguish the two subspecies and CABI/EPPO (1998a) does not attempt to present their distribution separately. In the distribution given below, the records of subsp. *undecimpunctata* are believed to be reliable, and show its presence essentially in the southwest; it is possible that some of the records in western North America given for subsp. *howardi* in fact refer to subsp. *undecimpunctata* (or both).

Diabrotica undecimpunctata undecimpunctata

EPPO region: Absent.

North America: USA (Arizona, California, Colorado, Oregon)

EU: Absent.

Diabrotica undecimpunctata howardi

EPPO region: Absent.

North America: Canada (Alberta, British Columbia, New Brunswick, Nova Scotia, Ontario, Québec, Saskatchewan), Mexico (Central highlands: Guanajuato, Morelos, Michoacán and Querétaro states), USA (Alabama, Arizona, Connecticut, Delaware, Florida, Georgia, Idaho, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Maine, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, Rhode Island, South Carolina, South Dakota, Tennessee, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, West Virginia, Wyoming)

EU: Absent.

Distribution map: See CABI/EPPO (1998a).

BIOLOGY

The two main subspecies have very similar biology (Metcalf & Metcalf, 1993). After overwintering under leaves and trash in woodland, the adults become active in the spring and feed on the flowers and foliage of many different host plants, moving to cucurbits as soon as they become available. They can fly when temperatures reach 21°C (Metcalf & Metcalf, 1993). Females lay 200 to 1,200 eggs singly in the soil, close to the bases of larval host plants. Newly laid eggs are dependent on sufficient soil moisture for survival within the first 24 to 72 h (Krysan, 1976); thus females prefer to oviposit in moist or wet, organic or clay soils (Brust & House, 1990). The larvae hatch after 7-10 days and bore into the roots of their usually poaceous hosts where they feed for 2-4 weeks, passing through three instars. During the latter part of the third instar, the larvae leave the host plants, burrow into the soil and enter the inactive or prepupal stage of the larval period which usually lasts 6-8 days. Pupation takes place in an earthen shell and lasts 6-12 days (Arant, 1929).

Adults of the new generation often move from one host to another, starting on the larval host maize (silks) or groundnut and moving onto the cucurbit hosts in mid-summer, and finally onto subsidiary hosts, such as chrysanthemums, in the autumn (Hays & Morgan, 1965). Even later in the year, the adults feed on winter legumes. The beetles feed until temperatures force them to become inactive. Mating occurs before the winter and before the onset of a reproductive diapause in response to a reduced photoperiod of 13 hours (Elsey, 1988). In southern North America, a complete life cycle requires 6-9 weeks and there are two or three generations per year. Continuous overlapping generations are possible in subtropical and tropical regions (Metcalf & Metcalf, 1993). In northern North America, there is one generation per year (Campbell *et al.*, 1989) and adults are unable to overwinter, flying in from areas further south.

It should be noted that *D. undecimpunctata* overwinters as adults, in contrast to *D. virgifera*, which overwinters as eggs. Populations of the latter species are accordingly concentrated in fields of the larval host (maize), whereas *D. undecimpunctata* tends to be associated with the host plants of the adults (cucurbits).

DETECTION AND IDENTIFICATION

Symptoms

Infested maize plants usually show the effect of larval infestation of the roots when they are 20-50 cm tall. Plants grow poorly, becoming stunted and yellow, but may survive and still produce grain. If the stem is attacked, internal drilling causes the bud to wither and die. The plant may be killed outright (Arant, 1929). Infested cucurbits show adult feeding holes in the leaves and scars on runners and young fruits. Scarring in the crown of the plant is also typical of adult damage.

Morphology

Eggs

Eggs are generally oval, 0.7 x 0.5 mm, light yellow when first oviposited, but become darker yellow as they age. The surface of the egg is covered with tiny hexagonal pits (Arant, 1929).

Larva

Larvae have a yellowish white, wrinkled body, 12-19 mm long, with six very small legs, and a greyish-brown head.

Pupa

Length about 6.3 mm, width about 3 mm. White becoming yellow with age.

Adult

Length 6-7.5 mm long. In *D. u. undecimpunctata*, the abdomen is greenish-yellow with 11 black spots on the elytra (Arnett, 1985), while in *D. u. howardi*, it is yellow to yellowish-red with 12 large black spots. The head, antennae and legs are entirely black (*howardi*) or with some greenish-yellow (*undecimpunctata*). *D. undecimpunctata* is a larger and heavier beetle than *D. virgifera*.

MEANS OF MOVEMENT AND DISPERSAL

The adults are strong fliers and can disperse rapidly, travelling readily from field to field during the summer. As in *D. virgifera* (western corn rootworm) which has already been introduced into the EPPO region (EPPO/CABI, 1997a), adults can be carried long distances by high-altitude air currents, e.g. up to 800 km in 3-4 days (Shands & Landis, 1964).

