Host Plant Relationships of *Leptodictya plana* (Hemiptera: Tingidae)[1]

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Abstract

Leptodictya plana Heidemann is an emerging pest on ornamental grasses in the southern United States. Thirty-two selections of commercially available ornamental grasses and sedges and five trial accessions of *Pennisetum purpureum* were evaluated for susceptibility to *L. plana* feeding and oviposition. No-choice studies were conducted in a greenhouse by securing four lace bugs to leaf blades of each plant using clip cages. Lace bugs stayed attached for five days. Damage and number eggs were recorded. Choice studies were conducted in the laboratory by placing leaf blades from each genus of plant species into a large petri dish in a spoke pattern. There were no plants tested that consistently received zero percent damage in either trial. Plants that sustained the least damage included *Acorus* spp., *Cordyline* spp., and *Panicum* spp. *Pennisetum* spp. entries exhibited the highest overall percent damage and were the only genera of plants that supported oviposition.

Index words: lace bug, Tingidae, ornamental grasses, *Pennisetum*, host plant resistance.

Species used in this study: *Acorus gramineus*; *Andropogon virginicus*; *Andropogon gerardi*; *Andropogon glomeratus*; *Calamagrostis acutiflora*; *Carex comans*; *Cordyline australis*; *Cordyline indivisa*; *Cortaderia selloana*; *Eragrostis spectabilis*; *Festuca glauca*; *Miscanthus sinensis*; *Muhlenbergia capillaris*; *Nassella tenuissima*; *Panicum virgatum*; *Pennisetum alopecuroides*; *Pennisetum glaucum*; *Pennisetum orientale*; *Pennisetum purpureum*; *Pennisetum setaceum*; *Phalaris arundacea*; *Schizachyrium scoparium*; *Scirpus cernuus*; *Sorghastrum nutans*; *Spartina bakerii*.

Significance to the Nursery Industry

Ornamental grasses are common staples used in many landscape settings for their easy maintenance, pest-free nature, and drought tolerance. The recent appearance of the previously rare lace bug, *Leptodictya plana*, causing extensive damage to common ornamental grasses in central Georgia, suggests a need to examine the range of susceptibility among common ornamental grass species and cultivars. Prior to this report, extensive damage to ornamental plants caused by large infestations of these lace bugs had not been documented. If *L. plana* feeds on other varieties of ornamental grass, it could pose a substantial economic issue. Therefore, it is critical to learn more about this pest in order to determine the most effective ways to manage and control its impact and potential further spread. This study examines

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37 different ornamental grasses and sedges for potential resistance to this damaging pest.

Introduction

Leptodictya plana Heidemann is a relatively uncommon lace bug that specializes on panicoid grasses and is mostly found in the southwest United States (10). *L. plana* is originally described as having an elongate, oblong, extremely flat body, with a distinct narrowness across the elytra and opaque pronotal lateral margins, a yellow head, greenish-grey thorax and light brown abdomen (5).

Damage caused by *L. plana* is similar to other species of lace bugs. Adults and nymphs presumably feed like the azalea lace bug, *Stephanitis pyrioides* Scott, by removing leaf mesophyll from the underside of the leaf blades by piercing their mouthparts through the stomata, resulting in characteristic chlorotic damage that can be viewed from above (1, 3, 4). Severe infestations can lead to leaf wilting and eventual death if left untreated.

Recently, *L. plana* was observed in central Georgia in a field plot of trial *Pennisetum purpureum* interspecific and trispecific grasses, inflicting substantial damage. Ornamental grasses are common staples used in many landscape settings for their easy maintenance, pest-free nature, and drought tolerance. Numerous ornamental grass species are available on the market throughout the United States. Very little information is known about the life history of *L. plana*. The purpose of this study was to assess the ornamental grass plant species most suitable for the survival and development of *L. plana*.

Materials and Methods

No-choice greenhouse studies. Thirty-seven ornamental grass or sedge selections representing 24 species (Table 1) were evaluated for feeding behavior and oviposition in a greenhouse study. No pesticides were applied prior to or during the study. Plants were arranged in a randomized block design with four spatial replications and two temporal replications.

