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PLANT BUG HOSTS (HETEROPTERA: MIRIDAE) OF SOME EUPHORINE PARASITES (HYMENOPTERA: BRACONIDAE) NEAR BELLEVILLE, ONTARIO, CANADA

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Résumé

Nous avons élevé des Euphorines parasites (14 espèces de *Peristenus* et 4 de *Leiophron*) à partir de 28 espèces de Mirides, récoltés près de Belleville, Ontario. Nous avons, en plus, obtenu plusieurs immatures d'Euphorines indéterminées chez 24 autres espèces d'hôtes. Les parasites de chaque espèce se rencontrent dans les nymphes d'une ou plusieurs espèces de mirides. La majorité des hôtes et tous les parasites n'ont qu'une seule génération annuelle. L'attaque des parasites ne se produit que durant la période nymphale de l'hôte. Les adultes hivernent en diapause, dans les cocons. Le taux de parasitisme est de 16 à 64%.

Abstract

Euphorine parasites, comprising 14 species of *Peristenus* and four of *Leiophron*, were reared from 28 plant bug species collected near Belleville, Ontario. Immature, unidentifiable euphorines were found in 24 other host species. Each of the parasite species attacked nymphs of one or more plant bugs. Most of the hosts, and all the parasites have one generation per year. Parasitism was limited to the portion of the season when the host(s) was in the nymphal stage. The overwintered parasites were inactive as diapausing adults in cocoons until the growing season of the following year. From 16-64 per cent of host nymphs were parasitized.

Introduction

Species of the euphorine genera *Peristenus* Foerster and *Leiophron* Nees parasitize nymphs of plant bugs (Miridae). The various parasite species ovoposit in the haemocoel of second and third instar nymphs. One mature parasite larva emerges from each parasitized nymph or teneral adult, spins a cocoon in soil, and develops to an adult which overwinters inside the cocoon. Parasite adults emerge the following year. Occurrence, hosts, and specificity of these parasites is poorly known except for species that parasitize important pests such as lygus bugs on alfalfa (Clancy & Pierce, 1966). Near Belleville, Ontario, euphorine parasitism was found in plant bugs from a wide range of host plants in 1963-1970. The parasites are listed in this paper with observations on their hosts, specificity and seasonality.

Materials and methods

Plant bugs were collected during May-August in representative habitats immediately north of Belleville, using a sweep net for low plants and a beating frame for higher vegetation. Samples of plant bugs were maintained on foliage in ice-cream cartons in the field and later were dissected to determine euphorine parasitism. If parasites were found, a sample of fifth instar host nymphs was collected and these were reared to the adult stage. Parasite larvae that emerged were reared and cocoons were stored outdoors in potted soil for the balance of the summer and over winter. The pots containing the cocoons were lifted from the ground in late April and held until parasite adults had emerged. All indoor rearings of plant bugs and cocons were at 21°C.

TABLE I

Feeding habitats for the various parasitized subfamilies

Plant growth-forms	*Mirinae*	*Orthotylinae*	*Phylinae*	*Deraeocorinae*	*Dicyphinae*	*Bryocorinae*
Trees	8	2	1	3	0	0
Shrubs-vines	8	5	7	0	2	0
Grasses-herbs	8	5	2	0	0	0
Ferns	0	0	0	0	0	1
Total species parasitized	24	12	10	3	2	1

Results

PARASITES AND HOSTS

Fourteen species of *Peristenus* and four of *Leiophron* were reared from 28 plant bugs species. Immature euphorine parasites were found in 24 other hosts species. Six families of Miridae were parasitized including a species of Bryocorinae, *Monalocoris americanus*. Euphorine parasitism of this subfamily previously was known only from Africa (Leston, 1959). The subfamily Mirinae contained 48 per cent of the parasitized species. All of the parasitized hosts are phytophagous except one species of *Pilophorus* and three of *Deraeocoris*, which are predaceous.

Feeding habitats for the various parasitized mirid subfamilies are listed in Table I.

