Pest Risk Analysis for *Maruca vitrata* (Fabricius), bean pod borer

Taxonomy

Synonyms: *Maruca testulalis* (Geyer)
Crochiphora testulalis

Pest type: insect
Class: Insecta
Order: Lepidoptera
Family: Crambidae

Maruca vitrata is the new name for *M. testulalis* (Zhang 1994). In the old concept of the family Pyralidae, there were three major divisions (Midiliformes, Crambiformes, and Pyraliformes). Recent workers recognize only two divisions, Pyralidae defined in a restricted sense, and Crambidae. *Maruca* is now in the Crambidae. Consult Solis and Munroe (1999) for a history of pyraloid classification.

Ecological Suitability: **H**igh

Distribution based on field collections: widely distributed in tropical and semitropical regions; central and southern Africa; southeastern Asia from India to Japan and Australia; Pacific Islands including Hawaii; southern Mexico to tropical South America, including the West Indies. See International Institute of Entomology (1996) Map no. 351 (revised).

Based on the above distribution, we predict *M. vitrata* would survive in the southern USA. Although only a small portion of the United States has a truly tropical climate, *M. vitrata* is recorded from Japan (Inoue et al. 1982) which suggests this species will tolerate more temperate climates if the hosts are available. Miller (1982) also agreed that the southern United States would be suitable for *M. vitrata*.

Host Specificity: High

The following are literature records based on field collections:
Taylor (1978) (legume hosts by subfamily):Faboideae (=Papilionoideae): *Arachis, Cajanus, Crotolaria, Dolichos, Gliricidia, Mucuna, Phaseolus, Psophocarpus, Sphenostylis, Stizolobium, Tephrosia, Vicia, Vigna,* Caesalpinaceae: *Poinciana*
Mimosaceae: *Esclerona*

Ferguson and BASS [1983] added: feeds on almost all cultivated legumes. Their host list included: *Canavalia, Delonix, Derris, Pisum, Sesbania*

In Indonesia, *M. vitrata* feeds on *Glycine, Pueraria, Caesalpinia* in addition to several of the genera listed above (van der Laan 1981).

We consider the following non-legume hosts to be doubtful, in agreement with Ferguson and BASS [1983]: sesame, Hibiscus, teak, *Xylia*, hemp, rice, and tobacco. Hill (1977) mentioned castor [bean], another record needing confirmation.

The host specificity of *M. vitrata* is not great. We predict that an established population would find suitable host material in most portions of the southern United States. The ability to feed on soybean is especially disturbing because this crop is widely grown in most of the eastern and midwestern United States.

Survey Methodology: Medium

1. Visual (Modified from Paddock 1976)

    a. Whenever bean or pea pods are available for inspection, on or off the vine, look for deformed, prematurely dropped or damaged pods. Eggs are laid in or near flower buds. Larvae bore into the buds and seed pods, but legumes with hard, tough pods are usually not infested (CAB 2000). Pupation takes place on or near the ground or sometimes in the pod. There are several generations annually.

    b. Active larvae maintain exit holes in pods to the outside. The exuded wet frass is clearly visible but easily knocked off when handled.

    c. Carefully cut open suspect pods in search of larvae. Submit specimens in a vial of alcohol (after boiling in water for two minutes). Note associated host.

2. Light trap - Adults are mildly attracted to light, and may appear in black-light traps. They are nocturnal and seldom seen in the field (Zimmerman 1958).

3. Pheromone trap - Pheromone structure has been isolated but is not known to be commercially available (The Pherolist 2000; Adati and Tatsuki 1999).

Taxonomic Recognition: High

Identification characteristics are best developed for the larva and adult.

RECOGNITION CHARACTERS

Adult - Moth with wing expanse of 20-22 mm (slightly less than one inch), forewings brown with a white oblong translucent spot often shaped like a “figure eight”, hind wings whitish and semitransparent with wide but irregular brown border. The genitalia were illustrated by Zimmerman (1958).

Easily recognized in the New World, Africa, and the Near East by the characteristic color pattern. In southeastern Asia, *M. vitrata* could potentially be confused with *M.*

ambonialis. The latter species has reduced white forewing markings and less brown on the hindwing apex than *M. vitrata* (Robinson et al. 1994). Both species were illustrated by Inohue et al. (1982). The adult of *M. vitrata* has been illustrated many times, two examples are Ferguson and BASS [1983] and Zimmerman (1958) (also see the right hand corner of this document).

Egg - Greenish white, oval, slightly convex, 0.6 mm. diameter and lightly sculptured. Deposited on floral buds or leaves in small clusters (Paddock 1976; Taylor 1978; Ferguson and BASS [1983]).

Larva - Cream-colored to pale green with sclerotized pinacula (setal plates), the somewhat elongated four dorsal pinacula on each abdominal segment are especially conspicuous (Fig.1). Approximately 20 mm in length at maturity (Ferguson and BASS [1983]).

