Plant Protection Service
P.O. Box 9102
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Short PRA

HARITALODES DEROGATA, Cotton Leaf Roller

June 2009

1. Reason for PRA
Interception during import inspection of one larva on one out of ten *Hibiscus* plants (5-aug-2008) from Sri Lanka.

2. Scientific names and taxonomy
Class: Insecta
Order: Lepidoptera
Family: Crambidae
Genus: Haritalodes (also: Sylepta)
Species: derogata Fabricius, 1775

Common names: Cotton leaf roller, chenille enrouleuse du cotonnier, baumwoll-blattroller (CABI, 2007)

3. PRA-area
The Netherlands

4. Host plant range (Worldwide)
Several host plants of 10 different families are known (The Natural History Museum, 2007). The most important host plants belong to the family of Malvaceae (*Abutilon* sp., *Alcea* sp., *Hibiscus* sp.) (Zang, 1994).

Host plants according to CABI (2007) are: *Abelmoschus esculentus* (okra), *Ceiba pentandra* (kapok), *Corchorus* sp. (jutes), *Corchorus capsularis* (white jute), *Corchorus olitorius* (jute), *Gossypium* (cotton), *Lycopersicon esculentum* (tomato)*, *Malvaceae*, *Manihot esculenta* (cassava), *Solanum melongena* (egg plant)*, *Coleus* sp., *Durio zibethinus* (durian), *Hibiscus* (rose mallows).
* Tomato and egg plant are doubtful as host plants as references are lacking and no records could be found in literature. Tomato and egg plant are, therefore, not considered as (important) host plants in the present PRA.

5. Host plant range (NL)
Malvaceae
Abutilon spp., *Alcea* spp., *Hibiscus* spp., *Lavatera* spp. and *Malva* spp. are produced as patio and/or garden plants outdoors and under protected conditions. The total production area is less than 20 ha (pers. comm. D. Smid, NPPO of the Netherlands, 2008).

6. What is the current area of distribution of the pest?
According to CABI (2007):
Asia: Bangladesh, Brunei Darussalam, Cambodia, China, India, Indonesia, Japan, Laos, Malaysia, Maldives, Myanmar, North Korea, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Vietnam.
Africa: Angola, Benin, Burkina Faso, Burundi, Cameroon, Chad, Congo Democratic Republic, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia.
Oceania: Australia, Federated states of Micronesia, Fiji, Papua New Guinea, Samoa, Solomon Islands.

7. Does it occur in the Netherlands?
No

8. Probability of entry: preliminary pathway analysis
Import of ornamental host plants, as larvae or pupae rolled in leaves.
Possible important trades: pot or patio plants
One known interception: the interception on Hibiscus from Sri Lanka in the Netherlands in 2008. This is the same interception as mentioned at Question 1.

9. Probability of establishment?
(a) Outdoors
In a laboratory study in Japan, the threshold temperature for larval development was 14°C and the temperature sum needed to complete the larval stages 315 degree days (Uematsu, 1986). The threshold temperature for development of larvae of *H. derogata* is relatively high as compared to those of native Lepidoptera species, like for example *Pieris rapae* (ca. 9°C, Cheng, 2003) and *Clepsis spectrana* (10°C, Bos, 1983). Using the threshold temperature and temperature sum from the study of Uematsu (1986) and Dutch weather data of the meteorological station in De Bilt in recent years (2001 – 2007) (source KNMI: http://www.knmi.nl), the pest would, however, be able to complete its life cycle in one year. The average temperature sum for the period 2001 – 2007 was 439 and varied from 360 – 612 among those years. It should, however, be noted that the threshold temperature and/or temperature sum may vary among studies possibly due to variation among strains or populations. In a laboratory study in Bangladesh performed by Ahsan & Khalequzzaman (1982), the duration of the larval stages was 36 days at 20°C, much shorter than 55 days as determined by Uematsu (1986) in Japan. Thus, the threshold temperature and/or temperature sum needed for full development in the study from Bangladesh must have been lower than those in the Japanese study.

Larvae may undergo diapause and survive cold (winter) periods. No information could, however, be found in literature on the minimum temperature for survival. *H. derogata* is present in tropical and subtopical areas. According to CABI (2007), it is, however, also present in Hokkaido in Japan where winter temperatures are much lower than in the Netherlands (see for example http://nl.allmetsat.com/klimaat/; website visited January 2008) suggesting that it can survive winter temperature in the Netherlands. No additional information could, however, be found on its presence in Hokkaido and the report may be based on a misidentification. According to Yamanaka (2008), *H. derogata* is not present in Hokkaido but *H. basipunctalis* does occur in Hokkaido. In the present PRA, we follow the report from Yamanaka that *H. derogata* is not present in Hokkaido and because of the (sub)tropical distribution of the pest and its relatively high threshold temperature we expect the pest not to survive outdoors in the Netherlands.

