Diabrotica speciosa

Scientific name
Diabrotica speciosa Germar

Synonyms:
Diabrotica amabilis, Diabrotica hexaspilota, Diabrotica simoni, Diabrotica simulans, Diabrotica vigens, and *Galeruca speciosa*

Common names
Cucurbit beetle, chrysanthemum beetle, San Antonio beetle, and South American corn rootworm

Type of pest
Beetle

Taxonomic position
Class: Insecta, **Order:** Coleoptera, **Family:** Chrysomelidae

Reason for Inclusion in Manual
CAPS Target: AHP Prioritized Pest List - 2010

Pest Description
Diabrotica speciosa was first described by Germar in 1824, as *Galeruca speciosa*. Two subspecies have been described, *D. speciosa vigens* (Bolivia, Peru and Ecuador), and *D. speciosa amabilis* (Bolivia, Colombia, Venezuela and Panama). These two subspecies differ mainly in the coloring of the head and elytra (Araujo Marques, 1941; Bechyne and Bechyne, 1962).

Eggs: Eggs are ovoid, about 0.74 x 0.36 mm, clear white to pale yellow. They exhibit fine reticulation that under the microscope appears like a pattern of polygonal ridges that enclose a variable number of pits (12 to 30) (Krysan, 1986). Eggs are laid in the soil near the base of a host plant in clusters, lightly agglutinated by a colorless secretion. The mandibles and anal plate of the developing larvae can be seen in mature eggs.

Larvae: Defago (1991) published a detailed description of the third instar of *D. speciosa*. First instars are about 1.2 mm long, and mature third instars are about 8.5 mm long. They are subcylindrical; chalky white; head capsule dirty yellow to light brown, epicraneal and frontal sutures lighter, with long light-brown setae; mandibles reddish dark brown; antennae and palpi pale yellow. Body covered by sparse, short, dark setae; light brown irregular prothoracic plate; dark brown anal plate on the ninth segment, with a pair of small urogomphi. A pygopod is formed by the tenth segment, which serves as a locomotion and adherence organ.

Pupae: Pupae are 5.8 to 7.1 mm long and white. Females with a pair of tubercles near the apex. Mature third instars build an 8 x 4 mm oval cell in the soil in which they pupate, and tenerals remain for about 3 days.

Figure 1. Adult *Diabrotica speciosa*. Photo courtesy of Hernan Tolosa.

Adults: Full descriptions of *D. speciosa* are given by Baly (1886), Araujo Marques (1941), and Christensen (1943). Adults are 5.5 to 7.3 mm long; antennae 4 to 5 mm (Fig. 1). General color grass-green (USDA, 1957); antennae filiform and dark (reddish-brown to black) and nearly equal to the body in length, first three basal segments lighter; head ranging from reddish brown to black; labrum, scutellum, metathorax, tibiae and tarsi black; elytra each with three large oval transverse spots, basal spots larger and usually reddish toward the humeral callus, the rest yellow. Ventrally, head and metathorax dark brown, prothorax green, mesothorax and abdomen light brown or yellow-green. Pronotum bi-foveate, convex, smooth, shiny, ¼ wider than long. Male antennae proportionally longer than female antennae. Males with an extra sclerite on the apex of the abdomen that makes it look blunt, compared with the rather pointed female apex.

Biology and Ecology

Eggs are laid on the soil near a larval host plant. An approximately 92% success rate at 27°C is takes place after about 8 days. *Diabrotica speciosa* undergoes three larval instars, which are easily differentiated by the size of the head capsule (see larval description above). In laboratory tests, maize was included in the grouping of most suitable hosts (along with wheat and peanuts), in terms of survival from egg to adult (Cabrera Walsh, 2003). First instars are normally scattered throughout the host's root system, but mature larvae tend to congregate in the upper 10 cm of the root under the crown. The larval stage lasts 23 to 25 days (~12 days in laboratory conditions at 25°C), including an inactive prepupal period of 2 to 3 days. At 25°C, the pupal stage lasts 6 days, and is followed by a period of 3 to 5 days during which the recently molted adults remain in the pupal cell, presumably for the cuticle to tan (USDA, 1957).