Several keys exist to identify families of Lepidoptera larvae. Consult Stehr (1987) for North America and the keys in Kristensen (1999) and Holloway et al. (1987) to identify economically important pest Lepidoptera of the world. These works will aid in recognizing pyraloid larvae.

Maruca, as a member of the Crambidae, has only a single L seta on A9. According to Solis (1999), Crambidae may be partially distinguished from Pyralidae because crambids have only a single L seta on A9 whereas pyralids have two or three setae on the same segment. This conflicts with the diagnosis by Passoa (1985) who characterized the Crambidae as having one or two L setae on A9 compared to two or three L setae in the Pyralidae.

Compared to other pyraloids in legume pods, larvae of *M. vitrata* may be recognized by having one L setae on A9 and a pair of pinacula without setae present on the mesothorax and metathorax posterior to the D pinacula (Passoa 1985). Other legume pod feeding pyralids (*Etiella*, *Fundella*) have three L setae on A9. Solis (1999) mentioned 2 L setae on A9 in *Etiella*, but this is either an error or an aberration (see Stehr (1987) for a drawing of A9 in *Etiella*). Some Tortricidae also feed in legume pods (*Cydia*), but unlike pyraloids, these tortricid larvae have a trisetose prespiracular group. Usua (1977) and Matuura (1952) gave a detailed description of the larvae of *M. vitrata*.

Because the larvae of *M. ambonialis* is undescribed, but known to have a similar host range to *M. vitrata* (CAB 2000), specimens from southeast Asia and India should be identified only to genus.

 

Pupa - About 13 mm long, elongated and with a shouldered appearance, green at first, later light brown and enclosed in a silken cocoon. Pupation may occur in pods, on convenient neighboring objects, on or just below ground surface beneath trash or litter (Paddock 1976). The U-shaped mesothoracic spiracle (Fig. 2) and extremely long cremaster (4x longer than wide, see Fig. 3) are unusual morphological features of the pupa of *M. vitrata* (Passoa 1985).

Potential Economic Impact: High

Maruca vitrata is a serious pest on several legume crops grown in the US and we would predict that this insect would survive in the southern US on these hosts. It is considered one of the most destructive pests of beans in Hawaii and is a major pest of cowpeas in most of Africa. Plants are not killed, but a large proportion of the pods may be damaged and unmarketable. Flowers are also eaten and destroyed (Ferguson and BASS [1983]).

Maruca vitrata was considered to be of quarantine significance by Pierce (1917) and was listed as a pest of export concern by Holdeman (1986) (under the name *Maruca testulatus*, a misspelling). *Maruca* was largely responsible for the initial quarantine of beans entering the United States from Puerto Rico (Leonard and Mills 1931).

Entry Potential and Destination of Infested Import Material: High

The following interception records are from US ports:

Miller (1982) and Ferguson and BASS [1983] noted that most interceptions for *M. vitrata* during the years 1970-1982 were from legumes, especially *Cajanus*, *Canavalia*, *Lablab*, *Phaseolus*, *Sesbania*, *Strongylodon*, and *Vicia*.

Solis (1999) recorded *Phaseolus* and *Vicia* as hosts in 1998. Before that time, legumes, *Cajanus*, and *Pisum* were mentioned. There was no mention of *Canavalia*.

A review of the PIN database from 1985-1998 contrasts strongly with summaries given by the previous authors. Of the 2,650 records in the database, nearly 1,750 of these come from *Canavalia* flowers. *Sesbania* accounts for nearly 400 additional records. The next largest category is *Phaseolus* with over 100 interceptions followed by *Strongylodon* with 40 records. Apparently importation of *Canavalia* flowers has been the major pathway for entry of *M. vitrata* into the US for the last decade.

These interceptions fall into eight categories (Miller 1982):
1. Cut Flowers (Mail)
2. Cut Flowers (Baggage)
3. Vegetables from Foreign Countries. (Baggage-Consumption)
4. Vegetables from Foreign Countries (Permit Cargo)
5. Vegetables from Offshore U.S. Areas (Baggage-Consumption)
6. Vegetables from Offshore U.S. Areas (Permit Cargo)
7. Hitchhikers on Aircraft
8. Ship's Store interceptions

The importation of various hosts as pods is a much greater pest risk than the importation of fresh seeds because of the difficulty of pod inspections (Miller 1982). Although there are no specific destinations available for survey, the following States represent a higher risk because collections have occurred outside of the AQI environment:

1. Texas, reared from string beans (Williamson 1943) but no further collections have been reported (Commonwealth Institute of Entomology 1996).

2. Florida, adult collected in March at Key Largo (Dickel 1981) .

3. Louisiana, adult collected at lights (Brou 1993).

Establishment Potential: High

Maruca vitrata would survive in the southern US and suitable hosts are in abundant supply. The introduction of *M. vitrata* into Hawaii (Zimmerman 1958) shows that this species has the ability to colonize new habitats.

