The Food & Environment Research Agency

Rapid Pest Risk Analysis for

Diabrotica speciosa (Germar)

This document provides a rapid assessment of the risks posed by the pest to the UK in order to assist Risk Managers decide on a response to a new or revised pest threat. It does not constitute a detailed Pest Risk Analysis (PRA) but includes advice on whether it would be helpful to develop such a PRA and, if so, whether the PRA area should be the UK or the EU and whether to use the UK or the EPPO PRA scheme.

STAGE 1: INITIATION

1. What is the name of the pest?
Diabrotica speciosa (Germar) Coleoptera Chrysomelidae cucurbit beetle

2. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC[1]) and in the lists of EPPO[2]?
Diabrotica speciosa has been listed on the EPPO A1 list of pests recommended for regulation since 2002 (EPPO PQR, 2013). The pest is not listed in the EC Plant Health Directive.

3. What is the reason for the rapid assessment?
The organism's listing as an EPPO A1 pest, together with the existence of a previous PRA (MacLeod, 1996) led to this organism being included in the first iteration of the Plant Health Risk Register in summer / autumn 2013. It was subsequently identified as a pest for which a pest risk analysis should be considered, hence the current assessment.

The 1996 PRA resulted from a derogation request by Argentina to market ware potatoes in the EU. The derogation was not granted and the pathway remains closed. However, this pest is also present in a number of other countries in Central and South America.

STAGE 2: RISK ASSESSMENT

4. What is the pest's present geographical distribution?
Argentina, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, French Guiana, Panama, Paraguay, Peru, Uruguay, Venezuela. (CABI/EPPO 2003).

5. Is the pest established or transient, or suspected to be established/transient in the UK?
No.

[1] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF
[2] http://archives.eppo.int/EPPOStandards/PM1_GENERAL/pm1-02(21)_A1A2_2012.pdf

6. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?
Diabrotica speciosa adults and larvae have different host ranges. Adults are highly polyphagous with over 70 host species recorded (Heineck-Leonel and Salles, 1997). Christensen (1943) lists 60 host plants in 22 families. Major hosts include:

- *Phaseolus vulgaris* (climbing French bean, climbing kidney bean, garden bean, kidney bean),
- *Solanum tuberosum* (potato),
- *Triticum aestivum* (wheat),
- *Zea mays* (maize).

This species is also known as the "Chrysanthemum Beetle" and adults cause damage to the leaves and flowers of dahlia and chrysanthemum plants (USDA 1957). Minor adult hosts include: *Arachis hypogaea* (peanut), *Brassica napus* (oilseed rape), *Brassica oleracea* (white cabbage), Citrus, *Cucurbita maxima* (marrow), *Cucurbita pepo* (edible gourd, garden marrow, pumpkin, summer squash), *Glycine max* (soya bean), *Ipomoea batatas* (sweet potato), *Malus domestica* (apple), *Prunus*, *Solanum lycopersicum* (tomato) (EPPO PQR)

The root-feeding larvae are also polyphagous on: maize, wheat, peanut, soya beans and potato.

Beans, potato, wheat, and maize (major hosts) as well as oilseed rape, cabbage, apple, *Prunus* and tomato (minor hosts) are of significant economic importance to the UK. Both adults and larvae can feed on *Brassica rapa* (turnip) (Bitencourt & Avila, 2007).

7. If the pest needs a vector, is it present in the UK?
No vector required.

8. What are the pathways on which the pest is likely to move and how likely is the pest to enter the UK? (*By pathway*):
Since this pest is so polyphagous, it can enter with a variety of commodities. An old USDA report (USDA, 1957) says it has been intercepted on several occasions. However, a more recent report (Sullivan *et al*., 2014) notes that, up to 2012, *D. speciosa* has only been intercepted twice at U.S. ports of entry: once on *Solanum lycopersicum* (tomato) originating from Argentina and once on *Lactuca* sp. (lettuce) originating from Peru. This pest has also been intercepted entering France on apples (European Commission, 2003) although there are no records of this species on Europhyt. Though small (up to 7.3 mm long), adults are highly distinctive (green with pronounced yellow dots), difficult to overlook and unlike any European species.

Larvae and eggs could be present in soil on its own or with roots and tubers and with vehicles, e.g. farm machinery. Adults may be transported with foliage (potted plants and cut flowers), fruit, vegetables, packaging material and machinery. Larvae could be moved with potatoes but we do not import potatoes from the regions where this pest is prevalent.

Two pathway types have been rated: (i) cut flowers, fruit and vegetables and (ii) plants for planting with soil. Although large volumes of cut flowers, fruit and vegetables are imported into the EU from South America, e.g. cut flowers from Colombia, and *D. speciosa* is an important pest of many crops in South America, the pathway is rated as unlikely. This is because only low numbers of adults are likely to be associated with the pathway at harvest, cut flowers for the export market are mainly grown in protected conditions, any treatments will severely affect adult survival and inspections are likely to spot a beetle with such dramatic colouring.