Young beetles have a yellowish or pale brown color, which turns green with bright yellow spots in 3 days if fresh food is provided. Under laboratory conditions, mating has been observed between 4 and 6 days after emergence, and some females were observed mating again at day 35. Each female laid an average of 1164 eggs during her lifetime, starting on day 8 and extending for a maximum of 77 days. Peak oviposition was observed on days 16 through 56. In a laboratory environment, oviposition on maize was preferred over pumpkin, potato and bean seedlings, and maize was as attractive as peanuts in choice tests (Cabrera Walsh, 2003). The number of overlapping generations is conditioned by latitude and climate, being continuous in tropical areas. In Buenos Aires, Argentina, observations indicate there are about three generations per year; the number and timing depends on latitude and climate. Overwintering occurs as an adult (USDA, 1957). These adults can be found concealed in the rosette and crown of winter-growing plants, and they are fairly cold-tolerant (EPPO, 2005).

Pest Importance

Diabrotica speciosa is considered to be an important pest throughout southern South America (except Chile), but, being highly polyphagous, qualitative reports of its impact on different crops vary in different regions. It is considered an important pest of maize, cucurbits, and orchard crops throughout its distribution (CABI, 2007). Although it migrates as an adult, no information on observed distances has been found. Redistributing soil via farm machinery that is contaminated with eggs and-or pupae is also a concern.

Adults of this chrysomelid feed on foliage, pollen, flowers and fruits of many plants. The larvae are pests of roots, especially maize. It is the most harmful species of *Diabrotica* in Argentina, mainly affecting peanuts in the center of the country. It causes considerable damage to watermelon, squash and tomatoes in Brazil, and potatoes and wheat in southeast Brazil. Young squash plantings and immature tomato fruits are severely damaged in Brazil. Populations are so heavy in some years in Paraguay that vegetable crops are almost completely destroyed. Severe injury also occurs on flowers of various ornamentals such as dahlias and chrysanthemums (USDA, 1957). Economic thresholds of two insects per plant for *Phaseolus vulgaris* were determined by Pereira et al. (1997).

IPM programs to combat *D. speciosa* in South America recommend no-till cultural practices, insecticides when reaching economically damaging levels and a rotation of maize, wheat, and soybeans. In South America, insecticides (carbamates, organophosphates and, more recently, tefluthrin and chlorethoxyfos) to control larvae and baits (along with broad-spectrum insecticides) to control adults are widely used. These baits are sliced roots of several different wild cucurbits laced with insecticides.

Although there is research into using parasitoids (brachonids and tachinids) and pathogens (*Beauveria* spp. and *Metarhizium anisopliae*) to combat this pest, no successful biological control programs have been mentioned.

Symptoms/Signs

The larval damage resulting from root feeding can cause host death when the host is small, but the larvae will usually only induce stunted growth in larger host plants, due to a reduction in nutrient uptake. In corn, attack on young plants by larvae produces a typical condition known as 'goose neck', in which the plant exhibits stunted growth, reduced vigor, and the first few internodes of the plant grow bent, sometimes to such an extent that the plant actually lies on the ground (Figure 2). In the case of peanuts and potatoes, the larvae cause external damage or short bores, similar to those of several other pests such as wireworms and other chrysomelids.

Figure 2. 'Gooseneck' growth form of corn. Photo courtesy of The Ohio State University.

On corn, the most economically important stage is the adult, which feeds on the tassels, preventing pollination and kernel number. Adults also cause defoliation and general feeding damage to leaves, flowers and fruit (EPPO, 2005). Like other *Diabrotica* spp., they are especially associated with Cucurbitaceae and are tolerant of cucubitacins and generally feed on pollen-rich plant structures of over 70 plant species. When flowers are scarce, beetles may feed on the tender green parts of other hosts, such as alfalfa, potatoes, corn, bean, soybean, lettuce, and cabbage causing plant damage, stunting, and possibly plant death (EPPO, 2005).

