Grower Summary

HNS PO 199a

Development of novel control options for agapanthus gall midge

Final Report

Project title:	Development of novel control options for agapanthus gall midge
Project number:	HNS PO 199a
Project leader:	Hayley Jones, Royal Horticultural Society
Report:	Final report March 2020
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Location of project:	RHS Garden Wisley, Surrey
Industry Representative:	Patrick Fairweather, Fairweather's Nursery, Hill Top Nursery, Beaulieu, Hants SO42 7YR
Date project commenced:	03 December 2018
Date project completed (or expected completion date):	31 March 2020

DISCLAIMER

The results and conclusions in this report are based on an investigation conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.]

AUTHENTICATION

We declare that this work was done under our supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

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GROWER SUMMARY

Headline

- A mulch of Strulch® reduced survival of agapanthus gall midge larvae by 20-25% in a laboratory pot test.
- Melcourt EcoBark® used as a pot topper did not reduce adult midge emergence but delayed it by three weeks.

Background

The agapanthus gall midge, *Enigmadiplosis agapanthi* poses a risk to both containerised plants and cut flowers. Midge infestation causes flower buds to be deformed and discoloured and often fail to open. Heavy infestations can lead to entire flower heads being aborted. It was first found in the UK in 2014 but has since spread, and has now been found in most counties in southern England and has successfully overwintered in Yorkshire

Due to the relative novelty and lack of information about the midge, there are no current recommendations available for control. Work carried out in HNS PO 199 did not identify any treatments other than cultural methods including removal of infested flower heads, destroying badly infested plants and avoiding growing highly susceptible cultivars such as Northern Star. None of the tested plant protection products had a significant effect when sprayed against larvae in the flowers. A test of drenches against the ground-dwelling stage of the larvae showed a significant effect of thiacloprid (Calypso), EAMU 2014/2153 (due to be withdrawn), but very high mortality in the water controls meant that drenches needed further study.

This project aims to address some crucial gaps in knowledge with the following objectives:

1. Review cultural control methods used for gall midge pests in a range of crops, identify knowledge gaps and produce a shortlist of candidate control treatments for objectives 3 and 4.
2. Evaluate the use of sticky traps and water traps for monitoring adult midge emergence.
3. Complete a field trial testing candidate novel spray treatments against first generation adults on a commercial cut flower farm.
4. Complete a laboratory pot test of candidate drenches of plant protection products, biological control agents and cultural control methods against the ground dwelling life stages.

Summary

Objective 1: Review of cultural control methods

The review highlights that there has been relatively little research into cultural control options against gall midges. Of the research that is available the most common effective strategies are:

- Use of resistant or less susceptible varieties of host plants
- Crop rotation or isolation
- Timing planting to avoid peak infestation
- Physical removal of infested material

Prior to this project there has been very little work done on barriers and other cultural techniques that target the ground-dwelling life cycle stages of these gall midges.

This literature review and knowledge of the project team indicated that timing was a crucial factor in control of gall midge species so for objective 3 (field trial of sprays targeting adults) the decision was taken to test a range of spray schedules rather than different products. For objective 4 (laboratory test of controls targeting larvae in the ground) cultural control in the form of mulches and barriers were prioritised due to a lack of data on effectiveness of these products against pests, the shortage of chemical control options and the increasing need to adopt IPM strategies. The biological, chemical and cultural control measures were selected based on literature review, grower opinions and using results from HNS PO 199. Selection of treatments was discussed with the host grower of the field trial (Greenyard Flowers UK Ltd) and with Patrick Fairweather (Fairweather's Nursery), to ensure they were appropriate and practical for industry needs.

Objective 2: Evaluate the use of sticky traps and water traps for monitoring

Work for objectives 2 and 3 was hosted by Greenyard Flowers UK Ltd at their site in Penzance, Cornwall. This is an outdoor cut flower grower with an ongoing problem with the midge. A suitable field trial area was selected, focusing on a large section of well-established plants of the earliest flowering varieties.

Three types of traps were tested for monitoring the midge; yellow and blue sticky traps and yellow water traps. Due to the impracticable methods required to identify the agapanthus gall midge to species level, all midges were counted that superficially resembled the agapanthus gall midge. Yellow water traps caught significantly more adult midges than either of the sticky traps. However despite relatively high number of midges seen in the water traps there was almost no midge damage in the field, possibly due to not all the midges in the traps being

agapanthus gall midge. Use of water traps may not be practical for growers due to the high numbers of other insects caught; the complicated process to empty and refill traps; the requirement for a microscope to detect midges reliably and difficulties in identification.