EFSA (2012) analysed EUROSTAT data and showed that over 53,000 tonnes of bulbs, tubers, tuberous roots, corms, crowns and rhizomes, as well as 1,385 tonnes of vegetable

and strawberry plants and outdoor rooted plants (excluding rhododendrons, azaleas, roses), were imported from South America into the EU between 2005 and March 2011. Although all these commodities could contain soil, only a few of these are likely to be from crops grown in fields where the main larval hosts are present and a significant proportion of this trade will not enter the UK. Adults may be associated with potted plants, but the densities are not likely to be high. As such, the plants for planting pathway is also rated as unlikely.

EFSA (2012) also analysed EUROSTAT for 1998-2011 and found no relevant non-compliance records related to soil. In addition, the EFSA opinion assumed that there would be very little movement of agricultural machinery from South America to Europe.

	Very unlikely	Unlikely	Moderately likely	Likely	Very likely
Cut flowers, fruit and vegetables	☐	✓	☐	☐	☐
Plants for planting transported with soil:	☐	✓	☐	☐	☐

9. How likely is the pest to establish outdoors or under protection in the UK?

The host plants in the native range of this species are widely cultivated in the UK and some are major crops, but climate is expected to limit the establishment of the pest. *D. speciosa* is a member of the *fucata* group of Diabrotica and as such is multivoltine and overwinters as an adult (Cabrera Walsh, 2003). The *fucata* group appear to have distributions limited by their intolerance for freezing temperatures – for example none of the *fucata* group *Diabrotica* species present in North America are able to overwinter in the temperate northern states (Krysan and Miller, 1986). Milanex and Parra, 2000 reared *D. speciosa* in temperatures ranging from 18°C to 32°C and from this data calculated the threshold temperature for development as 11.1°C for eggs, 10.9°C for the larval-adult period and 11.04°C for egg-adult. The degree-days for development were calculated as 119.1 for eggs, 355.9 for larval-adult period and 474.8 for egg-adult. In contrast studies in the laboratory where larvae were reared at different temperatures resulted in very few beetles able to complete development at 15°C and at 13°C no larvae hatched (Cabrera Walsh, 2001). Development time of larvae and pupae on potato at 25˚C is 36.5 days (Avila & Parra, 2002).

The minimum temperature for development of approximately 11ºC is the same as *D. virgifera virgifera* (whose larvae also feed on maize roots), a pest that is invasive in Europe and has previously been assessed as having potential to establish in limited areas of the UK (MacLeod *et al.,* 2007). However as a member of the *virgifera* group of *Diabrotica, D. v. virgifera* has a very different lifecycle to *D. speciosa*. Members of this group overwinter as eggs in the soil that are capable of diapause (Krysan and Miller, 1986), protecting them from the effects of cold winter temperatures – this is an adaption that has allowed them to establish in more temperate regions. Contrastingly *D. speciosa* overwinters as an adult in the rosettes and crowns of winter growing plants (EPPO, 2005), and diapause in adults has never been observed (Cabrera Walsh, 2003). In the laboratory, eggs of *D. speciosa* stored at 5°C did remain viable for a period of 60 days, though with a decline in viability beginning from the tenth day of storage (Cabrera Walsh, 2003) and as such eggs may also not be able to survive in significant numbers to overwinter in the UK. The southern limit of *D. speciosa* in South America is reported as Central Argentina and southern Uruguay (Cabrera Walsh, 2003) regions with much hotter summers and milder winters than the UK. The fact the pest is not found further south indicates its distribution may be limited by climate. Establishment outdoors in the UK is rated as unlikely. There is some uncertainty due to a lack of data on

the cold tolerance of overwintering adults, which are described by EPPO as “fairly tolerant of cold” (EPPO, 2005). Nether the less, the pest’s current distribution indicates the climate of the UK is unsuitable for establishment.

Although environmental conditions in protected cultivation would be suitable, there are no records of establishment in glasshouses and since its principal larval hosts (maize, wheat, soyabean, peanut and potato) are not grown there, establishment is also rated as unlikely.

	Very unlikely	Unlikely	Moderately likely	Likely	Very likely
Outdoors:		✓			
Under protection:		✓			

10. How quickly could the pest spread in the UK?

There is insufficient information available to estimate the natural spread of this species but flight is unlikely to be greater than the typical spread of 20 kilometres per year as reported for *D. virgifera virgifera* in Europe (MacLeod *et al.,* 2007), though *D. speciosa* may need higher temperatures before take-off. Its hosts are widespread but, as noted above, climatic conditions are likely to be marginal even in southern England restricting the potential for successful dispersal. Natural spread is rated as slowly, though with considerable uncertainty due to the lack of data on the flight capacity of *D. speciosa*.