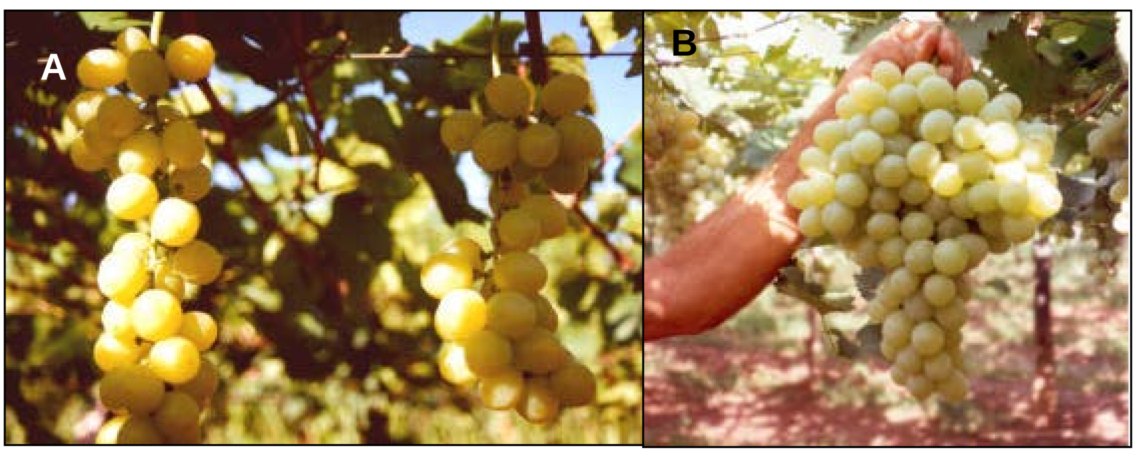

Figure 3. Grape cluster after a severe outbreak of *D. speciosa* during the bloom period (A) and normal cluster (B). Photos courtesy of Roberto et al. (2001).

In grape, adult beetles eat young leaf edges during budding, which usually does not seriously damage the host (Roberto et al., 2001). During the blooming period, however, beetles have been observed on flowers eating the style, stigma, and eventually the ovary. Beetle stigma feeding determines flower aborting and, as a consequence, clusters show low numbers of flowers and fruits (Fig. 3). Weedy hosts need to be controlled as beetles can also be observed feeding on and moving into grape from surrounding weeds.

Known Hosts

Root-feeding larvae of *D. speciosa* are polyphagous, but the known host range includes corn, wheat, peanut, soybean, and potato. Cabrera Walsh (2003) found that larvae developed well on corn, peanut, and soybean roots, but not so well on pumpkin, beans, and potato. Oviposition preferences roughly parallel larval suitability, but there was a clear preference for cucurbits as adult food, when available; pigweed, sunflower, and alfalfa are secondary hosts. As an adult, *D. speciosa* has been reported feeding on more than 70 host species (Christensen, 1943; Heineck-Leon and Salles, 1997).

Major hosts

Arachis spp*.* (peanut), *Capsicum* spp*.* (pepper), *Cucurbita maxima* (winter squash)*, Cucurbita pepo* (ornamental gourd), *Glycine max* (soybean), *Solanum tuberosum* (potato), *Triticum* spp. (wheat), *Vitis vinifera* (grape), and *Zea* spp. (corn).

Minor hosts

Allium spp. (onion, leek), *Alternanthera philoxeroides* (alligatorweed), *Amaranthus* spp. (pigweeds), *Apium graveolens* (celery)*, Arachis hypogaea* (peanut), *Artemisia* spp. (absinthium, tarragon), *Asparagus* spp. (asparagus), *Avena* spp. (oats), *Baccharis articulata*, *Beta vulgaris* (beet), *Brassica* spp. (mustards), *Bromus catharticus* (prairie grass)*, Camellia sinensis* var. *sinensis* (tea), *Capsicum annuum* (pepper), *Capsicum frutescens* (pepper), *Carica papaya* (papaya), *Cattleya* spp. (orchid), *Cayaponia* spp., *Chenopodium* spp., *Chrysanthemum* spp., *Cichorium* spp. (chicory, endive), *Citrullus lanatus* (watermelon), *Citrus* spp., *Coriandrum sativum* (coriander)*, Cucumis* spp. (melons, cucumbers, gerkins), *Cucurbita* spp. (cucurbits), *Cucurbitella asperata, Cynara* spp. (artichoke), *Cynodon dactylon* (Bahama crass),, *Dahlia pinnata* (pinnate dahlia)*, Datura* spp.*, Daucus carota* (carrot), *Fragaria vesca* (wild strawberry)*, Gossypium* spp. (cotton), *Helianthus annuus*(sunflower), *Helianthus tuberosus* (Jerusalem artichoke)*, Hibiscus* spp., *Ilex paraguayensis* (Paraguay tea)*, Ipomoea* spp. (sweet potato, morning glory), *Ipomoea purpurea* (common morning glory), *Lactuca sativa* (lettuce), *Lagenaria siceraria* (bottle gourd), *Lavandula angustifolia* subsp. *angustifolia* (English lavender)*, Lepidium didymum* (twin cress), *Lilium maculatum* (sukash-yuri)*, Linum usitatissimum* (flax)*, Lolium perenne* (rye grass)*, Luffa* spp. (loofah), *Malus* spp. (apple), *Malva* spp. (mallow), *Matricaria chamomilla* (chamomile)*, Medicago sativa* (alfalfa)*, Melilotus albus* (yellow sweet clover)*, Mentha* spp. (mint)*, Morrenia odorata* (latexplant)*, Musa* spp. (banana), *Nasturtium officinale* (watercress)*, Nicotiana tabacum* (tobacco), *Ocimum basilicum* (basil)*, Orginanum vulgare* (oregano)*, Oryza sativa* (rice), *Passiflora coerulea* (passion flower), *Petroselinum crispum* (parsley)*, Phaseolus* spp. (beans), *Physalis viscose* (starhair groundcherry)*, Pimpinella anisum* (anise)*, Pisum sativum* (pea), *Prunus* spp. (stone fruit), *Raphanus sativus* (radish)*, Rosa* spp. (rose), *Sechium edule* (chayote), *Sicyos polyacanthus, Solanum* spp.*, Solanum betaceum* (tree tomato), *Solanum lycopersicum* (tomato), *Solidago chilensis* (goldenrod)*, Sorghum* spp., *Spinacia oleracea* (spinach)*, Taraxicum officinale* (dandelion)*, Trifolium* spp. (clover), *Tropaeolum majus* (Nasturtium), *Vaccinium virgatum* (smallflower blueberry), *Vaccinium* *corymbosum* (highbrush blueberry), and *Zingiber officinale* (ginger) (Cabrera Walsh, 2003; Ministerio de Granaderia, Agricultura y Pesca, 2005; Anonymous, 2009)*.*