Two male and two female adult lace bugs were attached to the leaf blades of each plant using individualized clip containers. Clip containers were constructed by inserting the leaf blades through a hole in a plastic lid which was attached to a 32-ml plastic cup. The plastic cup was modified by replacing the bottom with mesh netting to allow for ventilation. Cups were secured to the plants by sealing the plastic opening holes with Parafilm M (American National Can, Greenwich, CT) where the leaf blades were inserted.

After five days attached to the plant, cups were removed. The number of eggs, number of living adults, and leaf dam-

Table 1. Ornamental grasses used in host plant resistance studies with *L. plana*.

Plant no	Species	Cultivar	Common name	Family	Subfamily
1	*Acorus gramineus*	'Ogon'	Golden Striped Sweet Flag	Araceae	Acoraceae
2	*Andropogon virginicus*		Broomsedge	Poaceae	Panicoideae
3	*Andropogon gerardii*		Big Bluestem	Poaceae	Panicoideae
4	*Andropogon glomeratus*		Bushy Bluestem	Poaceae	Panicoideae
5	*Calamagrostis acutiflora*	'Karl Foerster'	Feather Reed Grass	Poaceae	Pooideae
6	*Carex comans*	'Amazon Mist'	Sedge	Cyperaceae	Caricoideae
7	*Cordyline australis*	'Red Star'	Cabbage Tree	Laxmanniaceae	Rubioideae
8	*Cordyline indivisa*		Spike Dracaena	Laxmanniaceae	Rubioideae
9	*Cortaderia selloana*	'Pumila'	Dwarf Pampas Grass	Poaceae	Danthonioideae
10	*Eragrostis spectabilis*		Purple Love Grass	Poaceae	Chloridoideae
11	*Festuca glauca*	'Select'	Blue Fescue	Poaceae	Pooideae
12	*Festuca glauca*	'Elijah Blue'	Blue Fescue	Poaceae	Pooideae
13	*Miscanthus sinensis*	'Purpurascens'	Flame Grass	Poaceae	Panicoideae
14	*Miscanthus sinensis*	'Zebrinus'	Zebra Grass	Poaceae	Panicoideae
15	*Miscanthus sinensis*	'Morning Light'	Pink Muhly Grass	Poaceae	Chloridoideae
16	*Muhlenbergia capillaris*		Pink Muhly Grass	Poaceae	Chloridoideae
17	*Muhlenbergia capillaris*	'Pink Flamingo'	Pink Muhly Grass	Poaceae	Chloridoideae
18	*Nassella tenuissima*		Ponytail Grass	Poaceae	Pooideae
19	*Panicum virgatum*		Switchgrass	Poaceae	Panicoideae
20	*Panicum virgatum*	'Heavy Metal'	Blue Switchgrass	Poaceae	Panicoideae
21	*Panicum virgatum*	'Shenandoah'	Red Switchgrass	Poaceae	Panicoideae
22	*Pennisetum alopecuroides*		Fountain Grass	Poaceae	Panicoideae
23	*Pennisetum alopecuroides*	'Hamelin'	Dwarf Fountain Grass	Poaceae	Panicoideae
24	*Pennisetum alopecuroides*	'Moudry'	Black Fountain Grass	Poaceae	Panicoideae
25	*Pennisetum glaucum*	'Jester'	Ornamental Millet	Poaceae	Panicoideae
26	*Pennisetum orientale*	'Tall Tails'	Oriental Fountain Grass	Poaceae	Panicoideae
27	*Pennisetum setaceum*	'Rubrum'	Purple Fountain Grass	Poaceae	Panicoideae
28	*Phalaris arundacea*	'Picta'	Ribbon Grass	Poaceae	Panicoideae
29	*Schizachyrium scoparium*		Little Bluestem	Poaceae	Panicoideae
30	*Scirpus cernuus*		Fiber Optic grass	Cyperaceae	Cyperoideae
31	*Sorghastrum nutans*		Indian grass	Poaceae	Panicoideae
32	*Spartina bakerii*		Cord grass	Poaceae	Chloridoideae
33	*Pennisetum* spp. experimental hybrid			Poaceae	Panicoideae
34	*Pennisetum purpureum* × *P. glaucum* × *P. squamulatum*			Poaceae	Panicoideae
35	*Pennisetum* spp. experimental hybrid			Poaceae	Panicoideae
36	*Pennisetum* spp. experimental hybrid			Poaceae	Panicoideae
37	*Pennisetum* spp. experimental hybrid			Poaceae	Panicoideae

Table 2. Mean *L. plana* damage ratings for ornamental grass, choice and no-choice studies.