For now, growers may need to rely on timing treatments with susceptible flower head development, and this strategy is initially supported by our data as the peak of midges recorded in water traps coincided with the flower spikes approaching canopy height.

Objective 3: Field trial of spray treatments

As with other gall midges, timing is likely to be a critical factor for control efficacy, so the trial tested a range of spray schedules rather than different products. For example, in AHDB-funded research, a single application of the pyrethroid, lambda-cyhalothrin (Hallmark with Zeon Technology) targeted at the first sign of first generation adult saddle gall midge was as effective as a programme of up to three applications and sprays targeted against larvae were ineffective. The synthetic pyrethroid 'Decis Forte' (deltamethrin) was the selected treatment, with a label recommendation for use on outdoor ornamentals for the control of various pests.

Eight different spray schedules were tested, corresponding to a period in which the developing flower heads would be becoming susceptible to the midge:

1. Timing A – when developing flower heads are expected to be susceptible to the midge – i.e. reaching the height of the foliage.
2. Timing B (with B being 7-10 days after A.)
3. Timing C (14-17 days after A)
4. Timing A and B.
5. Timing B and C.
6. Timing A and C
7. Timing A, B and C.
8. Untreated control

The Decis Forte was applied at the label rate of 17.5 ml per 100 litres of water in 400L/ha.The rate was selected after testing a range of rates using water sensitive paper attached to the flower spikes and upper and lower leaves to achieve a medium spray.

Extremely low levels of midge infestation were recorded throughout the trial. No midge infested heads were recorded until the final assessment when five plots each had only one infested flower head. These infestation levels were too low to allow the data to be analysed.

The field site had extremely high levels of infestation in the previous year so the almost zero levels in the study were unexpected. It may be that as with midges that attack cereal crops, the populations naturally fluctuate or cycle, but the presence of midges in the traps means it is likely to reoccur in this field in the future. Additionally, the areas of the field outside the study area were sprayed regularly with a pyrethroid insecticide and although an appropriate buffer was in place it may be that the field level population was supressed.

Objective 4: Laboratory test of control methods against the ground dwelling life stages.

In order to test controls for the ground-dwelling larval stage a laboratory test was done using pots of growing media (Figure 1). After larvae were added the pots were monitored weekly for adult emergence.

A preliminary experiment was carried out to optimise conditions for adult emergence, in order to solve the problem of very low numbers of adult midges emerging in the water controls in HNS PO 199, which was likely to have been caused by excess moisture in the pots. Melcourt Sylvagrow® (a peat-free compost) was used at the moisture level direct from a freshly opened bag.

Test of control methods

Through literature review, grower opinions and using results from HNS PO 199 control measures were selected and applied to ten replicate pots per treatment (Table 1). All treatments that were not applied in liquid form had 28 ml water added to the pots. Images demonstrating the depth of mulches and application technique for black polythene are shown in Figure 2.

Figure 1. Experimental set up for laboratory tests of control measures against agapanthus gall midge larvae. **a.** Pot test in controlled environment room. **b.** Pots filled with 280ml growing media and water/ treatment subsequently added. **c.** Adult midges caught and counted on yellow sticky trap inside pot lid.

Table 1. Control treatments tested against the agapanthus gall midge in a laboratory pot test.

No.	Treatment (justification for choice)	Rate
1	Containermulch by Klasmann (a pot topper with adhesive properties with some evidence of pest control)	2 cm depth added on top of 180ml growing media.
2	Melcourt Ecobark (Used as a pot topper and similar to bark mulches used for outdoor grown plants)	2 cm depth added on top of 180ml growing media.
3	Strulch (a mineralised straw mulch used for outdoor flowerbeds)	3 cm depth added on top of 130ml growing media.
4	Black polythene (agapanthus plants in the field often planted into this for weed suppression and gave significant control of blackberry leaf midge adults emerging in SF 102)	Circles of 8cm diameter cut from polythene sheet with small X cut through to simulate planting through. (Figure 5)
5	Nemasys (used on protected HNS for sciarid fly control)	*S. feltiae* - 1,000,000 nematodes/m^2 in 1 L/m^2 water (rate for curative drench for sciarid fly control).
6	Gnatrol (Bti) (label rec. for sciarid fly control as a drench in protected ornamentals)	Highest label rate:10 ml/ m^2
7	Pitcher – Garlic granules applied to compost surface (EAMU for vine weevil and leaf & bud nematode control but some evidence in SP 23 (Bennison & Brown, 2018) that garlic controls sciarid fly larvae)	24g/m^2 granules were sprinkled evenly over the surface. (EAMU 2018/3744).
8	Calypso (thiacloprid) (has EAMU for use as drench on protected ornamentals for control of vine weevil and sciarid fly. Included as a positive control despite pending withdrawal as it showed an effect on agapanthus gall midge in HNSPO199)	83 ml in 100 L per m^3 compost (per 1000L compost) (EAMU 2014/2153 drench for vine weevil and sciarid fly control).
9	Water-treated control	28 ml per pot