This species could also spread with human assistance, e.g. larvae on or in turnip roots and potato tubers. However, damage caused by larvae to root vegetables and potatoes would likely lead to them being graded out, limiting spread on this pathway. Spread in trade is rated as moderate pace.

	Very slowly	Slowly	Moderate pace	Quickly	Very quickly
Natural spread:		✓			
In trade:			✓		

11. What is the area endangered by the pest?

D. speciosa is a pest on wheat and potatoes in Argentina and Brazil and these are widely grown in the UK. Southern UK would be at greatest risk, but climatic conditions would confine this species to areas with the hottest summers and mildest winters.

12. What is the pest’s economic, environmental or social impact within its existing distribution?

D. speciosa is considered to be an important pest in South America, particularly Argentina and Brazil (Avila and Santana, 2013; CABI CPC). The adults feed on the foliage, flowers and fruit of many hosts. Larvae feed on the roots of maize causing goose-necking symptoms like *D. virgifera virgifera*. Although five larvae per maize plant can cause a 73% reduction in yield (Fogaca & Calafiori, 1992), damage caused by adults feeding on the tassels of maize and reducing grain set is considered to be more important. In Argentina its impact is mainly on groundnuts whilst in Brazil it mainly affects potatoes and wheat. Adults also feed on watermelon, squash and tomatoes in Brazil, vegetables in Paraguay and ornamental flowers such as dahlias and chrysanthemums (USDA, 1957). The economic threshold for damage on beans is two insects per plant of *Phaseolus vulgaris* (beans) (Pereira *et al.,* 1997).

Very small		Small		Medium		Large	✓	Very large	

13. What is the pest's potential to cause economic, environmental or social impacts in the UK?

Its very large host range, that includes major crops in the UK such as wheat and potatoes, and its importance as a pest in South America suggests that *D. speciosa* would have a high economic impact if it became established in the UK. However, unlike *D. virgifera virgifera*, it spends its winters above ground as an adult where it is more vulnerable to cold and any populations that do establish are not likely to be large enough to cause more than minor damage. The larval stages would have a much greater economic impact than adults by feeding on potato tubers. It is much more difficult to control larvae than adults. Large amounts of insecticides are required to successfully control the larvae (EPPO, 2014). Seed treatments are not effective because the damage to the crop occurs 45 days after plant emergence and by then the effect of the pesticide has diminished. IPM programmes are used successfully in Brazil (Hamerschmidt, 1985).

Very small		Small	✓	Medium		Large		Very large	

14. What is the pest's potential as a vector of plant pathogens?

Sullivan *et a*l. (2004) summarised the pathogens vectored by the pest: several comoviruses, tymoviruses and carmoviruses are transmitted by *D. speciosa* and it may also transmit bacterial wilt caused by *Erwinia tracheiphila* in cucurbits. *D. speciosa* vectors Passionfruit Yellow Mosaic Virus (Crestani *et al.,* 1986; Varon de Agudelo *et al.,*1992), Mimosa Mosaic Virus Southern Bean Mosaic Virus and Purple Granadilla Mosaic Virus (Germain, 2000) and Cowpea Severe Mosaic Virus (Lin et al., 1984) and Eggplant Mosaic Virus (Ribeiro et al. 1996). None of these viruses currently occur in the UK (pers. comm. Adrian Fox.)

STAGE 3: PEST RISK MANAGEMENT

15. What are the risk management options for the UK?

Exclusion: The lack of interceptions of this pest (only one known interception in the EU) suggests that it is not arriving regularly. In addition, inspections are carried out in the UK on produce from third countries and the beetles are relatively conspicuous. They are grass green with yellow spots and about 5-7mm long and there therefore should be a good chance of the pest being detected when present. Raising awareness of the pest with importers of relevant South American produce such as dahlias and chrysanthemums would help to reduce risks. In addition, if effective traps become available, these could be placed in pack houses in the UK. The import of any plants with soil would be a particular risk (EPPO; 2005). Listing in Annex IAI of the EC Plant Health Directive should be considered since it is likely to establish and cause much greater damage in southern Europe. Its polyphagy and the multitude of potential pathways suggests that it would not be possible to identify effective Annex IIAI or Annex IVAI measures.

Eradication Measures and non-statutory controls: The broad host range of this pest would make it very difficult to eradicate. Measures including the application of contact insecticides to target the adults and crop rotation could be used in an eradication campaign. No appropriate chemical soil treatments are currently approved in the UK and soil treatments are not thought to be persistent enough to be effective (Gassen, 1994; Avila & Santana, 2013).