SPECIFICITY OF PLANT BUGS

The host plants of parasitized plant bugs are listed in Tables II-V. Some plant bug species were found on only one species of host plant, e.g. *Diaphnocoris chlorionis* on *Gleditsia triacanthos*. Other species occurred on closely related plants, e.g. *Dicyphus similis* on *Rubus odoratus* and *R. ideaus*, while still others had nymphal populations limited to a type of vegetation, e.g. *Lygus lineolaris* on forage crop legumes. The plant bugs' specificity probably ensured that the parasite adults emerged in proximity of host nymphs. Hence, the level of parasitism by euphorines may depend on the distribution of the host plants of the plant bug as well as the availability of an appropriate host.

SPECIFICITY OF EUPHORINES

Seven of the euphorine species parasitized plant bug species that occurred alone on host plants. Other euphorines parasitized one or more of a complex of host species (Tables II-V). On forage crops in May and June, *Leiophron trigonotylidis* parasitized only *Trigonotylus coelestialium* from among a complex of mirid nymphs while *Peristenus pallipes* parasitized six species of plant bugs but not *T. coelestialium* or species of *Collaria, Irbisia, Litomeris, Stenodema* or *Stenotus*. Each of the major residents on *Solidago canadensis* was parasitized by one or two species of euphorines: in June and July *Slaterocoris* spp. and *Polymerus venaticus* by *Peristenus solidaginis, Slaterocoris* spp. by *P. bicolor;* and *Plagiognathus* spp. by *P. reidi;* in late summer *Lygus vanduzeei* by *P. pseudopallipes* and *L. lineolaris* by *P. pseudopallipes* and *Leiophron lygivora*.

SEASONALITY

The hosts and parasites found in May and early June, in late June and early July, and in August are listed in Tables II-V, respectively. *Lygus lineolaris* and *Adelphocoris lineolatus* were the only host species with nymphs occurring in early and again in late summer (Loan, 1965). Nymphs of all others occurred only once on host plants, and developed from overwintered eggs whose hatch date depended on the winter dormant period and developmental rates of the species (Reid *et al.*, 1975). The adult parasites were active only when the host was in the nymphal stage.

Hosts				Parasites					
							Larval instar		
Species	Date collected	Host plant	No. dissected	Species	Percent parasitism	Egg	1	2 + 3	4
Halticus bracteatus (Say)	9 June 1967	*Clematis virginiana* L.	100	*Peristenus clematidis* Loan	35.0	0	18(9 N3; 9 N4)	7(N4)	10(3 N4; 7 N5)
Dicyphus similis Kelton	13 June 1963	*Rubus odoratus* L.	76	*Peristenus dicyphovora* Loan	52.6	2(1 N2; 1 N3)	22(2 N3; 12 N4; 8 N5)	12(2 N4; 10 N5)	8(N5)
Dichrooscytus tinctipennis Knight	20 May 1968	*Juniperus virginiana* L.	75	*Peristenus juniperinus* Loan	29.3	0	8 (N4)	4(1 N4; 3 N5)	10(N5)
Bolteria luteifrons Knight	9 June 1966	*Juniperus communis* L.	100	*Peristenus juniperoides* Loan	42.0	0	32(27 N4; 5 N5)	7(N4)	3(N5)
Tropidosteptus canadensis Van Duzee	7 June 1970	*Fraxinus americana* L.	38	*Peristenus nixoni* Loan	57.9	0	0	3(N4)	19(N5)
Macrotylus sexguttatus (Provancher)	8 June 1966	*Asarum canadense* L.	85	*Peristenus zingiberis* Loan	23.5	0	20(3 N3; 5 N4; 12 N5)	0	0
Adelphocoris lineolatus (Goeze)	11 June 1963	Forage legumes and grasses	100	*Peristenus pallipes* (Curtis)	49.0	0	42(N5)	7(N4)	
rapidus (Say)	8 June 1963	Forage legumes and grasses	100	*Peristenus pallipes* (Curtis)	42.0	0	40(N4)	2(N4)	
Capsus ater L.	28 May 1963	Forage legumes and grasses	84	*Peristenus pallipes* (Curtis)	30.9	0	12(7 N4; 5 N5)	8(5 N4; 3 N5)	6(N5)
Labops hirtus Knight	30 May 1963	Forage legumes and grasses	98	*Peristenus pallipes* (Curtis)	21.4	0			21(A)
Leptopterna dolobrata (L.)	7 June 1963	Forage legumes and grasses	100	*Peristenus pallipes* (Curtis)	42.0	0	38(6 N3; 32 N4)	4(N4)	
Trigonotylus coelestialium (Kirkaldy)	31 May 1970	Forage legumes and grasses	100	*Leiophron trigonotylidis* (Loan)	43.0	0	14(6 N4; 8 N5)	26(11 N4; 15 N5)	4(N5)
Diaphnocoris chlorionis (Say)	12 June 1970	*Gleditsia triacanthos* L.	81	*Leiophron maculipennis* (Ashmead)	64.2	5(N5)	35(N5)	12(N5)	

