



▲ A galled flower bud has been marked to avoid it being counted a second time in a study to find effective pesticides against the *Hemerocallis* gall midge at the Royal Horticultural Society's Wisley Garden, Woking, Surrey, UK. — photo courtesy of Andrew Halstead

Hemerocallis gall midge study

Report on the AHS-funded study of some insecticides against the *Hemerocallis* gall midge

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Hemerocallis gall midge (*Contarinia quinquenotata* Loew) is an important insect pest of daylilies in Europe, and in parts of Canada and USA. Many *Hemerocallis* species are native plants of China, Japan and other parts of East Asia, and that area is likely to be the origin of this pest. The midge was first detected in Europe during the 1880s in Austria (Loew 1885). It is now widespread in Europe, but was not detected in the UK until 1989 (Halstead and Harris 1990). It is a more recent arrival in North America, where it was first discovered in British Columbia, Canada in 2001 (Anon 2001). It has since spread to the state of Washington, in the USA.

In the UK, the two-millimeter-long flies emerge from pupae in the soil during late May and June, and lay eggs in the developing flower buds. As many as 382 larvae have been found within a single flower bud at the Royal Horticultural Society's (RHS) Garden, Wisley, Surrey, UK, (RHS data) although this may be the progeny of more than one midge. The larvae are up to three millimeters long and are whitish and semi-transparent. Affected buds are much wider and shorter than normal and they fail to open as flowers. The petals within a galled bud are abnormally thickened, and the larvae swim around in a watery liquid. When fully fed, the larvae leave the buds and drop into the soil, where they pupate within silk cocoons. This pest has one generation a year; and in the UK, the development of new galled buds usually ends after the first week of July.

There are currently no recommendations by the manufacturers of pesticides for the use of their products against this pest in the UK, Canada or USA. This study attempted to establish whether pesticides available to home gardeners in the UK will be effective in protecting daylilies

against the gall midge. Originally intended as a one year project, it was extended to three years.

Experimental design and methods

Hemerocallis 'Cynthia Mary' (Pole, 1982) was chosen for the project as earlier observations of the gall midge at Wisley Garden had indicated that this cultivar flowered at a suitable time for the midge and could become heavily infested. A total of 64 plants were planted on 25 February 2009 at one-meter spacings in four replicated plots, each containing 16 plants in a four-by-four pattern, at Deer's Farm, an experimental area close to Wisley Garden, Surrey, UK. Planting was done later than originally intended because the 2008-9 winter was colder than usual, resulting in frozen soil.

In 2009, the pesticides used were bifenthrin (Scott's Bug Clear), which is a contact action pyrethroid insecticide, and two systemic neonicotinoid insecticides, thiacloprid (Bayer Provado Ultimate Bug Killer) and acetamiprid (Scott's Bug Clear Ultra). When it became apparent in 2009 that no galled buds were developing on the trial plants, buds infested with late instar (development stage) larvae were collected from plants in Wisley Garden and buried in the mulch around the trial plants. This was done to increase the chances of adult gall midges emerging and laying eggs on the flower buds in 2010.

In 2010 and 2011, another pyrethroid, deltamethrin (Bayer Sprayday Greenfly Killer), was used instead of bifenthrin as the latter was being withdrawn from garden use in the UK. In the absence of any specific label recommendation for the treatment of pests on daylilies, these pesticides were applied at the dilution rate given on the product label for use against other pests. These were: bifenthrin 14 milliliters/litre of water (2009 only); deltamethrin 0.5 milliliters/litre of water; thiacloprid 20 milliliters/litre of water; acetamiprid 10 milliliters/litre of water. Water was used as the control treatment in all three years.



(Top photo) Daylily flower buds are shown at the stage when the plant is treated for *hemerocallis* gall midge.
 (Below) The trial daylily beds at RHS Wisley Garden.
 — photos courtesy of Andrew Halstead

During June and July, the numbers of galled and normal flower buds were counted and analyzed as a percentage of galled-to-normal flowers for each treatment, although for technical reasons, analysis was not possible in 2010. To avoid double counting, galled buds were marked and normal flowers removed as they developed.