Known Vectors (or associated organisms)

There is evidence that *D. speciosa* is a viral vector for comoviruses, southern bean mosaic virus, mimosa mosaic virus, tymoviruses (such as passionfruit yellow mosaic virus), carmoviruses, and purple granadilla mosaic virus (Ribeiro et al., 1996; Germain, 2000). Lin et al. (1984) showed that *D. speciosa* transmitted cowpea severe mosaic virus (CPSMV – comovirus) to bean. Ribeiro et al. (1996) showed that eggplant mosaic virus (EMV – tymovirus) was transmitted to tobacco by *D. speciosa*. Carbrera Walsh (2003) mention that *D. speciosa* may also transmit bacterial wilt, caused by *Erwinia tracheiphila*, in cucurbits.

Known Distribution

Central America: Costa Rica and Panama. **South America:** Argentina, Bolivia, Brazil, Columbia, Ecuador, French Guiana, Paraguay, Peru, Uruguay, and Venezuela. There is a record of *D. speciosa* from Mexico, but according to Krysan (1986), it is almost certainly an error.

Pathway

Diabrotica speciosa could potentially move through international trade. This species has only been intercepted at U.S. ports of entry 2 times. Once from *Solanum lycopersicum* (tomato) originating from Argentina and once from *Lactuca* sp. originating from Peru. However, *Diabrotica* sp. have been intercepted over 1,000 times at U.S. ports of entry. Of these, 84 interceptions originated from countries where *D. speciosa* is known to occur (32 from Columbia, 21 from Ecuador, 16 from Costa Rica, 4 from Brazil, Peru, and Venezuela, 2 from Panama, and 1 from Argentina). These interceptions occurred in permit cargo (72), general cargo (6), holds (3), baggage (2), and miscellaneous (1). Interceptions occurred most commonly on *Chryssanthemum* sp. (6), *Aster* sp. (5), at large (5), *Musa* sp. (5), *Delphinium* sp. (5), and *Ananas comosus* (4) (AQAS, 2012; queried August 6, 2012).

Potential Distribution within the United States

According to a recent risk analysis by USDA-APHIS-PPQ-CPHST, the greatest risk for establishment of *D. speciosa* based on the presence of hosts and climate suitability occurs in much of the Midwest and portions of the South. The pest occurs from temperate Argentina to tropical Brazil. The polyphagous nature of *D. speciosa* increases the likelihood of finding hosts and suitable environment if it were introduced into the United States, and is thought to be able to adapt to more temperate climates.

Survey

CAPS-Approved Method*:
Visual.

