



Department for Environment Food & Rural Affairs

Rapid Pest Risk Analysis (PRA) for: Agapanthus gall midge (Diptera: Cecidomyiidae) November 2015

Summary and conclusions of the rapid PRA

The agapanthus gall midge, which is new to science, is a damaging pest of *Agapanthus*. In June 2015, the pest was added to the Plant Health Risk Register and it was decided that statutory action should be taken against findings of the agapanthus gall midge on commercially traded plants. At this time, the midge had only been recorded at three sites in southern England. The midge has now been found to have spread widely across the south of England and has been recorded in West Yorkshire. A PRA has therefore been initiated to see if statutory action in trade is still justified.

Risk of entry

The agapanthus gall midge is already present in the UK, and is suspected to have arrived from southern Africa where *Agapanthus* is native, possibly on plants for planting or cut flowers. However, there are no official records of the midge outside of the UK and Guernsey. Therefore, entry has been rated as likely with medium confidence.

Risk of establishment

The agapanthus gall midge is already established in the UK and is widespread in the south of England. There has also been a record of the agapanthus gall midge in a garden in West Yorkshire. It seems likely that the midge can establish wherever *Agapanthus* is grown. Therefore, establishment has been rated as very likely with high confidence.

Economic, environmental and social impact

Larval feeding within flower buds can lead to the discolouration and deformation of the buds, and generally causes them to not open, while larvae that feed between developing stems within the flower head sheath can lead to the collapse of the entire flower head. These symptoms make the *Agapanthus* unmarketable in trade and unattractive in a non-commercial setting. At peak flowering, almost 20% of flowers heads were affected at RHS Wisley. Its economic impact has therefore been rated as large, but due to the lack of data, this is with low confidence. Environmental impacts are expected to be very small (with high confidence), and social impacts medium (low confidence) to take into account the high value of *Agapanthus* and the effect that the agapanthus gall midge may have on collectors of *Agapanthus*.

Endangered area

Based on its current distribution, the entire range of *Agapanthus* in the UK is considered to be endangered by the agapanthus gall midge.

Risk management options

Due to the widespread nature of the midge in the UK, eradication in the wider environment is not considered a practical or cost-effective option. Instead, any risk management should be based on suppressing the spread of the agapanthus gall midge in trade. Current measures are in place to prevent the spread of the midge by not allowing the movement of *Agapanthus* plants in infested premises until the midge has been eradicated or is not considered to be present on a plant for movement. There are no biological and chemical controls that have been scientifically proven to be effective against the midge.

Key uncertainties and topics that would benefit from further investigation

As the agapanthus gall midge is new to science, there is very little information on its life cycle and biology. There is also large uncertainty over its worldwide distribution, the true extent of its impact, how quickly it will spread both naturally and in trade, and if there are any effective control methods.

Research proposed by the RHS will investigate the life cycle of the midge, and explore control options for home gardeners and commercial growers (Jones *et al.*, 2015). Also, as part of the plant sentinel network, botanical gardens in South Africa (where the midge is thought to originate), Australia and, possibly, New Zealand, will be looking out for the agapanthus gall midge, and its symptoms on *Agapanthus*.

Images of the pest

	
<p>Agapanthus gall midge adult. Image by Hayley Jones, Royal Horticultural Society.</p>	<p>Larval damage to an <i>Agapanthus</i> flower head. Image by Hayley Jones, Royal Horticultural Society.</p>

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

The uncertainties that remain are due to a lack of primary research. Further literature searches are considered to be unlikely to add any significant new information, and are unlikely to change any of the judgements made here.

No	✓				
Yes		PRA area: UK or EU		PRA scheme: UK or EPPO	

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

The agapanthus gall midge is widespread in the south of England and has been found in West Yorkshire where it appears to have overwintered. There is also the possibility that it is more widespread in the UK than is currently known; prior to August 2015, potentially infested *Agapanthus* plants were being freely moved across the country, and, at low infestation levels, there is the possibility that the midge could remain undetected in soil or in closed buds, especially when *Agapanthus* plants are sold prior to flowering. Some non-commercial growers of *Agapanthus* may also not be aware that the pest should be notified to the RHS. In addition, due to the cryptic lifecycle of the pest, there is a high likelihood that any treatments proposed as part of statutory action will fail to control the agapanthus gall midge. This would restrict nurseries infested with the midge from moving their stock, possibly indefinitely. When the increasing spread of the midge is coupled with the ineffectiveness of controls on trade, statutory action is no longer considered to be appropriate.

Yes
Statutory action

No
Statutory action

Stage 1: Initiation

1. What is the name of the pest?

Agapanthus gall midge (Diptera: Cecidomyiidae)

This species is new to science, has yet to be formally described, and is suspected to represent a new genus. Consequently, little is known about the biology, lifecycle, and impact of the midge, and any effective control methods.