Probability of establishment outdoors: low (uncertainty: medium)

(b) In protected cultivation
The average temperature in Dutch glasshouses of many ornamental species is about 20°C throughout the year. Larval stages were completed in 36 and 55 days at 20°C in laboratory studies performed in Bangladesh and Japan, respectively (Ahsan & Khalequzzaman, 1982; Uematsu, 1986). Thus, the pest can likely develop en survive in glasshouses.

Probability of establishment in protected cultivation: high (uncertainty: low)

10. How likely is the pest to spread? (*naturally and by human assistance*)

<u>Natural dispersal</u>
No information could be found on natural movement by *H. derogata* or other *Haritalodes* spp. Some information is available on natural dispersal by species belonging the same family (Crambidae) as *H. derogata*. The distribution of The European corn borer (ECB, Ostrinia nubilalis) was studied in Rhineland between Aachen and Cologne in Germany from 2000 to 2003 (Gathman, 2005). In 2001, the area of distribution moved 12 km northwards as compared to 2000 and in 2002 the distribution area moved another 13 km northwards. In 2003, the distribution area did not enlarge possibly due to the extreme hot and dry weather conditions. The distribution of another species from the family Crambidae, *Eoreuma loftini*, was studied in Texas from 2000 to 2005 and the average dispersal rate was assessed to be 23 km per year (Reay-Jones et al., 2007). No information is available on dispersal of

other species of Crambidae and it is, therefore, difficult to assess the natural spread potential of *H. derogata*. Assuming that *H. derogata* can move many km's per year, it would be able to spread among glasshouses during the summer in the Netherlands.

Probability of natural spread: medium (uncertainty: medium)

Human assistance
A few glasshouse nurseries grow host plants. These nurseries grow, as far as known, their own propagation material and do not sell plants to other glasshouse nurseries. The probability of spread through human assistance between glasshouse nurseries is, therefore, assessed to be low.

Probability of spread by human assistance: low (uncertainty: low)

11. **What is the potential damage when the pest would become introduced?** (*without the use of control measures*)

H. derogata has been reported as a serious pest of cotton in India and south-west Nigeria (Sidhu & Dhawan, 1979; Odebiyi, 1982). CABI (2007) describes it as a common pest on malvaceous plants. The pest has for example been reported to cause damage to *Hibiscus cannabinus* in Kagoshima in Japan and in Pakistan (Zaman & Karimullah, 1987; Hiramatsu, 2001) and to *H. esculentus* in Togo and India (Adhikary, 1984; Mahal et al., 1980). When introduced, the pest will probably cause cosmetic damage on ornamental plants of the family of Malvaceae, like *Hibiscus* spp. and *Abutilon* spp. at glasshouse productions sites. The larvae eat from the leaf margins, causing the leaves to curl and droop (CABI, 2007). Leaf damage will make the plants unmarketable.

Potential economic impact without extra control measures: medium - high (uncertainty: medium)

12. **What is the expected damage when the pest would become introduced?** (*with the use of available control measures; indicate efficacy of available pesticides and non-chemical methods; also discuss the availability of control measures in the future taking into account the possibility of resistance development against pesticides and possible withdrawal of pesticides*)

Efficacy of available control measures and expected impact for growers:
Damage can probably be limited by the application of insecticides. In the Netherlands, several insecticides which are generally effective against caterpillars are currently registered for use in floricultural crops under protected conditions. These insecticides are based on the active ingredients deltamethrin, methoxyfenozide, spinosad, Bacillus thuringiensis, azadirachtin, indoxacarb and teflubenzuron (www.ctb.agro.nl). These active ingredients have all been registered in the EU except azadirachtin (see EU Pesticides database on http://ec.europa.eu/sanco_pesticides/public/). In the Netherlands, registration of the product based on azadirachtin, Neemazal, will expire on 31 December 2010 and it is highly uncertain if it will be available in the future.

Information on efficacy of insecticides against *H. derogata* from literature:
Several publications describe the efficacy of insecticides that are not registered in the Netherlands (Adenuga, 1971; Chakraborty & Pahari, 2002; Dhawan *et al*, 1979; Jafri *et al*, 1988; Maini *et al*, 1982). Almost all of the active substances described in these papers have not been included in the list of active substances of the EU. The information from these papers is, therefore, not included in this PRA and we have limited our search to substances that are currently available in the Netherlands for use against caterpillars.

Fadare & Amusa (2003) tested three commercial formulations of *Bacillus thuringiensis* isolates, Dipel, Biotrol and Thuricide in cotton. All three pesticides significantly suppressed populations of the cotton leafroller (52 – 60%) and the effects were not significantly different from those by pesticides based on monocrotophops, endosulfan and carbaryl. Monocrotophos, endosulfan and carbaryl have not been included on the list of active substances in the EU (EU Pesticides database on http://ec.europa.eu/sanco_pesticides/public/).