Entry no	Plant name/cultivar	Greenhouse no–choice trial damage rating (1–10)		Pennisetum choice trial damage rating (1–10)		Genus rep. choice trial damage rating (1–10)	
		6/30–7/09	7/16–7/21	7/29–7/31	8/5–8/7	7/29–7/31	8/5–8/7
1	*Acorus gramineus* 'Ogon'	0.00f	1.25gh	—	—	—	—
2	*Andropogon virginicus*	4.25a–f	5.50a–h	—	—	0.00e	1.00cd
3	*Andropogon gerardii*	2.25c–f	4.50a–h	—	—	—	—
4	*Andropogon glomeratus*	0.75ef	0.75h	—	—	—	—
5	*Calamagrostis acutiflora* 'Karl Foerster'	1.75c–f	2.50d–h	—	—	2.83b	4.00b
6	*Carex comans* 'Amazon Mist'	3.25b–f	2.75d–h	—	—	—	—
7	*Cordyline australis* 'Red Star'	0.00f	0.00h	—	—	—	—
8	*Cordyline indivisa*	0.25f	1.75e–h	—	—	—	—
9	*Cortaderia selloana* 'Pumila'	2.00c–f	2.50d–h	—	—	0.00e	0.00d
10	*Eragrostis spectabilis*	0.50ef	3.50b–h	—	—	0.00e	1.33cd
11	*Festuca glauca* 'Select'	4.75a–f	7.25a–g	—	—	0.17e	2.17c
12	*Festuca glauca* 'Elijah Blue'	3.25b–f	3.50b–h	—	—	—	—
13	*Miscanthus sinensis* 'Purpurascens'	1.75c–f	3.00c–h	—	—	0.50e–e	0.00d
14	*Miscanthus sinensis* 'Zebrinus'	0.25f	1.50f–h	—	—	—	—
15	*Miscanthus sinensis* 'Morning Light'	1.50d–f	6.00b–g	—	—	—	—
16	*Muhlenbergia capillaris*	2.00c–f	2.50d–h	—	—	—	—
17	*Muhlenbergia capillaris* 'Pink Flamingo'	2.25c–f	2.75d–h	—	—	0.00e	0.17d
18	*Nassella tenuissima*	0.25f	1.75e–h	—	—	0.33de	0.00d
19	*Panicum virgatum*	0.75ef	0.50h	—	—	—	—
20	*Panicum virgatum* 'Heavy Metal'	1.00ef	1.25gh	—	—	0.33de	0.17d
21	*Panicum virgatum* 'Shenandoah'	0.75ef	0.75h	—	—	—	—
22	*Pennisetum alopecuroides*	5.75a–e	10.00a	0.67b	4.50ab	—	—
23	*Pennisetum alopecuroides* 'Hamelin'	8.75a	9.50ab	3.17a	1.50b	7.33a	7.67a
24	*Pennisetum alopecuroides* 'Moudry'	7.75ab	9.50ab	3.50a	2.17b	—	—
25	*Pennisetum glaucum* 'Jester'	6.75a–d	5.25a–h	—	—	—	—
26	*Pennisetum orientale* 'Tall Tails'	8.25ab	9.00a–c	0.67b	6.00a	—	—
27	*Pennisetum setaceum* 'Rubrum'	7.00a–c	7.75a–e	0.83b	4.83ab	—	—
28	*Phalaris arundacea* 'Picta'	0.00f	1.50f–h	—	—	1.17c	2.33bc
29	*Schizachyrium scoparium*	5.25a–f	4.75a–h	—	—	0.33de	0.17d
30	*Scirpus cernuus*	0.50ef	2.25d–h	—	—	—	—
31	*Sorghastrum nutans*	2.00c–f	6.00a–h	—	—	1.00cd	0.33d
32	*Spartina bakerii*	3.25b–f	5.00a–h	—	—	0.00e	0.17d
33	# 12 *Pennisetum* experimental hybrid	4.25a–f	7.25a–g	0.83b	3.33ab	—	—
34	# 17 *Pennisetum* experimental hybrid	5.25a–f	8.00a–d	0.50b	2.50b	—	—
35	# 26 *Pennisetum* experimental hybrid	4.50a–f	8.25a–d	0.83b	3.67ab	—	—
36	# 10 *Pennisetum* experimental hybrid	4.25a–f	7.50a–f	0.16b	3.83ab	—	—
37	# 8 *Pennisetum* experimental hybrid	5.25a–f	8.00a–d	0.83b	4.50ab	—	—