2. What initiated this rapid PRA?

In June 2015, the pest was added to the UK Plant Health Risk Register and it was decided that statutory action should be taken against findings of the agapanthus gall midge on commercially traded plants. At this time, the midge had only been recorded at three sites in southern England. However, following an intensive survey by the Plant Health and Seeds Inspectorate (PHSI) of almost 200 commercial premises in August and September 2015, the agapanthus gall midge was recorded at a further 9 sites across southern England (Long, 2015, unpublished report). A call to the public by the RHS also gave six more sites where the agapanthus gall midge was present, including one site in West Yorkshire (Jones *et al.*, 2015). A PRA has therefore been initiated to see if statutory action in trade is still justified.

3. What is the PRA area?

The PRA area is the United Kingdom of Great Britain and Northern Ireland.

Stage 2: Risk Assessment

4. What is the pest's status in the EC Plant Health Directive (Council Directive 2000/29/EC¹) and in the lists of EPPO²?

The agapanthus gall midge is not listed in the EC Plant Health Directive and is not recommended for regulation as a quarantine pest by EPPO. It is also not on the EPPO Alert List.

¹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CONSLEG:2000L0029:20100113:EN:PDF>

² <https://www.eppo.int/QUARANTINE/quarantine.htm>

5. What is the pest's current geographical distribution?

The agapanthus gall midge has currently only been recorded in the UK and Guernsey, though it is suspected to originate from Southern Africa, where *Agapanthus* is native.

Table 1: Distribution of agapanthus gall midge

North America:	No records
Central America:	No records
South America:	No records
Europe:	Present (UK and Guernsey)
Africa:	No records
Asia:	No records
Oceania:	No records

6. Is the pest established or transient, or suspected to be established/transient in the UK?

The first samples of agapanthus gall midge damage were sent to the RHS in July 2014 from a garden in Surrey. Later samples received by the RHS from a garden in London were also accompanied by a photograph from 2013, showing the same symptoms. The agapanthus gall midge has also been recorded in Cornwall, Devon, Dorset, Essex, Hampshire, Somerset, and West Sussex, and so seems to be widely distributed in the south of England (Long, 2015, unpublished report). There has also been a record of the agapanthus gall midge in a garden in West Yorkshire, where their most recently acquired *Agapanthus* plant was from Guernsey in spring 2014, and there is a possible, but unconfirmed, record in Cumbria (Hayley Jones pers. comm., 2015).

Prior to August 2015, nurseries that were infested with the agapanthus gall midge were freely trading with other nurseries and retail garden centres (Long, 2015, unpublished report). One nursery in the south of England, for example, had distributed approximately 3870 plants from affected *Agapanthus* varieties between April and August 2015, primarily through the Homebase retail chain to stores nationwide and to some other garden centres (Long, 2015, unpublished report). Due to limited PHSI resources, not all of these could be traced, and so there is the possibility that the agapanthus gall midge has spread further in trade than is currently known.

7. What are the pest's natural and experimental host plants; of these, which are of economic and/or environmental importance in the UK?

The agapanthus gall midge has only been recorded on *Agapanthus* (African lily) to date. The majority of gall midges are highly host specific (Carneiro *et al.*, 2009) and it is unlikely that this species will attack other plant genera. Trade in *Agapanthus*, predominantly as an ornamental, is small in the UK.

8. What pathways provide opportunities for the pest to enter and transfer to a suitable host and what is the likelihood of entering the UK?

The agapanthus gall midge is already present in the UK. It is unknown where the midge came from, but a gall midge, which might be the same midge, has been observed attacking *Agapanthus* in South Africa (Winter and Reynolds, 2004) and an anecdotal report suggests that the agapanthus gall midge is widespread in both the wider environment and commercial trade in South Africa (Patrick Fairweather pers. comm., 2015). Pathways from South Africa and other possible source countries include plants for planting and cut flowers, as adults lay eggs in flower buds or flower head sheaths, and larvae subsequently develop in these structures. The midge may also be present in any associated soil, as the larvae are thought to enter the soil to overwinter and pupate. Overall, the risk of entry is rated as likely with medium confidence.

Entry Very unlikely Unlikely Moderately likely Likely Very likely

Confidence High Confidence Medium Confidence Low Confidence

9. If the pest needs a vector, is it present in the UK?

The agapanthus gall midge does not require a vector; it is a free-living organism.

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

The agapanthus gall midge has already established outdoors and under protection in the UK. There is no data on the climatic requirements of this pest, but based on current observations it seems likely that the gall midge will be able to establish anywhere in the UK where *Agapanthus* is grown.