Neem was found to be effective in Ghana (Cobbinah & Osei-Owusu, 1988). The effect of treatment with a 20% aqueous-methanol (4 : 1) extract of defatted neem seed cake was most pronounced on the first and second instar larvae where 100% mortality was recorded.

Chemical trials of more than 40 compounds were described by Silvie (1989), with details of efficacy and toxicity to mammals. Of these 40 compounds only deltamethrin is registered in the Netherlands. Deltamethrin was tested at a dosage of 10-15 g a.i./ha and the efficacy was indicated as good (no quantitative data were given in that study).

Yein and Barthakur (1985) found synthetic pyrethroids (fenvalerate, permethrin and deltamethrin [at 0.1 kg a.i./ha]) to be effective chemical controls in India, reducing infestation by 83 - 100%. However, Dhawan *et al*. (1988) found the pyrethroids fenvalerate, permethrin, cypermethrin, deltamethrin and flucythrinate to be less effective than monocrotophos, endosulfan and carbaryl in India. When using deltamethrin (10 g a.i./ha), mortality of the larvae was 13 – 25% within 3 days after treatment. Increasing the dose to 15 g a.i./ha resulted in a mortality of 59% within 3 days (one experiment), and increasing to 20 g a.i./ha in 63% within 7 days after treatment (also one experiment). The effects of pesticides based on monocrotophos, endosulfan and carbaryl were significantly better (95 – 100% mortality). They mentioned that for the control of *H. derogata* higher doses of pyrethroids were necessary than for other bollworms. In the Netherlands, deltamethrin may be used at a maximum dosage of 2.48 g a.i. per 100 L. The spray volume in the cultivation of pot plants is 500 - 1000 L per ha which means that about 12.4 – 24.8 g a.i. per ha is applied. This dosage possibly kills only part of the population.

Except for deltamethrin, *Bacillus thuringiensis* and azadirachtin (Neem) no information was found in literature about efficacy of insecticides that are registered in the Netherlands and are used against caterpillars. Data from literature indicate that deltamethrin will probably not be very effective with dosages that are allowed to use in the Netherlands. Neem proved to be very effective in Ghana but these data are difficult to extrapolate to the Dutch situation since concentrations of the active substance azadirachtin can be different. Deltamethrin and other pyrethroids are known to be insecticides against which several pests has developed (partial) resistance or tolerance and that higher dosages are needed to get sufficient control (Abo-El-Ghar *et al*, 1986; Daly, 1988; Forrester *et al*, 1993; Sawicki, 1986). It is expected that (repeated) application of one or more of the insecticides mentioned above and registered in the Netherlands with the exception of deltamethrin (thus insecticides based on methoxyfenozide, spinosad, Bacillus thuringiensis, azadirachtin, indoxacarb and/or teflubenzuron) will sufficiently control *H. derogata* and prevent serious plant losses. This expectation is based upon the fact that presently no (major) problems are known with caterpillars currently present in glasshouses in floricultural crops in the Netherlands (e.g. *Clepsis spectrana*, *Spodoptora exigua*). The exception may be *Duponchelia fovealis* which is sometimes difficult to control because it can be present near the base of the plant where it is difficult to hit by insecticides. *H. derogata* is a leafroller and not known to occur (mainly) on the inner parts of the plant.

<u>Side effects of control measures</u>:
Several of the insecticides mentioned above cannot be used in integrated control systems with biological control agents. However, biological control agents are usually not applied in the cultivation of pot plants in the Netherlands and, therefore, the use of these insecticides will not or only to a limited extent disrupt existing integrated control systems.

The environmental impact of insecticide use against *H. derogata* will be limited considering the small area with host plants (less than 20 ha while for example the total glasshouse area is about 10,000 ha (http://statline.cbs.nl/)).

<u>Conclusion about the possibilities to control the pest in the PRA-area and its impact:</u>
In the Netherlands, various insecticides are available to control caterpillars in floricultural crops and in tree nurseries and caterpillars usually do not cause much damage in floricultural crops and tree nurseries. No reports are known about resistance development of *H. derogata* against insecticides except that dosages of deltamethrin (a pyrethroid) that are allowed to use in the Netherlands are possibly to low for good control.

Potential economic impact: low (uncertainty: medium)

13. Conclusion

H. derogata is considered a pest with a low phytosanitary risk in the Netherlands for the following reasons:

- The pest can probably not survive outdoors;
- The total area with commercially grown host plants is less than 20 ha;
- Incidental introductions may occur, but significant economic damage is not expected because several insecticides are available to control the pest.

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