JOURNAL OF THE KANSAS ENTOMOLOGICAL SOCIETY
62(4), 1989, pp. 602–606

Dryinid (Hymenoptera: Dryinidae) Parasites of Leafhoppers and Planthoppers (Homoptera) in Forage-Type Bermudagrass

G. DAVID BUNTIN
Department of Entomology, University of Georgia,
College of Agriculture Experiment Stations,
Georgia Station, Griffin, Georgia 30223

ABSTRACT: The occurrence and parasitization rates of leafhoppers and planthoppers by dryinid wasps were studied in 'Coastal' bermudagrass, *Cynodon dactylon* (L.) Pers. Dryinids parasitized nymphs and adults of *Endria inimica* (Say), *Exitianus exitiosus* (Uhler), *Graminella nigrifrons* (Forbes), *Graminella sonora* (Ball), *Planicephalus flavocostatus* (Van Duzee), *Polyamia obtecta* (Osborn & Ball), *Polyamia weedi* (Van Duzee), and *Psammotettix lividellus* (Zetterstedt). *Gonatopus ashmeadi* Kieffer was reared from *E. exitiosus* and *G. nigrifrons,* and *Tetrodontochelys peculiaris* (Brues) was reared from *E. exitiosus.* Seasonal parasitization rates of all leafhopper taxa were <5.0% for nymphs and <3.6% for adults. Parasitization rates of nymphs generally were greater than for adults of the same species. No leafhoppers of the subfamily Cicadellinae were parasitized by dryinids. Adults of the planthoppers *Delphacodes propinqua* (Fieber), *Liburniella ornata* (Stål), and *Sogatella kolophon* (Kirkaldy) were parasitized by dryinids, but seasonal parasitization rates of all species were <1.5%. Planthopper nymphs rarely were parasitized. These results suggest that dryinids have minimal impact on leafhopper and planthopper populations in forage-type bermudagrass.

Leafhoppers and planthoppers are potentially important pests of forage-type bermudagrass, *Cynodon dactylon* (L.) Pers., which is the most extensively grown warm-season perennial forage grass in the southeastern U.S. (Buntin, 1988a). Substantial yield losses of hay have been reported when leafhoppers and planthoppers were not controlled (Byers, 1967; Hawkins et al., 1979). Buntin (1988a) collected 28 species of leafhoppers and 4 species of planthoppers infesting forage-type bermudagrass in Georgia. Predominant leafhopper species were *Endria inimica* (Say), *Exitianus exitiosus* (Uhler), *Graminella nigrifrons* (Forbes), *Graminella sonora* (Ball), *Polyamia weedi* (Van Duzee), *Planicephalus flavocostatus* (Van Duzee), *Psammotettix lividellus* (Zetterstedt) and *Stirellus bicolor* (Van Duzee). Predominant planthoppers were *Delphacodes propinqua* (Fieber) and *Liburniella ornata* (Stål).

Larvae of dryinid wasps are conspicuous parasites of leafhoppers and planthoppers. Larvae of most dryinids develop externally on the host by feeding in the intersegmental membrane between two sclerites. As the larva develops, it forms a large external sac on the host. The host dies soon after larval emergence from the larval sac. Larvae of the genus *Aphelopus* develop internally in the host, but these dryinids attack leafhoppers of the subfamily Typhlocybinae (Freytag, 1985) which accounted for ≤0.15% of all leafhoppers collected in bermudagrass (Buntin, 1988a).

Unlike most parasitic Hymenoptera, female adults also are predaceous (Perkins, 1905; Clausen, 1940). Because of their combination of predatory and parasitic habits and broad host range, dryinids have been viewed favorably for biological control programs (Clausen, 1940). Generally, the low natural incidence of parasitism and lack of mass-rearing procedures, however, have prevented the development of dryinids as biocontrol agents (Chandra, 1980). The impact of dryinids on leafhopper and planthopper populations in grasslands generally is not well known, and information is lacking on parasitism rates of leafhoppers and planthoppers by dryinids in bermudagrass. The objectives of this research were to quantify the incidence of parasitism of leafhoppers and planthoppers by dryinids and to determine dryinid host associations.