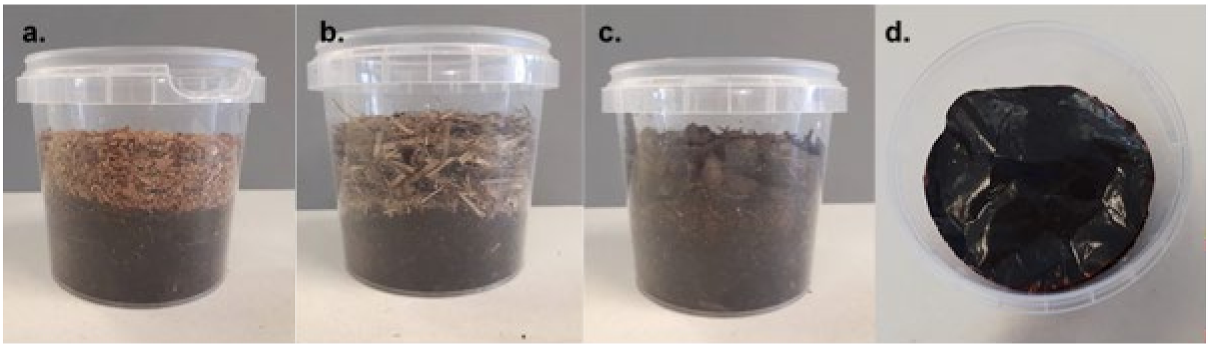

Figure 2. Barriers and mulches tested for control of agapanthus gall midge larvae.
a. Klasmann Containermulch **b.** Melcourt EcoBark **c.** Strulch and **d.** Black polythene.

Two treatments, Calypso and Strulch, significantly reduced adult emergence (by 20-25% compared to the other treatments) (Figure 3). Calypso currently has an EAMU for use as a drench on protected ornamentals for control of vine weevil and sciarid fly (2014/2153). However, thiacloprid is due to be withdrawn from the market in 2021 and many retailers ask growers not to apply neonicotinoids so use of Calypso is not a sustainable option for growers to control agapanthus gall midge.

Barriers and mulches are a more sustainable choice for control. Strulch significantly reduced midge emergence. This product is mostly used as a mulch for beds, and so may be a relatively practical option for growers of outdoor cut flower agapanthus. It may be appropriate as a pot mulch for containerised agapanthus, particularly if the surrounding surfaces are not suitable for the midge to burrow into to pupate.

Melcourt EcoBark did not reduce the number of adult midges emerging, but delayed their emergence by around three weeks. This may be useful if it can delay adult midge emergence to outside of the susceptible flowering period of the plants in the vicinity. However, its possible usefulness is limited by the long flowering time of many agapanthus cultivars and overlapping generations of the midge, so targeting the first generation would be a key strategy.
The other treatments (Klaasman Containermulch, black polythene, Nemasys, Gnatrol and Pitcher) did not have a significant effect on number of midges emerging, although the latter two may have delayed midge emergence by 2-4 days. If they were ineffective under these controlled conditions then they are very unlikely to be successful in field conditions.

A priority for future work would be to test the successful treatments in commercial conditions, both for containerised and field-grown agapanthus. Evaluation of other barrier and mulch solutions would also be justified.