*For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Literature-Based Methods:
Visual survey: Visual detection of adults is easy, as their feeding period spans from dawn until dusk. Detection of larval damage, on the other hand, is more difficult. First instars are very difficult to sample, and even large infestations can go undetected until the damage caused to the host is extensive. Larger larvae can sometimes be observed feeding on the roots of plants immediately after pulling out of the soil, but methodical sampling and counting methods have not been developed, as they have been for the North American pest species (Fisher and Bergman, 1986).

Figure 4. Adult banded cucumber beetle, *Diabrotica balteata. Photo courtesy of* John L. Capinera, University of Florida

Figure 5. Western corn rootworm, *Diabrotica virgifera.* Courtesy of USDA-ARS.

Trapping: Adults of *D. speciosa* appear to be universally attracted to aromatic compounds from squash blossoms, though the specific compound(s) that attract the beetles varies from species to species. Often, simple blends of two or three compounds are much more potent attractants than any single compound. In addition, female-produced sex attractant pheromones are used for mate location in this genus. In a preliminary trapping test in Brazil, a number of squash volatiles were screened for potential attraction, and 1,4-dimethoxybenzene showed promise as an attractant for *D. speciosa* (Ventura et al., 2000). Traps baited with 1,4-dimethoxybenzene, a volatile substance of *Cucurbita maxima* blossoms captured 29.4 times and 9.4 times more beetles than controls in soybean and common bean fields, respectively (Ventura et al., 2000).

The USDA-CPHST laboratory in Otis, MA has applied for funding to manufacture and test potential lures for *D. speciosa*, but has yet to begin work toward this goal.

Key Diagnostics/Identification

CAPS-Approved Method*: Confirmation of *D. speciosa* is by morphological identification. *Diabrotica speciosa* is almost identical to *D. balteata* (Fig. 4), which is widely present in the southern United States. Confirmation by a chrysomelid specialist is required. *Diabrotica speciosa* can also be confused with *Diabrotica viridula* (not present in the United States) and other pestiferous *Diabrotica* spe cies in South America. *For the most up-to-date methods for survey and identification, see Approved Methods on the CAPS Resource and Collaboration Site, at http://caps.ceris.purdue.edu/.

Literature-Based Methods:
Diabrotica speciosa somewhat resembles the other main pestiferous *Diabrotica* in South America, *D. viridula*, in coloring, size, biology and host range; but *D. viridula* has dark brown areas toward the cephalic edge of the elytral spots, and distinct humeral plicae. Also, the larvae of *D. viridula* lack urogomphi on the anal plate.

Figure 6. Southern corn rootworm, *Diabrotica undecimpunctata*. Courtesy of Clemson University - USDA Cooperative Extension Slide Series, http://www.bugwood.org/.

Diabrotica ID is available at http://idtools.org/id/beetles/diabrotica/. *Diabrotica ID* is designed to allow identification of *Diabrotica* species that originate from North and Central America to users lacking an expertise in taxonomy of *Diabrotica*. The tool treats and provides identification support for all 112 North and Central American species of the genus recognized by the authors. Each species is fully illustrated, treated with a fact sheet, and included in the key.

Easily Confused Pests

Survey and detection based on visual detection of symptoms is quite difficult and many other pests can be easily confused. Symptoms, such as dead heart in wheat, goose neck in maize, or stunted growth in most of the larval hosts of *D. speciosa*, could be attributed to several other root feeders, such as wireworms (*Conoderus* spp.; Elateridae), white grubs, (*Phytalus* spp., *Cyclocephala* spp., *Diloboderus abderus*; Melolonthidae), *Pantomorus spp.* and *Listronotus bonariensis* (Curculionidae), and several chrysomelids (*Caeporis* spp., *Colaspis* spp., *Maecolaspis* spp., *Diphaulaca* spp. and *Cerotoma arcuata*) (Gassen, 1984, 1989).

Other rootworms (western corn rootworm, southern corn rootworm) are easily distinguished from *D. speciosa* as adults by the markings on elytra (compare Figs. 1, 5 and 6).

References

Anonymous. 2009. *Diabrotica speciosa*. Orchids online. Accessed April 10, 2012 from: http://www.orchidsonline.com.au/node/7074.

AQAS. 2012. *Diabrotica* sp. interceptions. Last accessed August 6, 2012 from: https://mokcs14.aphis.usda.gov/aqas/HomePageInit.do#defaultAnchor.