LITERATURE CITED AND BIBLIOGRAPHY

Adati, T. and Tatsuki, S. 1999. Identification of Female Sex Pheromone of the Legume Pod Borer, *Maruca vitrata* and Antagonistic Effects of Geometrical Isomers. Journal of Chemical Ecology. 25: 105-116.

Brou, Jr. V. 1993. Another new record of a global agricultural pest. Southern Lepidopterists' News. vol. 15.

Dickel, T. S. 1981. *Maruca testulalis*. In D. Winter (ed.). 1980 Season Summary. News of the Lepidopterists' Society.

Hill, D. 1977. Agricultural insect pests of the tropics and their control. Cambridge University Press.

Hazard Identification Analysis: Evaluation of San Juan Pre-departure Interceptions in Baggage (FY 1994-96) http://www.aphis.usda.gov/ppq/pra/commodity/hazardsanjuan.html

Herbison-Evans, D., Crossley, S. and Hacobian, B. (updated 11 September 2000) http://linus.socs.uts.edu.au/~don/larvae/pyra/vitrat.html

Holdeman, Q. L. 1986. Plant pests of phytosanitary and regulatory significance to

importing countries and states. California Department of Food and Agriculture.
Holloway et al. 1987. CIE guide to insects of importance to man. 1. Lepidoptera. CAB International, United Kingdom.
Ferguson, D. and Biological Assessment Support Staff. [1983]. Bean Pod Borer: *Maruca testulalis.* Pests not known to occur in the United States or of limited distribution. Number 40. USDA/APHIS/PPQ. 6 pages.
International Institute of Entomology. December, 1996. *Maruca vitrata*. Distribution Maps of Pests No. 351 (revised).
Inoue et al. 1982. The moths of Japan. Kodansha, Japan.
King, A.B.S. and J.L. Saunders. 1984. The invertebrate pests of annual food crops in Central America. Overseas Development Administration, London (illustrates two color forms of the larva and a damaged pod with frass extruded).
Kogan et al. 1988. World Bibliography of Soybean Entomology. Two volumes (not seen, but likely an excellent review of *Maruca* references).
Kristensen. 1999. Handbook of Zoology. Lepidoptera. Volume 1. Walter de Gruyter.
Matuura, A. 1952. On the morphological characters of the larvae of Japanese Pyrustinae (sic) [Pyraustinae]. Bulletin of the Naniwa University. Series B Agricultural and Natural Science. Vol 2: 25-34.
Miller, C. E. 1982. *Maruca testulalis*. Unpublished risk assessment by APHIS/PPQ/BASS.
Okeyo-Owuor J. B. and P. O. Agwaro. 1982. Studies on the legume pod-borer *Maruca* testulalis Geyer,- III. The use of a pheromone trap in population studies. Insect Science and its Application 3 (2/3): 233-235.
Paddock, E. L. 1976. Bean pod borer. Exclusion and Detection Manual. California Department of Food and Agriculture.
Passoa, S., 1985. Pyralidae of economic importance in Honduras. Ms Thesis, University of Florida, Gainesville, Florida (cites other *Maruca* references in Latin America).
Pierce, W. D. 1917. A Manual of Dangerous Insects, USDA Government Printing Office.
Robinson et al. 1994. Field Guide to the smaller moths of South-East Asia. Malaysian Nature Society.
Stehr, F. 1987. Immature Insects. Kendall/ Hunt.
Solis, M.A. 1999. Key to selected Pyraloidea (Lepidoptera) larvae intercepted at U.S. ports of entry: revision of Pyraloidea in “Keys to some frequently intercepted lepidopterous larva” by D.M. Weisman 1986. Proc. Entomol. Soc. Wash. 101 (3):645-686.
Solis, M.A. and E. Munroe. 1999. Pyraloidea. In Kristensen. Handbook of Zoology. Lepidoptera. Volume 1. Walter de Gruyter.
Taylor, T.A. 1978. *Maruca testulalis*: an important pest of tropical grain legumes. In S.R. Singh et al. Pests of grain legumes: ecology and control. Academic Press, New York.
The Pherolist, Updated 2 September, 2000. http://nysaes.cornell.edu/pheronet - Cornell University, Geneva NY.
Usua, E. J. 1976. Description of the larva and pupa of *Maruca testulalis* Geyer (Lep., Pyralidae). Nigerian J. Sci. 10 (1,2): 179-189.
Van der Laan, P.A. The pests of crops in Indonesia. P.T. I. Baru- Van Hoeve, Indonesia.
Williamson, A. L. 1943. Two foreign pod borers discovered in Texas. Journal of

Economic Entomology. 36: 936-937.
Zang, C. B. 1994. Index of economical important Lepidoptera. CAB International. CAB International, United Kingdom.
Zimmerman, E. C. 1958. The Insects of Hawaii. Volume 8: Pyraloidea. University of Hawaii Press, Hawaii.

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