MATERIALS AND METHODS: Leafhopper and planthopper populations were sampled in three 'Coastal' bermudagrass fields during 1985 and 1986 in Pike County, Ga. Field are described by Buntin (1988a). Leafhoppers, planthoppers and adult dryinid wasps were sampled using a D-Vac vacuum machine (Model 1A, D-Vac Co., Riverside, Ca.) equipped with a 0.09-m^2 sampling cone. One subsample consisted of placing the sampling cone over the foliage and pressing it to the ground for 15 sec. Fifteen subsamples were collected about 1 m apart for each sample, and 8 samples were collected per field and sample date. Fields were sampled between 1300 and 1700 hours every 7–10 days from 30 May to 10 October in 1985 and 1 April to 7 November in 1986. D-Vac samples were returned to the

laboratory, where each sample was placed in an extraction box designed to separate live insects from the plant debris. The recovery rate of the extraction box was about 94% for both leafhoppers and planthoppers. Sampling procedures are discussed in more detail by Buntin (1988b).

Samples were sorted, and leafhopper and planthopper nymphs and adults were identified and counted by species. Identification of voucher specimens were made by J. P. Kramer of the Systematic Entomology Laboratory, Biosystematics and Beneficial Insects Institute, U.S. Department of Agriculture. Nymphs of *Graminella* spp. and *P. lividellus* were counted as one group, and planthopper nymphs were not separated by species. Leafhoppers and planthoppers that were visibly parasitized by a dryinid larva also were counted. Parasitization rates were calculated by month and for the entire season. Because dryinid larvae could not be identified to species, parasitization rates for a particular host taxon reflect parasitism by all dryinid species.

Dryinid host associations were examined by collecting and rearing parasitized leafhoppers and planthoppers. A sweep net was used to collect parasitized leafhoppers and planthoppers during September and October 1985. Each parasitized individual was reared in a 15 cm long glass tube (1.5 cm diameter) which contained foam plugs at both ends. A bermudagrass sprig was inserted into each tube with the basal end of the sprig being immersed in water. Sprigs were replaced every 2–3 days. Leafhoppers and planthoppers were reared in a growth chamber under conditions of 24°C and a 14L:10D regime. A total of about 100 parasitized leafhoppers and planthoppers of various species were collected and reared in 1985. Collections also were made in 1986, but no dryinids were reared successfully. Dryinids were identified by P. Freytag, Department of Entomology, University of Kentucky, Lexington.

RESULTS AND DISCUSSION: Most parasitized leafhoppers and planthoppers died before producing an adult dryinid. *Gonatopus ashmeadi* Kieffer was reared from three nymphs and one adult of *E. exitiosus,* and *Tetrodontochelys peculiaris* (Brues) was reared from three nymphs and two adults of *E. exitiosus. Gonatopus* sp., probably *G. ashmeadi,* was reared from an adult of *G. nigrifrons.* A nymph of *Graminella* sp., which probably was parasitized by *Gonatopus* sp., was hyperparasitized and produced three adults of *Helogonatopus pseudophanes* (Perkins). One female of *Pseudogonatopus freytagi* Olmi was reared from a nymph of *L. ornata.* Baldridge and Blocker (1980) also reared *Gonatopus* sp. from *E. exitiosus,* and *G. nigrifrons* has been previously reported as a host for *G. ashmeadi* (Freytag and Back, 1977).