It was necessary to run the experiment for a third year with a latin square randomization of the treatments, with the hope that the level of midge infestation would build up and produce results to

which an analysis of variance (ANOVA) statistical test could be applied.

In 2011, the plants were sprayed with the same pesticides as in 2010 and they were applied on 1 June, see Figure 1.

Figure 1. Latin square design used for allocation of treatments in the *hemerocallis* gall midge trial in 2011.

Where in Plot 1: A = Deltamethrin, B = Acetamiprid, C = Thiacloprid, D = Control;

Plot 2: A = Deltamethrin, B = Control, C = Acetamiprid, D = Thiacloprid;

Plot 3: A = Thiacloprid, B = Acetamiprid, C = Control, D = Deltamethrin;

Plot 4: A = Acetamiprid, B = Control, C = Deltamethrin, D = Thiacloprid.

A	B	C	D
B	C	D	A
C	D	A	B
D	A	B	C

The first galled buds were seen on 15 June, and the last galled buds appeared on 24 June. As in 2010, the numbers of galled and normal flowers were recorded during the period that galled buds were forming. These figures are given in Table 2.

Analysis

An ANOVA was carried out on the proportion of galled buds using the statistical program, Genstat 9.1.0 (Lawes Agricultural Trust).

Results and discussion

Frustratingly in 2009, none of the plants developed any galled buds. This was despite the pest being present in a garden only 50 meters away from the experimental plots. The relatively late date for flower scape development and spraying in the first year (18 June) may have been due to the fact these were new plants. Their flowering period was, however, within the egg-laying period of the midge.

In 2010, the first galled buds were seen on 22 June and the gall formation period ended on 5 July. The numbers of galled buds and normal flowers for each of the treatments during that period are given in Table 1.

While there was a reduction in the percentage of galling between the

Table 1. Galled buds and normal flowers in 2010 (22 June – 5 July)

	water	deltamethrin	thiacloprid	acetamiprid
Plot 1				
Galled buds	8	4	3	4
Normal flowers	75	62	56	53
Plot 2				
Galled buds	12	1	2	2
Normal flowers	97	61	117	61
Plot 3				
Galled buds	8	2	5	2
Normal flowers	42	39	62	56
Plot 4				
Galled buds	11	3	4	4
Normal flowers	51	51	67	35
Total of 4 plots				
Galled buds	39	10	14	12
Normal flowers	265	213	302	205
Percent galled	14.72%	4.69%	3.02%	5.85%

pesticide treatments and the water control, the manner in which the treatments had been randomized in 2010 did not allow a statistical analysis to be used. In 2011 levels of infestation were lower than in 2010, but the improved Latin square design allowed the data given in Table 2 to

Table 2. Galled buds and normal flowers in 2011 (15 - 24 June)

	water	deltamethrin	thiacloprid	acetamiprid
Plot 1				
Galled buds	9	2	2	5
Normal flowers	109	66	76	113
Plot 2				
Galled buds	3	9	1	0
Normal flowers	83	149	63	130
Plot 3				
Galled buds	3	2	0	2
Normal flowers	66	101	65	56
Plot 4				
Galled buds	3	3	9	0
Normal flowers	92	75	91	48
Total of 4 plots				
Galled buds	18	16	3	7
Normal flowers	350	391	205	347
Percent galled	5.17%	4.09%	1.01%	2.02%

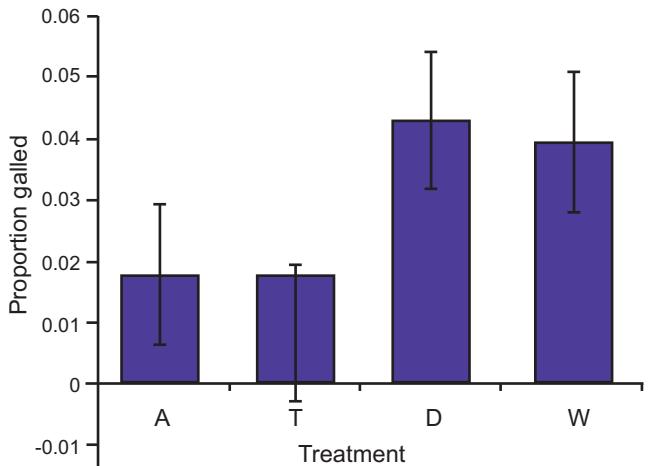
be statistically analyzed.