PEST SIGNIFICANCE

Economic impact

D. undecimpunctata is more abundant and destructive in the southern part of its range. Adults damage various vegetable and flower crops, especially cucurbits. In this respect, they are more significant pests than the adults of *D. virgifera* and *D. barberi*. In general, indeed, *D. undecimpunctata* is more often cited as a pest of cucumber than of maize (hence its common name). For practical purposes, *D. undecimpunctata* is often considered together with another chrysomelid *Acalymma vittata* (striped cucumber beetle), which causes very similar damage. In Canada, Beirne (1971) reported a 100% loss of watermelon seedlings as a result of attack by *D. u. howardi*. Attacks on older plants result in a

general leaf parching. Attacked fruits of cucumber and pumpkin have a characteristic pinhole appearance that can reduce their market value (Beirne, 1971). *D. u. howardi* has been reported to attack glasshouse-grown cucumbers after moving from field-grown cucumber plantings (Beirne, 1971). *D. undecimpunctata* is also cited as the most important soil-inhabiting pest which feeds on the foliage of groundnut in North Carolina and Virginia.

D. undecimpunctata is also a root pest of maize, but is of lesser importance on this crop than the related *D. virgifera* and *D. barberi*. Subspecies *howardi* is mainly concerned in this respect. Damage by *D. u. howardi* occurs most often on heavy clay soils or soil high in organic content. During periods of very wet weather, it may cause damage on any soil type, even sandy soils (French, 1978). The geographical range of *D. u. howardi* is almost entirely enclosed within the recorded range of *D. barberi* (CABI/EPPO, 1998b), and it is not clear whether the damage caused specifically by southern corn rootworm is generally distinguished from that attributable to its northern sister species.

D. undecimpunctata is also important as a vector, particularly of cucurbit diseases, such as bacterial wilt (*Erwinia tracheiphila*), *Pseudomonas syringae* pv. *lachrymans* and cucumber mosaic cucumovirus (Howard *et al.*, 1994). On maize, in addition to direct feeding damage, *D. undecimpunctata* can vector viruses such as maize chlorotic mottle machlovirus, which can cause lethal necrosis in conjunction with maize dwarf mosaic or wheat streak mosaic potyviruses (Nault *et al.*, 1978). *D. undecimpunctata* also vectors the pathogen of bacterial wilt of maize (*Pantoea stewartii*) (EPPO/CABI, 1997b), but to a lesser extent than *Chaetocnema pulicaria*. Legume viruses vectored by *D. undecimpunctata* include bean mild mosaic carmovirus, bean southern mosaic sobemovirus and cowpea mosaic comovirus.

Control

The incidence of corn rootworms is limited by rotation of maize with other crops (in North America, typically soybean). Nevertheless, soil application of insecticides to control corn rootworms represents one of the largest uses of plant protection products in North America, mainly directed at *D. virgifera* and *D. barberi* (EPPO/CABI, 1997a). Control techniques used in North America include treating the soil with granular insecticides such as terbufos or isofenphos at the time of planting (Sutter *et al.*, 1990), late planting into land that has been ploughed earlier in the spring and applying granular baits containing cucurbitacin arrestants, which control adults when broadcast just before egg laying.

Control of adult *D. undecimpunctata* forms part of integrated pest management schemes for cucurbits, groundnut, beans etc. in USA. Early ploughing removes vegetation and discourages egg laying. Transparent screens can be used to exclude the beetles from cucurbit crops. Early trap plantings of cucurbits can be used to attract adults, which are then destroyed with insecticides. Various chemical attractants can be used to monitor populations and to provide some control (formulated as baits). Varietal resistance is sought in cucurbits and groundnut in particular. Despite these possibilities, chemical insecticides very commonly have to be used against spotted cucumber beetle, mainly to protect plants at the cotyledon stage and allow a good stand to establish, but also as foliar applications to prevent transmission of bacteria and viruses.

Phytosanitary risk

The closely related species *Diabrotica virgifera* (western corn rootworm) has been introduced into Serbia (YU) and is now spreading in the lower Danube basin (see www.eppo.org). As a result, this species has been classified as an A2 quarantine pest for EPPO, and the related *D. barberi* (northern corn rootworm) as an A1 quarantine pest. *D. undecimpunctata* presents a similar, but lesser, risk to maize cultivation in Europe. Adults of this species are also, more than in the case of *D. virgifera* and *D. barberi*, associated with damage to cucurbit and other vegetable or flower crops, and can vector bacterial and viral diseases. Existing experience of the spread of *D. virgifera* strongly suggests that *D. undecimpunctata* would rapidly spread in Europe if it entered. Its wide distribution (especially *D. u. howardi*) in North America also suggests that it could be damaging in large parts of the EPPO region, though mainly in the south.

PHYTOSANITARY MEASURES

No specific measures have yet been recommended at the European level. The risk of the presence of *D. undecimpunctata* in consignments of plants with soil arises particularly for fields of preferred hosts of the pest (such as cucurbits), rather than for fields on which maize was previously grown (as in the case of *D. virgifera*). These preferred hosts are relatively unlikely to enter transatlantic trade, while nurseries in which the more regularly traded plants are grown are relatively unlikely to harbour *D. undecimpunctata*. In most cases, the regular phytosanitary certificate requirement should be adequate, but for preferred hosts, such as cucurbits, place of production freedom might be required.

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