Seasonal abundance and parasitization rates of leafhopper adults with >20 adults being collected per field during one of 2 years are listed in Table 1. Adults of all of the species of the Deltocephalinae listed in Table 1 were parasitized by dryinids except for *Balclutha guajanae* (DeLong). Seasonal abundance of leafhopper nymphs and seasonal and monthly parasitization rates of nymphs by dryinids are shown in Table 2. Dryinids parasitized both nymphs and adults of *E. inimica, E. exitiosus, G. nigrifrons, G. sonora, P. lividellus, Polyamia obtecta* (Osborn & Ball), *P. weedi* and *P. flavocostatus.* Dryinids were found parasitizing only adults of *S. bicolor.* Although parasitized adults of *Chlorotettix viridius* Van Duzee were not collected, one parasitized nymph of this species was collected. Leafhopper species with <20 adults per field in both years were *Agallia constricta* (Van Duzee), *Chlorotettix viridius* Van Duzee, *Flexamia producta* (Walker), *Laevicephalus unicoloratus* (Gillette & Baker), *Macrosteles fascifrons* (Stål), *Paraphlepsius irroratus* (Say), *Scaphytopius frontalis* (Van Duzee), *Ciminius hartii* (Ball), *Cuerna costalis* (F.), *Draeculacephala portola* (Ball), *Graphocephala versuta* (Say), *Tylozygus bifidus* (Say), *Xerophloea viridius* (F.), *Negosiana dualis* (DeLong) and *Dikraneura angustata* Ball & DeLong. No dryinid-parasitized adults of these species were collected. One parasitized adult of *Xestocephalus desertorum* (Berg) was collected during June of 1986 which produced a seasonal parasitization rate of 2.4%.

Dryinids are primarily known to attack leafhoppers of the subfamilies Deltocephalinae and Typhlocybinae (Freytag, 1985). No dryinid-parasitized specimens of any species of the Cicadellinae (i.e., *C. flaviceps, C. hartii, C. costalis, Draeculacephala* spp., *G. versuta* and *T. bifidus*) were collected (Tables 1, 2). Freytag (1985) also reported that leafhoppers of the subfamily Cicadellinae are not attacked by dryinids.

The seasonal parasitization rates of nymphs and adults of all leafhopper taxa were low, with rates ranging from 0 to 3.6% for adults and from 0 to 5.0% for nymphs. Seasonal parasitization rates generally were greater for nymphs than adults of the same species. Examination of the monthly parasitization rates revealed that parasitism of most taxa of nymphs was greater during June and July than later in the summer. Monthly parasitization rates of adults were variable with most species not showing consistent phenological trends. Adults of *P. lividellus* and *G. sonoro* were parasitized mostly during the period of greatest host abundance, and parasitization of *E. exitiosus* adults was greater during May through July than later in the year.

Planthopper species collected in order of abundance were *D. propinqua, L. ornata, Sogatella kolophon*

Table 1. Monthly percentage of selected[a] leafhopper adults parasitized by dryinid larvae in bermudagrass.

Taxa	Year	Seasonal total of adults collected (no./field)	% Parasitized adults								
			April	May	June	July	August	Sep.	Oct.	Nov.	Seasonal total
Deltocephalinae											
Balclutha quajanae	1985	17	—	[b]	0	[b]	0	0	0	0	0
(Say)	1986	56	[b]	[b]	0	0	0	0	0	0	0
Endria inimica	1985	427	—	0.9	0	0.8	8.5	4.7	0	—	1.2
(Say)	1986	461	[b]	0.3	2.8	0	0	0.2	0.2	0	0.6
Exitianus exitiosus	1985	506	—	5.6	4.1	3.6	2.8	1.5	0.3	—	1.5
(Uhler)	1986	1364	0	1.1	2.9	1.7	1.0	0.5	0.6	0.9	1.4
Graminella nigrifrons	1985	979	—	0	2.5	2.1	1.1	4.4	1.2	—	1.4
(Forbes)	1986	390	0	0	3.8	0	0	0	0.6	0.7	0.7
Graminella sonora	1985	190	—	[b]	0	0	0	1.6	0.9	—	0.9
(Ball)	1986	381	0	0	0	0	0	1.2	0.4	0.5	0.5
Polyamia obtecta	1985	15	—	0	0	0	0	0	0	—	0
(Osborn & Ball)	1986	29	[b]	0	1.6	0	0	0	0	0	0.8
Polyamia weedi	1985	246	—	0	2.5	3.7	0.9	1.6	2.9	—	1.4
(Van Duzee)	1986	221	[b]	0.6	1.7	1.3	11.1	0	0.6	0	1.7
Planicephalus flavocostatus	1985	68	—	0	0	0	0	1.1	0	—	0.3
(Van Duzee)	1986	44	[b]	[b]	0	0	0.6	0	0	0	0.3
Psammotettix lividellus	1985	118	—	0	2.6	1.7	0	0	0	—	1.5
(Zetterstedt)	1986	189	0	3.1	0.3	0.8	1.0	0	0	0	1.6
Stirellus bicolor	1985	34	—	0	0	0	6.7	5.6	0	—	3.6
(Van Duzee)	1986	60	0	11.1	0.7	0	0	4.2	0	0	1.2
Cicadellinae											
Carneocephala flaviceps	1985	102	—	0	0	0	0	0	0	—	0
(Riley)	1986	14	0	0	0	0	[b]	[b]	0	0	0
Draeculacephala antica	1985	29	—	0	0	0	0	0	0	—	0
(Walker)	1986	15	0	0	0	0	0	0	0	[b]	0