<i>Outdoors</i>	Very unlikely	<input type="checkbox"/>	Unlikely	<input type="checkbox"/>	Moderately likely	<input type="checkbox"/>	Likely	<input type="checkbox"/>	Very likely	<input checked="" type="checkbox"/>
<i>Confidence</i>	High Confidence	<input checked="" type="checkbox"/>	Medium Confidence	<input type="checkbox"/>	Low Confidence	<input type="checkbox"/>				
<i>Under Protection</i>	Very unlikely	<input type="checkbox"/>	Unlikely	<input type="checkbox"/>	Moderately likely	<input type="checkbox"/>	Likely	<input type="checkbox"/>	Very likely	<input checked="" type="checkbox"/>
<i>Confidence</i>	High Confidence	<input checked="" type="checkbox"/>	Medium Confidence	<input type="checkbox"/>	Low Confidence	<input type="checkbox"/>				

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

Natural spread

There is currently little information on how quickly the agapanthus gall midge can spread naturally. The midge has been present in Surrey for over a year, and possibly in London since 2013, and is now known to be fairly widely distributed in the south of England in non-commercial premises (Long, 2015, unpublished report). It is therefore possible that the midge has spread rapidly in this time. However, it is not known where the midge first appeared. The midge may also have been present at sites much longer than is thought, and movement between sites may have been facilitated by trade rather than by natural spread.

Because larvae feed within flower head sheaths and flower buds, and have limited mobility, adults are likely to be the main life-stage for long-range dispersal. Observations by the RHS indicate that the midge may have multiple generations per year, with adults seen right up to early September (Jones *et al.*, 2015). Although the spring emergence date of adults is currently unknown, infestation has been observed before the opening of flower head sheaths, and so emergence may occur early in the season. Adults may therefore be active through most of spring and summer, giving ample time for dispersal. Also, while small winged invertebrates, such as midges, are generally weak fliers and unable to travel long distances under their own steam, they can be carried tens, or even hundreds, of kilometres by the wind (e.g., Hardy and Cheng, 1986; Met Office, 2014). However, for the midge to be carried such distances, the midge must first rise above their flight boundary layer (= where wind speed is lower than an invertebrate's flight speed), and this is unlikely in warm, sheltered habitats where *Agapanthus* is grown. When this is coupled with the discontinuous distribution of *Agapanthus* in the UK, the agapanthus gall midge is likely to move only slowly by natural spread, but due to the lack of data, this is with low confidence.

With trade

Agapanthus spp. are sold as ornamentals as plants for planting and as cut flowers. These plants are traded between commercial plant nurseries and retail outlets nationwide, as well as directly to customers (Long, 2015, unpublished report). Stages of the agapanthus gall midge that are present on these plants and associated soil are the larvae and pupae; larvae feed within flower head sheaths and flower buds, and enter the soil to pupate and

overwinter. Although heavily infested *Agapanthus* plants are unlikely to be traded, *Agapanthus* with low levels of infestation may be traded if a sufficient number of flower heads are healthy. There is also the possibility that the midge could remain undetected at low levels of infestation in soil or in closed buds, particularly when *Agapanthus* plants are sold prior to flowering (which is the case for at least one nursery; Helen Long pers. comm., 2015). It should be noted that the agapanthus gall midge has been found at nurseries which had received *Agapanthus* from infested nurseries.

Movement in trade is not just restricted to within the UK, but also from Guernsey. While there is no commercial production of *Agapanthus* in Guernsey, there is the possibility of *Agapanthus* plants for planting and cut flowers being exported into the UK through mail order companies that receive plants from outside of Guernsey (possibly from the UK) (Nigel Clarke pers. comm., 2015). *Agapanthus* plants are also sold at local garden centres (Nigel Clarke pers. comm., 2015). Indeed, the agapanthus gall midge found in West Yorkshire likely came from a plant acquired from Guernsey (Hayley Jones pers. comm., 2015). Movement in trade is therefore judged to be quickly, but due to the small amount of data, this is with medium confidence.

<i>Natural Spread</i>	Very slowly <input type="checkbox"/>	Slowly <input checked="" type="checkbox"/>	Moderate pace <input type="checkbox"/>	Quickly <input type="checkbox"/>	Very quickly <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		
<i>With trade</i>	Very slowly <input type="checkbox"/>	Slowly <input type="checkbox"/>	Moderate pace <input type="checkbox"/>	Quickly <input checked="" type="checkbox"/>	Very quickly <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input checked="" type="checkbox"/>	Low Confidence <input type="checkbox"/>		