TABLE III

Hosts, host plants, occurrence and percent parasitism of immature euphorinae parasites of mirids in late June and early July.
N = host nymph; A = host adult

Hosts				Parasites				
						Larval instar		
Species	Date collected	Host plant	No. dissected	Species	Percent parasitism	Egg	1	2 + 3	4
Plagiognathus albonotatus Knight	26 June 1963	*Spiraea latifolia* L.		*Peristenus plagiognathi* (Loan)	66.0	2(1 N2; 1 N4)	64(14 N3)	0	0
cornicola Knight	26 June 1963	*Spiraea latifolia* L.	100						
Lopidea marginalis (Reuter)	14 July 1966	*Spiraea latifolia* L.	112	*Leiophron muesebecki* (Loan)	25.0	0	26(11 N3; 12 N4; 3 N5)	1(N4)	1(N5)
Phytocoris lasiomerus Reuter *pallidicornis* Reuter	10 July 1967	*Cornus racemosa* Lam.	105	*Peristenus dumestris* Loan	36.2	0	20(11 N3; 9 N4)	10(N4)	8(N5)
Plagiognathus cornicola	28 June 1967		77	*Peristenus reidi* Loan	45.5	2(1 N3; 1 N4)	38(17 N4; 21 N5)	8(6 N4; 2 N5)	7(1 N4; 6 N5)
Slaterocoris breviatus (Knight) *atritibialis* (Knight)	28 June 1968	*Solidago canadensis* L.	100	*Peristenus solidaginis* Loan *bicolor* Loan	41.0	0	21(11 N4; 5 N5; 5 A)	4(2 N5; 2A)	16A
Polymerus venaticus (Uhler)	24 June 1968	*Solidago canadensis* L.	100	*Peristenus solidaginis*	31.0	0	4(3 N4; 1 N5)	4(N4)	23(N5)
Plagiognathus nigronitens Knight *cuneatus* Knight *politus* Knight	27 June 1967	*Solidago canadensis* L.	77	*Peristenus reidi* Loan	35.0	0	12(6 N4)	9(N4)	6(N5)
Lygocoris inconspicuus (Knight)	27 June 1967	*Vitis Labrusca* L.	98	*Peristenus vitidis*	35.6	0	18(9 N4; 9 N5)	12(3 N4; 9 N5)	5(N5)
Taedia scrupeus (Say)				(Loan)					
Lygus lineolaris	30 June 1963	Forage legumes	100	*Peristenus pallipes*	62.0	0	47(8 N4; 16 N5; 23A)	13(A)	0

TABLE IV

Hosts, host plants, occurrence and percent parasitism of immature euphorine parasites of mirids in August.

N = host nymph

Hosts				Parasites					
							Larval instar		
Species	*Date collected*	*Host plant*	*No. dissected*	*Species*	*Percent parasitism*	*Egg*	1	2+3	4
Lygus lineolaris vanduzeei Knight	22 August 1969	*Solidago canadensis*	100	*Peristenus pseudopallipes* (Loan) *Leiophron lygivora* (Loan)	8.0	0	6(2N3; 4 N4)	2(N4)	0

Waloff (1967) in England found that adults of the euphorines on plant bugs of broom emerged from overwintered cocoons when host nymphs were beginning to develop. Adults of *Peristenus pseudopallipes* remained in cocoons from July and August of 1970 to July of the following year and parasitized *Lygus vanduzeei* and second generation *Lygus lineolaris* on *Solidago canadensis* in late summer (Loan, 1970a).