Araujo Marques, M. 1941. Contributio ao estudo dos crisomeledeos do gunero *Diabrotica*. Bol. Escola Nac. Agron., 2:61-143. (In Portuguese)

Baly, J. S. 1886. The Colombian species of the genus *Diabrotica*, with descriptions of those hitherto uncharacterized. Part I. Zoological Journal of the Linnean Society, 19:213-229.

Bechyne, J. and B. Bechyne. 1962. Liste der bisher in Rio Grande do Sul gefundenen Galeruciden. Pesquisas (Zool.), 6:1-63.

CABI. 2007. Crop Protection Compendium. Wallingford, UK: CAB International. www.cabicompendium.org/cpc.

Cabrera Walsh, G. 2003. Host range and reproductive traits of *Diabrotica speciosa* (Germar) and *Diabrotica viridula* (F.) (Coleoptera: Chrysomelidae) two species of South American pest rootworms, with notes on other species of Diabroticina. Environmental Entomology 32(2): 276-285.

Christensen, J. R. 1943. Estudio sobre el g'nero *Diabrotica* Chev. en la Argentina (In Spanish). Rev. Facultad de Agronomia y Veterinaria, 10:464-516.

Defago, M. T. 1991. Caracterizacion del tercer estadio larval de *Diabrotica speciosa*. Rev. Peruana de Ent., 33:102-104. (In Spanish)

EPPO. 2005. *Diabrotica speciosa*. OEPP/EPPO Bulletin 35: 374-376.

Fisher, J. R. and M. K. Bergman. 1986. In: [Krysan JL, Miller TA, eds.] Methods for the Study of Pest Diabrotica. New York, USA: Springer.

Gassen, D. N. 1984. Insetos associados a cultura do trigo no Brasil. Circular Tecnica, 3. Passo Fundo, RS, Brazil: EMRAPA-CPNT.

Gassen, D. N. 1989. Insetos subterraneos prejudiciais as culturas no sul do Brasil. EMBRAPA-CNPT. Documentos, 13. Passo Fundo, RS, Brazil: EMBRAPA-CNPT.

Germain, J. F. 2000. *Diabrotica speciosa* (Germar), PRA Area: Europe (01/8504). 1-3. European and Mediterranean Plant Protection Organization.

Heineck-Leonel, M. A. and L. A. B. Salles. 1997. Incidence of parasitoids and pathogens in adults of *Diabrotica speciosa* (Germ.) (Coleoptera: Chysomelidae) in Pelotas, RS. Anais da Sociedade Entomológica do Brasil, 26(1):81-85.

Krysan, J. L. 1986. Introduction: biology, distribution, and identification of pest *Diabrotica*. In: [Krysan JL, Miller TA, eds.] Methods for the Study of Pest *Diabrotica*. New York, USA: Springer.

Lin, M. T., J. H. Hill, E. W. Kitajima, and C. L. Costa. 1984. Two new serotypes of cowpea severe mosaic virus. Phytopathology 74: 581-585.

Ministerio de Granaderia, Agricultura y Pesca. 2005. Information Requested for Pest Risk Analysis to Export Blueberries Fruit (*Vaccinium corymbosum* and *V. ashei*) from Uruguay to United States. Ministerio de Granaderia, Agricultural y Pesca, Direccion General de Servicios Agricolas, Division Proteccion Agricola. 9 pp.

Pereira, M. F. A., L. G. Delfini, M. R. Antoniacomi, and M. H. Calafiori. 1997. Damage caused by the leaf beetle, *Diabrotica speciosa* (Germar, 1824), on beans (*Phaseolus vulgaris* L.), with integrated management. Ecossistema, 22:17-20.

Ribeiro, S. G., E. W. Kitajima, C. R. B. Oliveira, and R. Koenig. 1996. A strain of eggplant mosaic virus isolated from naturally infected tobacco plants in Brazil. Plant Dis. 80: 446-449.

Roberto, S. R., W. Genta, and M. U. Ventura. 2001. *Diabrotica speciosa* (Ger.) (Coleoptera: Chrysomelida): New Pest in Table Grape Orchards. Neotropical Entomology 30(4): 721-722.

USDA, 1957. Cooperative Economic Insect Report, 7(2):5-6.

Ventura, M. U., M. C. Martins, and A. Pasini. 2000. Response of *Diabrotica speciosa* and *Cerotoma acuata tingomariana* (Coleoptera: Chrysomelidae) to volatile attractants. Florida Entomologist 83(4): 403-410.