Adults can be controlled using organophosphate insecticides sprays (particularly chlorpyrifos) onto growing plants. Chlorpyrifos containing products are approved for use on a range of growing crops (including the major fruits, cereals and brassicas grown in the UK) until 31st December 2021. Larvae can be controlled by applying granular insecticides into the furrow at planting of maize.

Some progress has been made on the development of lures for trapping adult *D. speciosa.* These are based on aromatic compounds from squash blossoms. It may also be possible to produce a lure based on female-produced sex pheromones. 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 (Sullivan, 2014).

16. Summary and conclusion of rapid assessment.

This is a polyphagous pest which has never been intercepted entering the UK. It has only been intercepted entering the EU on one occasion. The most likely sources of *D. speciosa* entering the UK are: cut flowers, fruit, vegetables and plants for planting with soil arriving from South America. However, it is unlikely that *D. speciosa* will enter the UK and unlikely that it will establish if it does. If this species does establish briefly it is likely that this would only be in the South of England in a particularly warm year. The largest risk of crop damage would be larval damage to potatoes and it is unlikely to cause damage at an economic level. Eradication would be difficult if *D. speciosa* were to establish in the UK, however control measures are available and monitoring traps may be available soon.

Risk of entry – Unlikely

It is considered unlikely that *D. speciosa* will enter the UK by either of the two pathway types rated: (i) cut flowers, fruit and vegetables and (ii) plants for planting with soil. Although large volumes of cut flowers, fruit and vegetables are imported into the EU from South America the pathway is rated as unlikely. This is because only low numbers of adults are likely to be associated with the pathway at harvest, cut flowers for the export market are mainly grown in

protected conditions, any treatments will severely affect adult survival and inspections are likely to spot a beetle with such dramatic colouring.

Risk of establishment – Unlikely

This rapid assessment shows that while *D. speciosa* is a pest of some major crops grown in the UK it is unlikely to establish outdoors in the UK due to its overwintering biology and climatic conditions. Environmental conditions in protected cultivation would be suitable for establishment but there are no records of establishment in glasshouses and the major larval hosts (maize, wheat, soyabean, peanut and potato) are not grown under protection in the UK. *D. speciosa* is, therefore, also unlikely to establish under protection in the UK.

Economic impact in the UK - Small

Although *D. speciosa* has a high economic impact in Argentina and Brazil this is unlikely in the UK. It is unlikely that *D. speciosa* larvae or adults would reach population densities sufficient to cause damage to its hosts in the UK.

Endangered area – South of England

Southern UK would be at greatest risk, but climatic conditions would confine this species to areas with the hottest summers and mildest winters.

Risk management – Exclude and eradicate if an outbreak occurs

Raising awareness of the pest with importers of relevant South American produce such as dahlias and chrysanthemums would help to reduce risks. If effective traps become available, these could be placed in pack houses in the UK. The import of any plants with soil would be a particular risk. Listing in Annex IAI of the EC Plant Health Directive should be considered since it is likely to establish and cause much greater damage in southern Europe. *D. speciosa* would be very difficult to eradicate if did establish in the UK. Contact insecticides could be used to target the adults and crop rotation could be used in an eradication campaign. No appropriate chemical soil treatments are currently approved in the UK and soil treatments are not thought to be persistent enough to be effective. Adults can be controlled using organophosphate insecticides sprays (particularly chlorpyrifos) onto growing plants. Larvae can be controlled by applying granular insecticides into the furrow at planting of maize.

17. Is there a need for a detailed PRA? If yes, select the PRA area (UK or EU) and the PRA scheme (UK or EPPO) to be used.

No	✓

Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

18. IMAGES OF PEST

Photo 1 (pest)	*Photo 2 (e.g. symptoms?)*
Adult: *http://www.vetores.ufsc.br/coleopteros/Pagina3/Chrysomelidae/DiabroticaSpeciosaNet.jpg* *Eggs and larvae:* *http://panorama.cnpms.embrapa.br/insetos-praga/identificacao/pragas-subterraneas/larva-alfinete-diabrotica-speciosa-germar-1824-coleoptera-chrysomelidae* *Adult and larva (fig 8 & 9):* *http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Amora/SistemaProducaoAmoreiraPreta/pragas.htm*	Image of damage to –potato http://www.batatas.com.br/pragas/vaguinha.asp Adult damage to potato leaves: http://www.abbabatatabrasileira.com.br/revista18_011.htm Adult damage to cucurbits: http://www.agronomicabr.com.br/mobile/foto.asp?id=107
Source/ copyright owner	*Source/ copyright owner*

19. Given the information assembled within the time scale required, is statutory action considered appropriate / justified?

Yes Statutory action		No Statutory action	✓

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