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

Adults lay eggs in developing flower buds or within flower head sheaths. Larvae that feed within the buds cause discolouration and deformation of the buds, and sometimes cause the buds not to open, while larvae that feed between developing stems within the flower head sheath can lead to the collapse of the entire flower head (Jones *et al.*, 2015). These symptoms would make the *Agapanthus* plants unmarketable and make them unattractive in a non-commercial setting (e.g., in the wild or in private gardens). In the *Agapanthus* trial at Wisley, the number of infested flower heads remained roughly between 50 and 200 throughout the season (June – October) (Jones *et al.*, 2015). This was largely unaffected by the number of flower heads available; the number of flower heads peaked in late July (~1800), but only resulted in a slight rise in infested flower heads. This suggests that the number of flower heads is not limiting and that the agapanthus gall midge is constrained by other factors, including the cultivar, size of its current population, environmental

conditions and/or natural enemies. Still, even at peak flowering, ~ 20% of flower heads were affected. An initial study on cultivar resistance by Jones *et al.* (2015) showed that 81% of cultivars suffered symptoms, of which almost half exhibited severe symptoms (greater than 25% of buds affected within a flower head). Anecdotal reports from private gardens also suggest that damage can be extensive, and more severe on certain varieties (e.g., Nigel Clarke pers. comm., 2015). In addition, the closely related hemerocallis gall midge, *Contarinia quinquenotata*, can cause serious damage, but to daylilies (*Hemerocallis* spp.) (RHS, 2015). Economic impacts are therefore rated as large for the *Agapanthus* sector, but due to the lack of data, this is with low confidence. If the impact was judged in relation to the whole ornamental sector, it would be much lower due to the small size of the *Agapanthus* industry.

Social impacts are rated as medium because *Agapanthus* plants are highly valued ornamentals (with a cut flower industry of over 1 million plants) and the midge may have an effect on collectors, such as those responsible for the UK National Collection of *Agapanthus*, whereas environmental impacts are rated as very small, because while *Agapanthus* plants have naturalised in the wild in southern England (see BSBI distribution database - <http://bsbidb.org.uk/maps/#taxonid=2cd4p9h.3hkbdy>), they are not native to the UK. Due to the lack of data, social impacts are rated with low confidence, while environmental impacts are rated with high confidence due to the specificity of the midge on *Agapanthus*.

<i>Economic Impacts</i>	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input type="checkbox"/>	Large <input checked="" type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		
<i>Environmental Impacts</i>	Very small <input checked="" type="checkbox"/>	Small <input type="checkbox"/>	Medium <input type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input checked="" type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input type="checkbox"/>		
<i>Social Impacts</i>	Very small <input type="checkbox"/>	Small <input type="checkbox"/>	Medium <input checked="" type="checkbox"/>	Large <input type="checkbox"/>	Very large <input type="checkbox"/>
<i>Confidence</i>	High Confidence <input type="checkbox"/>	Medium Confidence <input type="checkbox"/>	Low Confidence <input checked="" type="checkbox"/>		

13. What is the pest’s potential as a vector of plant pathogens?

There are currently no records of the agapanthus gall midge being a vector of plant pathogens.

14. What is the area endangered by the pest?

The agapanthus gall midge is widespread in the south of England and has also been recorded in West Yorkshire in 2015, towards the northern limit of the *Agapanthus* growing

range. The most recently acquired *Agapanthus* plant in the garden in West Yorkshire was from Guernsey in spring 2014, so it is likely that the agapanthus gall midge overwintered and established on that site. The whole distribution of *Agapanthus* in the UK is therefore suspected to be endangered by the pest.

Stage 3: Pest Risk Management

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

Due to the widespread nature of the midge in the UK, eradication in the wider environment is not considered a practical or cost-effective option. Instead, any risk management should be based on suppressing the spread of the agapanthus gall midge in trade. Current measures are in place to prevent the spread of the midge by not allowing the movement of *Agapanthus* plants in infested premises until the midge has been eradicated or is not considered to be present on a plant to be moved (Long, 2015, unpublished report). The following options are available to trade:

- 1) Destroy affected material and at risk plants by burning or deep burial.
- 2) Remove all flower heads from *Agapanthus* stocks and dispose of them by burning on site or by incineration and deep burial at an approved landfill site. Repot the plants to remove the risk of any larvae or pupae in soil, to allow movement for sale in the same season (2015) and of dormant material. Dispose of old compost securely (double bagged) by deep burial to landfill.
- 3) If stock is to be overwintered on the nursery after applying action at point 2, a chemical treatment programme aimed at the adult emergence next spring will be required. PHSI will carry out official follow up inspection to confirm its effectiveness prior to the release of *Agapanthus* plants from the notice.

Because eggs and larvae are concealed within flower buds or in the scapes of flower heads, control with chemicals will be difficult. For chemicals to have any effect on these stages, they would have to be systemic (taken up and spread throughout the plant), whereas for adults, the treatments would have to be well timed. Because effective chemical (or biological) treatments are not known, there is a high likelihood that any treatments proposed as part of statutory action will fail to control the agapanthus gall midge. This would restrict nurseries infested with the midge from moving their stock (under current statutory action), possibly indefinitely. Statutory action may therefore be inappropriate.

16. References

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