age rating were recorded. Damage ratings were estimated by observing the amount of chlorotic injury per total leaf area on a scale from 0 to 10, with 0 being no damage observed and 10 being complete injury, or 100% chlorosis.

Choice containerized studies. One representative grass species from each of 14 genera (Table 2) was placed into a large 30 cm petri dish. The 14 leaf blades were arranged in a spoke pattern so that they were at equal distances from one another. In the center, a moistened piece of filter paper was placed over the cut ends of the blades to prevent desiccation. The blades were randomized within each of the six spatial repetitions, and there were two temporal repetitions performed.

In the first trial, five male and five female adult lace bugs were placed into the center of each petri dish. In the second trial, ten male and ten female adult lace bugs were placed into the petri dishes. The locations of the lace bugs were recorded 3, 27, and 51 hours after being placed into the dishes. At 51 hours, an overall damage rating was also recorded for each leaf blade and the insects were removed. Damage ratings were estimated as previously described.

A second choice study was performed using 10 different species of *Pennisetum* grasses to further determine performance within the genus because prior experiments had shown them to be the ovipositional host for *L. plana*. The ten leaf blades were arranged and the data was collected in the same manner as the other choice test conducted.

Statistical analyses. Data were analyzed by analysis of variance (ANOVA) using the PROC GLM procedure in SAS (SAS Institute 2003, Cary, NC) to determine differences in susceptibility among the plant selections. Means in the choice containerized study were separated using a least significant difference (LSD) test at $\alpha = 0.05$. Means in the no-choice greenhouse study were separated using Tukey's studentized range test (HSD) at $\alpha = 0.05$. All damage rating data were transformed using an arcsine square root transformation prior to analysis. The data presented in tables and figures are untransformed means.

Results and Discussion

All plants in the study had at least a few spots of feeding damage observed (Table 2). There were no plants tested that consistently received zero percent damage in both trials. Plants that sustained the least damage included *Acorus* spp., *Cordyline* spp., and *Panicum* spp. All non-grass selections,