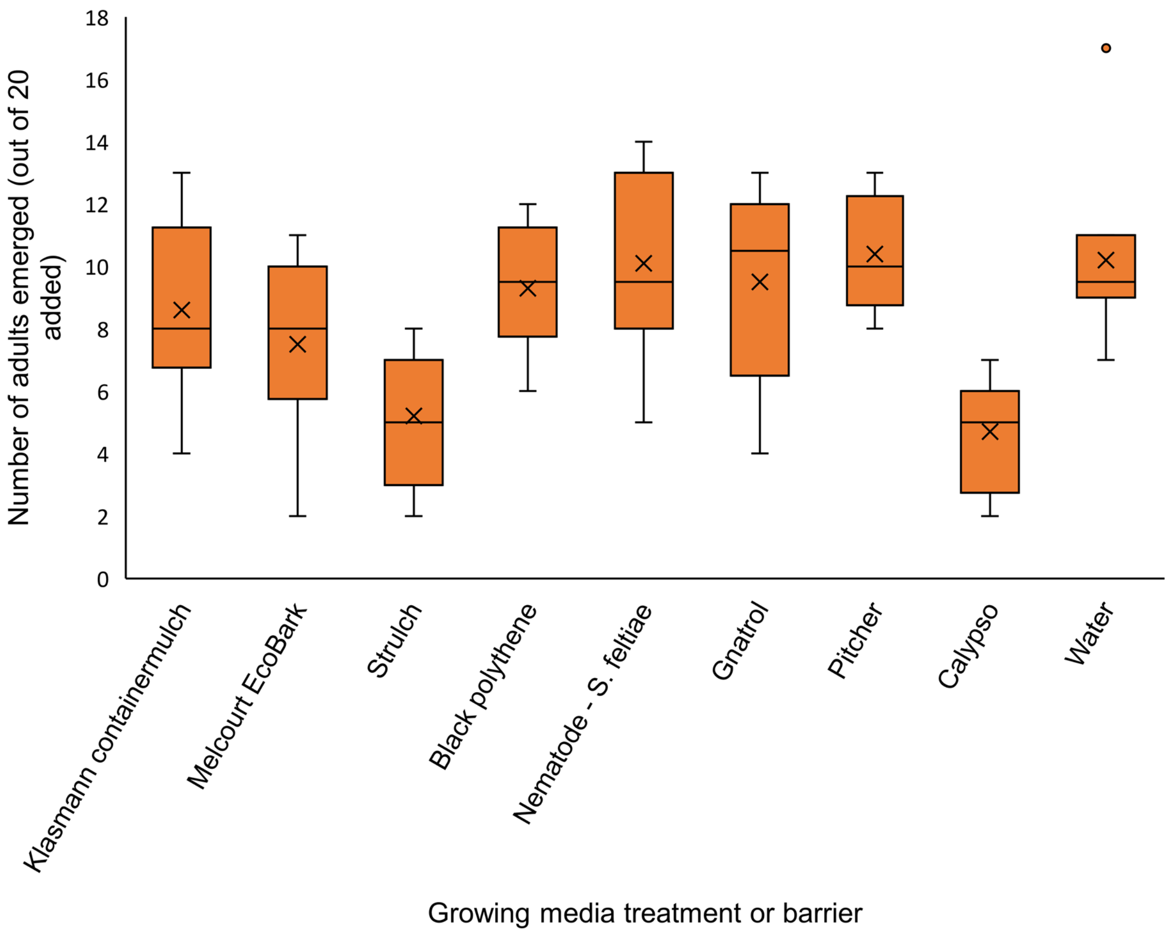

Figure 3. Box and whisker plot showing number of midges emerging from pots treated with cultural, biological or chemical controls. X shows mean, inner bar median and box spans the interquartile range.

Financial Benefits

A 25% reduction in damage could equate to a saving of £210,000 (based on an estimate of £3 production cost per pot and potential crop loss of 70% in an infested nursery costing approximately £840,000). In cut flowers a 25% reduction in damage could mean a saving of £75,000 (based on a cut flower grower estimate of midge infestation currently causing around 50% crop loss. A grower hoping to harvest 1.2 million stems would therefore suffer a loss of approximately £300,000).

Action Points

- Do not rely on insecticide sprays for control of the pest. Research has not yet demonstrated an effective method for controlling agapanthus gall midge with pesticides. In HNS PO 199, a pyrethroid spray targeting larvae in flowers was ineffective in a laboratory test. Research on control of other midge pests indicates that chemical control is most effective when targeted against first generation adults but this has not yet been demonstrated with agapanthus gall midge.

- Source agapanthus plants from uninfested nurseries
- Avoid highly susceptible cultivars such as Northern Star
- As plants may not yet be showing symptoms when brought onto the nursery, monitor closely for symptoms as soon as they start to flower
- Remove and destroy infested flower heads and destroy badly infested plants
- Consider water traps as a way to monitor for presence of the midge in fields, but be aware that other similar insects may be caught and that that numbers of midges in the trap may not reflect severity of infestation in the field.
- The results of this project indicated that a drench of Calypso (used according to EAMU 2014/2153 for control of vine weevil and sciarid larvae in protected ornamentals) may give some control of the larvae or pupae in the growing media after the larvae have dropped to the ground to pupate. However as thiacloprid is due to be withdrawn from the market this is not a future option for control.
- Consider using Strulch (a mineralised straw mulch) on field grown agapanthus and possibly as a pot topper for containerised plants. However, so far this has only been tested in a laboratory pot test and this result needs validating under commercial conditions. Growers may wish to test the product is suitable for their crops before widespread use.
- Melcourt EcoBark had a delaying effect on midge emergence which means that bark-based pot toppers may be useful to prevent egg laying at the susceptible flower stage, however further research is needed to test this further.