FIELD DEVELOPMENT

The occurrence of parasite eggs and larvae is shown in Tables II-V. Most were found in May and June with fewer as the season advanced. Larvae of most parasite species completed development in, and emerged from, fifth instar nymphs. A few species, however, matured in, and emerged from, teneral adults of *Labops hirtus, Lygus lineolaris* (first generation), *Plagiognathus albonotatus* and *P. cornicola* (Loan, 1965, 1966). Unidentified euphorines were found in teneral adults of *Dereacoris alnicola, Lygocoris communis, Macrotylus sexguttatus* and *Monalocoris americanus.* Emergence from adults hosts appeared to follow arrested development of first instar parasite larvae in host nymphs. In a few cases, parasite larvae emerged from nymphs and adults of a host species: for example, from adult *Diaphnocoris chlorionis* in 1970 and from adult *Slaterocoris* in 1968. Parasitism of these adult hosts may have resulted from egg deposition in late instar nymphs with eggs and first instar larvae carried over to the teneral adult plant bugs. The period from egg deposition to emergence of the final instar larva ranged from four weeks for species emerging from nymphal hosts to seven weeks for species in adult hosts.

The euphorine larvae formed cocoons in the soil after emerging from their hosts. Larvae of *Leiophron maculipennis* that ermerged late in June 1969 had developed into adults by late July; and larvae of *Peristenus pallipes* that emerged early in July 1967 were adults early in August. However, the adults did not emerge from cocoons until the following year.

Discussion

Near Belleville, Ontario, euphorine parasitism was found in 52 species of plant bugs on a wide range of plant hosts from late spring to late summer. The 18 reared eu-

TABLE V

Plant bugs parasitized by unidentified euphorines near Belleville, Ontario

Agnocoris rubicundus Fallén	*Macrolophus tenuicornis* Blatchley
Ceratocapsus modestus (Uhler)	*Monalocoris americanus* Wagner and Slater
humilis (Uhler)	*Neurocolpus jessiae* Knight
Coccobaphes sanguinarius Uhler	*Orthotylus dorsalis* (Provancher)
Deraeocoris alnicola Knight	*Phytocoris tibialis* Reuter
laricicola Knight	*Phytocoris* sp.
nitenatus Knight	*Pilophorus uhleri* Knight
Lepidopsallus rubidus (Uhler)	*Plagiognatus suffusipennis* Knight
Lygocoris communis (Knight)	*Psallus drakei* Knight
ostryae (Knight)	*parshleyi* Knight
tiliae (Knight)	*Rhinocapsus vanduzeei* Uhler
Lygocoris sp.	*Tropidosteptes cardinalis* Uhler

phorines parasitized 17-64 per cent of host nymphs in 1963-1970. They may be important mortality factors of plant bug populations, though Waloff (1967) found a density-dependent relationship for only one of the three euphorines on broom.

Some species of euphorine larvae emerge from adult hosts as well as nymphs. This was first observed in England by Leston (1961) who found that adult hosts were arboreal and, usually, species that appear early in the season. In the Belleville area, parasitized adults utilize a wide range of plants, especially in midsummer.

Ten of the 18 euphorines are apparently monophages and are, therefore, components of simple food chains with population levels probably fluctuating with the density of host species. Others attack two or more hosts and are part of complex food webs. *Peristenus pallipes* is the most polyphagous species with six known hosts. It appears that nearly all the euphorines have a certain degree of host, or host habitat, specificity and seldom attack two or more species unless the hosts are on the same host plant or same type of vegetation. My findings thus agree with those of Taylor (1945) in Africa, whereas Waloff (1967) concluded that none of the three species parasitizing five hosts on broom was strictly specific. However, her field rearings showed that the parasite species preferred some hosts over others.

The 52 species of plant bugs parasitized by euphorines represent only about ten per cent of the plant bug species in the Belleville area. Since the parasite species appear to be highly host specific, and many died and could not be identified, it is probable that there are many unknown species of *Peristenus* and *Leiophron*. Difficulties in rearing parasite larvae need to be overcome and more extensive research made on other potential hosts. Knowledge of the parasite species and their specificity and seasonal occurrence will enable a sounder selection of candidate agents for biocontrol of economic plant bugs.

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