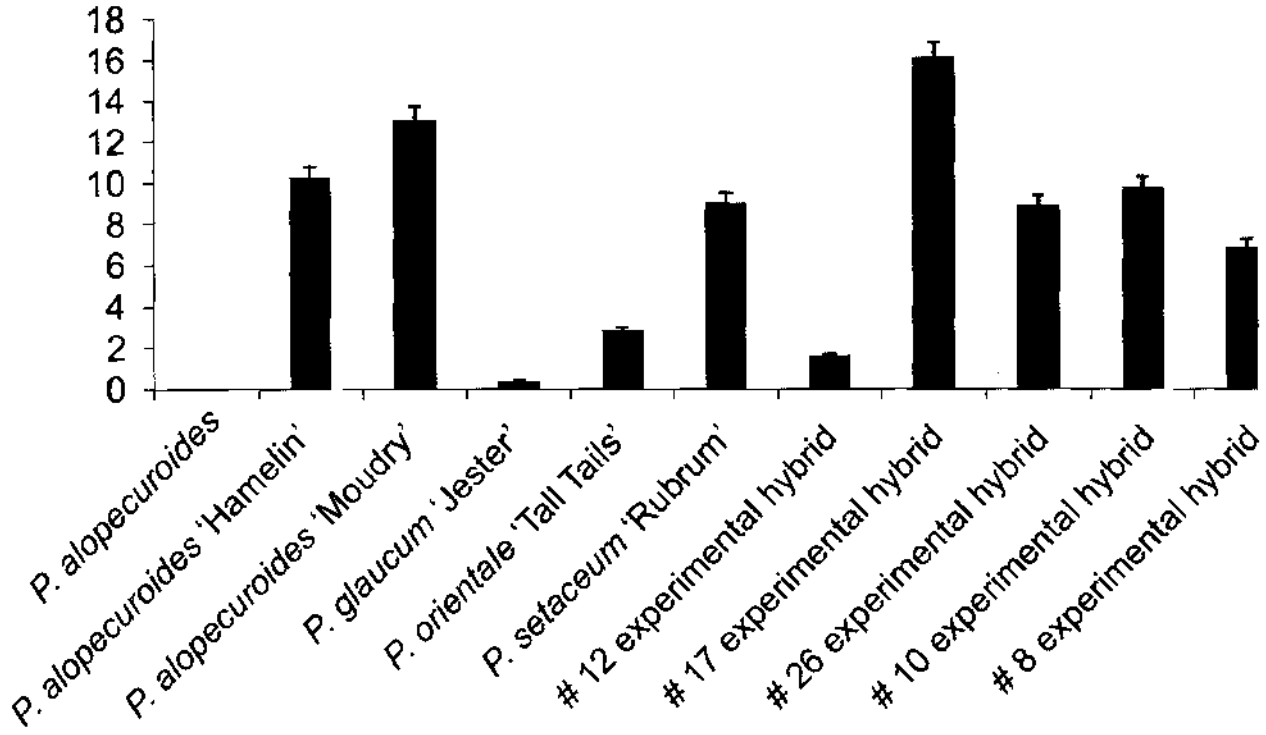

Fig 1. Mean number ± SEM of *Leptodictya plana* eggs laid on *Pennisetum* spp. grasses in greenhouse no-choice study over a five day period

including sedges, were consistently among the lowest damaged plants in all trials performed. It is evident that *L. plana* prefers grasses within the family Poaceae based on feeding damage incurred in our studies.

Pennisetum spp. plants incurred the highest overall percent damage. Other genera with substantial feeding damage observed (greater than 25%) were *Andropogon*, *Schizachyrium*, *Festuca*, *Spartina* and *Sorghastrum*. Plants that were not acceptable feeding host plants typically resulted in death of the insects after one day, which included *Scirpus cernuus*, *Cordyline* spp., *Acorus gramineus*, and *Carex comans*.

Pennisetum plants were the only genera that supported oviposition. The overall average number of eggs laid per leaf blade was 7.1 (Fig. 1). All *Pennisetum* cultivars had eggs laid inside the leaf blades except for *P. alopecuroides*. The cultivars that had the most number of eggs were experimental hybrid variety #17, *P. alopecuroides* 'Moudry', and *P. alopecuroides* 'Hamelin'.

Choice containerized studies. In both of the choice studies conducted, *Pennisetum* grasses sustained the highest overall damage ratings (Table 2). In the first trials conducted, damage ratings were low across all grass leaf blades; therefore, in the second trials the number of lace bugs was increased to 20 per petri dish. Some genera which had previously been fed on heavily under the no-choice experiment were hardly fed on at all in the choice experiment, such as *Miscanthus*, *Cortaderia*, *Muhlenbergia*, and *Spartina*.

At the 3 hour check time, lace bugs were more uniformly distributed among the leaf blade samples than they were at the 27 and 51 hour check times (Table 3). At the two later check times, there was a higher concentration of lace bugs on *Pennisetum*, *Phalaris*, and *Calagmograstis* leaf blades. This indicates that at first, lace bugs did not show a host preference, apparently probing and attempting to feed on the plants to determine the suitability of the host plant. The preferred host in the choice study was *Pennisetum alopecuroides* 'Hamelin'. The least preferred ornamental grass in the choice studies was *Cortaderia selloana* 'Pumila'.