[a] Species with >20 adults being collected per field during 1 or 2 years.
[b] Species not collected in this month.

Table 2. Seasonal number of nymphs collected and monthly and seasonal percentage of nymphs parasitized by dryinid larvae in bermudagrass.

Taxa	Year	Seasonal total of nymphs collected (no./field)	% Parasitized nymphs								
			April	May	June	July	August	Sep.	Oct.	Nov.	Seasonal total
Carneocephala flaviceps	1985	1005	—	0	0	0	0	0	0	—	0
(Riley)	1986	24	0	0	0	0	0	0	0	0	0
Chlorotettix viridius	1985	33	—	[a]	0	0	0	1.7	0	—	0.6
(Van Duzee)	1986	9	[a]	0	0	0	0	0	0	0	0
Draeculacephala spp.	1985	74	—	0	0	0	0	0	0	—	0
	1986	21	0	0	0	0	0	0	0	0	0
Endria inimica	1985	2089	—	0.2	4.8	5.1	3.1	0.6	0.8	—	2.0
(Say)	1986	941	0	3.1	3.7	4.0	0	0	3.2	14.8	2.7
Exitianus exitiosus	1985	5414	—	1.3	7.0	5.5	4.1	1.8	3.0	—	3.7
(Uhler)	1986	5469	0	1.8	3.3	4.2	3.2	1.7	1.7	2.8	2.8
Graminella spp. +	1985	3525	—	2.1	8.7	11.0	3.6	1.8	2.8	—	3.0
Psammotettix sp.	1986	1065	0	3.1	3.2	6.6	6.8	1.7	1.4	1.6	2.9
Planicephalus flavocostatus	1985	50	—	1.8	3.2	0	0	0	0	—	1.5
(Van Duzee)	1986	43	[a]	[a]	4.8	0	0	0.4	0	0	4.4
Polyamia weedi	1985	2220	—	0.9	2.3	3.0	2.1	1.0	0.6	—	1.6
(Van Duzee)	1986	1178	0	12.7	4.1	10.3	2.1	3.8	3.4	0	5.0
Polyamia obtecta	1985	95	—	[a]	3.5	10.6	0	0.7	0	—	2.6
(Osborn & Ball)	1986	81	[a]	0	0.7	0.8	0	0	8.3	0	4.4

[a] Taxa not collected in this month.

(Kirkaldy) and *Delphacodes puella* (Van Duzee). Adults of all species were parasitized by dryinids, except *D. puella*. *L. ornata* was parasitized more frequently than the other species, with seasonal parasitization rates of 1.2% in 1985 and 0.7% in 1986. Seasonal parasitization rates for *D. propinqua* in 1985 and 1986 were 1.5% in 1985 and 0% in 1986, and for *S. kolophon* were 0% in 1985 and 0.1% in 1986. Parasitization of planthopper nymphs was rare with only two parasitized nymphs being collected in both years.