The results in 2011 showed that application with the systemic neonicotinoid insecticides acetamiprid and thiacloprid significantly reduced *hemerocallis* gall midge infestation compared to spraying with water or the synthetic pyrethroid deltamethrin. Thiacloprid (available as Calypso® in North America, where it is only registered for use on fruit trees) was the most effective treatment resulting in a five-fold decrease in the proportion of galled buds compared with the water control. In both 2010 and 2011, the levels of gall midge infestation, as measured by the proportion of galled to normal buds, was low, even on the control plants sprayed with just water.

Conclusions

The results obtained in 2011 indicate that the systemic pesticides used can reduce the amount of galled buds that develop but not prevent damage entirely. In both 2010 and 2011, the levels of gall midge infestation,

Figure 2. Proportion of daylily flower buds galled under four treatment regimes. A = Acetamiprid, T = Thiacloprid D = Deltamethrin, W = Water. Where treatment differences $F = 3, 4.41$. $p = 0.01$. Error bar = 1 s.e.d.



as measured by the proportion of galled to normal buds, was low, even on the water-treated plants. Systemic pesticides are absorbed into the plant tissues and could be having an impact on larvae developing within the buds, whereas contact sprays, such as deltamethrin, remain on the outside of the plant. Deltamethrin should control adult midges that come into contact with treated surfaces, but it is unlikely to affect larvae inside the buds.

Spraying on its own is unlikely to eliminate hemerocallis gall midge from a garden. It is worthwhile removing galled buds as they appear to prevent the larvae from completing their development. Galled buds must be removed from the garden and not left on the ground or put on compost heaps. Neighbors who grow daylilies should be encouraged to be equally vigilant in destroying galled flower buds.

Because hemerocallis gall midge has only one generation a year in early summer, it is possible largely to avoid the pest by growing cultivars that flower relatively late in the summer. Those plants that have a flowering period of July-August will be little affected compared to those with a flowering period of late May-June. ■

Acknowledgements

I would like to thank the American Hemerocallis Society for encouraging and funding this work. Thanks are due to Andrew Salisbury for help with the experimental design and analysis, and to Emma Cox for maintaining the plots.

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- AHS Scientific Studies Committee note: Several North American products contain the active ingredients tested in this UK study, but these formulations are not necessarily labeled appropriately for use against the daylily gall midge, nor locally available to all classes of users. Also, products in different regions may contain different active ingredients, and product formulations are sometimes changed. Contact your nearest Extension office or equivalent if you wish to ascertain local availability of products containing the active ingredients tested in this study. In North America, imidacloprid is a more widely available neonicotinoid insecticide than thiacloprid and acetamiprid, but it was not tested in this study.

DJ Winter 12
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'Cosmic Blast'
(Salter, 2011)

'Don't Touch That'
(Smith-Harry-P., 2011)

'Fantasy Fringe'
(Stamile-Pierce, 2010)

'Freaky Good'
(Smith-Harry-P., 2012)

'Geometric Wizard'
(Salter-E.H., 2012)

'Ghosts and Goblins'
(Carpenter-Carpenter, 2011)

'Hooked'
(Stamile-Pierce, 2011)

'Indigo Edge'
(Smith-Harry-P., 2012)

'Master of the Moon'
(Salter-E.H., 2010)

'Orange Ruffles'
(Smith-Harry-P., 2012)

'Quiet Riot'
(Salter, 2012)

'Retro Afternoon'
(Salter, 2011)

'Tuscany Skies'
(Stamile-Pierce, 2010)

'Wickedly Wild and Wonderful'
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