The experimental hybrids were heavily preferred host plants for both feeding and oviposition. This correlates with previous data since all were *Pennisetum* spp. hybrids. The least preferred of the trial varieties was #12, whereas the most preferred was #17. The greenhouse and laboratory assays showed that the preferred host plants of *L. plana* belong to the genus *Pennisetum*. Among *Pennisetum* spp., the commercial cultivars most preferred were *P. alopecuroides* 'Hamelin' and 'Moudry'. If planted among other ornamental grasses, these cultivars could serve as indicator species due to their high susceptibility. Plants not belonging to the panicoid subfamily had the overall lowest levels of damage incurred. These results correspond to Wheeler's (10) previous findings in the field, that *Pennisetum* spp. grasses are suitable host plants for feeding and development of *L. plana*.

The reason that some plant species were not preferred is unknown, however, heavily fed upon species had some morphological similarities. Plants possessing broad leaf blades with stiff, pronounced midribs as well as reduced pubescence on the undersides of the leaves seemed to be favored over species without these characteristics. Previous studies have examined color, pubescence, leaf wax composition, leaf water content, stomata and origin of plants to be correlated with possible resistance mechanisms against lace bugs (3, 6, 7, 9). The experimental setup used in our studies resembled previous studies testing host preference of lace bugs (2, 8, 9).

Table 3. Mean number of *L. plana* adults present on leaf blades at each check during laboratory choice test.

Plant species/cultivar	Genus representatives			*Pennisetum* spp. only		
	3 hrs	27 hrs	51 hrs	3 hrs	27 hrs	51 hrs
Andropogon virginicus	1.17bc	0.00c	0.67b–d	—	—	—
Calamagrostis acutiflora 'Karl Foerster'	2.83a	2.50a	1.17bc	—	—	—
Cortaderia selloana 'Pumila'	0.33bc	0.50c	0.67b–d	—	—	—
Eragrostis spectabilis	1.17bc	0.83bc	0.67b–d	—	—	—
Festuca glauca 'Select'	0.33bc	0.50c	0.50b–d	—	—	—
Miscanthus sinensis 'Purpurascens'	0.83bc	0.17c	0.33cd	—	—	—
Muhlenbergia capillaris 'Pink Flamingo'	0.33bc	0.33c	0.33cd	—	—	—
Nassella tenuissima	0.00c	0.00c	0.00d	—	—	—
Panicum virgatum 'Heavy Metal'	0.83bc	0.83bc	0.67b–d	—	—	—
Pennisetum alopecuroides	—	—	—	1.33a–c	1.00bc	0.17c
Pennisetum alopecuroides 'Hamelin'	0.67bc	2.67a	3.83a	0.33c	0.33c	0.50bc
Pennisetum alopecuroides 'Moudry'	—	—	—	1.00a–c	1.67a–c	0.50bc
Pennisetum orientale 'Tall Tails'	—	—	—	2.33ab	1.67a–c	1.67bc
Pennisetum setaceum 'Rubrum'	—	—	—	0.83a–c	1.33bc	1.67bc
Phalaris arundacea 'Picta'	1.50b	1.83ab	1.50b	—	—	—
Schizachyrium scoparium	0.83bc	0.17c	0.17cd	—	—	—
Sorghastrum nutans	0.50bc	0.17c	0.50b–d	—	—	—
Spartina bakerii	0.00c	0.00c	0.33cd	—	—	—
# 12 *Pennisetum* experimental hybrid	—	—	—	1.50a–c	2.67ab	2.00a–c
# 17 *Pennisetum* experimental hybrid	—	—	—	0.67bc	0.67c	2.17a–c
# 26 *Pennisetum* experimental hybrid	—	—	—	1.50a–c	2.00a–c	2.67ab
# 10 *Pennisetum* experimental hybrid	—	—	—	2.50a	1.33bc	1.83bc
# 8 *Pennisetum* experimental hybrid	—	—	—	1.50a–c	3.33a	4.17a

There are no previous reports of this lace bug occurring on ornamental grasses or of it occurring on the species of *Pennisetum* that we observed. Hence, it is important to start monitoring the movement and host preferences of *L. plana* throughout the southeast to ensure that it does not become a widespread pest problem.

L. plana is an emerging pest, with still very little information known about its origins and potential impact in the southeastern United States. From our studies, it is apparent that this insect causes significant damage and thrives in a hot, dry climate. Additional host plant assays should be conducted to broaden our knowledge about its host range and damage capabilities.

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