The results of this study show that the incidence of parasitism by dryinids was very low for most leafhopper and planthopper taxa, with seasonal rates of parasitism not exceeding 5% and monthly rates usually not exceeding 10% for any group. These rates are typical of parasitization rates by dryinids reported for leafhoppers and planthoppers in other grass hosts (Waloff, 1975; Sweezy, 1936; Stiling and Strong, 1982; Chandra, 1980), although higher rates have been reported in some instances (Barrett et al., 1965; Freytag, 1985). Dryinids have not been found to be key regulating agents of leafhopper and planthopper populations inhabiting rice (Chandra, 1980) and acidic grasslands in England (Waloff, 1975). Low parasitization rates suggest that dryinids also are not key regulating agents of leafhoppers and planthoppers in bermudagrass. Low rates of parasitization by dryinids in bermudagrass may be partly caused by the frequent cutting of forage for hay and the occasional use of insecticides, which restricts the build up of large populations of natural enemies.

ACKNOWLEDGMENTS: I thank L. Sisk and D. Kinard for technical assistance and K. Caldwell, M. Cannafax, L. Johnson and H. Jones for permission to sample their fields.

Baldridge, R. S., and H. D. Blocker. 1980. Parasites of leafhoppers (Homoptera: Cicadellidae) from Kansas grasslands. J. Kansas Entomol. Soc. 53:441–447.

Buntin, G. D. 1988a. Species composition and phenology of leafhoppers (Homoptera: Cicadellidae) and planthoppers (Homoptera: Delphacidae) in bermudagrass forage. J. Econ. Entomol. 81: 201–207.

Buntin, G. D. 1988b. Sampling techniques, population dispersion and sampling plans for leafhoppers (Homoptera: Cicadellidae) in bermudagrass. Environ. Entomol. 17:872–877.

Byers, R. A. 1967. Increased yields of 'Coastal' bermudagrass after application of insecticides to control insect complex. J. Econ. Entomol. 60:315–318.

Chandra, G. 1980. Dryinid parasitoids of rice leafhoppers and planthoppers in the Philippines I. Taxonomy and bionomics. Oecol. Applicata 1:161–172.

Clausen, C. P. 1940. Entomophagous Insects. McGraw-Hill, New York.

Freytag, P. H. 1985. The insect parasites of leafhoppers, and related groups. *In* L. R. Nault and J. G. Rodriguez, The Leafhoppers and Planthoppers, pp. 423–467. John Wiley & Sons, New York.

Freytag, P. H., and D. W. Back. 1977. Redescription, synonymy and host of *Gonatopus bicolor* (Hymenoptera: Dryinidae). Entomol. News 88:221–227.

Hawkins, J. A., B. H. Wilson, C. L. Mondart, D. P. Nelson, R. A. Farlow, and P. E. Schilling. 1979. Leafhoppers and planthoppers in 'Coastal' bermudagrass: effect on yield and quality and control by harvest frequency. J. Econ. Entomol. 72:101–104.

Perkins, R. C. L. 1905. Leafhoppers and their natural enemies (Part I, Dryinidae). Hawaiian Sugar Planter's Assoc. Exp. Stn. Bull. 1:1–69.

Stiling, P. D., and D. R. Strong. 1982. Parasitoids of the planthopper, *Prokelisia marginata* (Homoptera: Delphacidae). Fla. Entomol. 65:191–192.

Sweezy, O. H. 1936. Biological control of the sugarcane leafhopper in Hawaii. Hawaiian Sugar Planter's Assoc. Exp. Stn. Bull. 21:76–79.

Waloff, N. 1975. The parasitoids of the nymphal and adult stages of leafhoppers (Auchenorrhyncha: Homoptera) of acidic grasslands. Trans. R. Entomol. Soc. (London) 126:637–686.

Accepted for publication 8 June 1989.