INSECT HOSTS AND NYMPHAL DEVELOPMENT OF PODISUS MACULIVENTRIS SAY AND PERILLUS BIOCULATUS F. (HEMIPTERA, PENTATOMIDAE)

B. J. LANDIS,
Bureau of Entomology and Plant Quarantine,
U. S. Department of Agriculture

Two predacious pentatomids found commonly in Ohio, *Podisus maculiventris* Say and *Perillus bioculatus* F., have been observed feeding on various insects and insect stages in the field. It seems probable that many insects are fed upon at times because of the absence of more favorable hosts. Theoretically, a favorable host is one that allows rapid growth and causes little mortality in the predator population supported by it. Presented here are results of attempts to classify a few of the insects fed upon by these two predators, their suitability being measured by the rate of growth and percent of mortality occurring among sets of nymphs reared in the insectary.

Available insects found to be acceptable to nymphs of *Podisus maculiventris* were the Colorado potato beetle (*Leptinotarsa decemlineata* Say), the asparagus beetle (*Crioceris asparagi* L.), the three-lined potato beetle (*Lema trilineata* Oliv.), the Mexican bean beetle (*Epilachna varivestis* Muls.), the fall webworm (*Hyphantria cunea* Dru.), and the diamondback moth (*Plutella maculipennis* Curt.). Nymphs of *Perillus bioculatus* were reared on the Colorado potato beetle, the asparagus beetle, the three-lined potato beetle, the cabbage looper (*Autographa brassicae* Riley), and the spinach flea beetle (*Disonycha xanthomelaena* Dalm.).

The larvae of two species of host insects were reared on a number of cultivated plants and weeds. Sets of larvae of the same species so reared are considered as having been plant-conditioned according to the kind of plant on which feeding occurred. Plant-conditioned larvae of *Leptinotarsa decemlineata* were reared on potato, tomato, eggplant, ornamental tobacco (*Nicotiana affinis*), matrimony vine (*Solanum dulcamara*), bull nettle (*Solanum carolinense*), and an ornamental, *Solanum atropurpureum*. Plant-conditioned larvae of *Lema trilineata* were reared on jimsonweed (*Datura stramonium*), trumpet flower (*Datura cornucopia*), Chinese lantern flower (*Physalis francheti*), and an ornamental, *Solanum arboreum*.

TECHNIQUE

Predator eggs were collected from the field and from pairs of adults confined in the insectary. Nymphs molting from the phytophagous first instar to the carnivorous second instar were placed in separate small shell vials to which a constant type of food was supplied daily. The size and number of individuals of the hosts placed in each vial were increased as the nymphs grew so that there was an excess of easily available food present at all times.

Podisus maculiventris Say

Eggs of at least three species of hosts fed upon in the larval, the pupal, and occasionally the adult stage do not appear to be acceptable food for the nymphs of this predator. Of 24 second-instar nymphs confined with eggs of *Epilachna varivestis*, all but two died within four days and without feeding. One nymph consumed 12 eggs and another 13 eggs and lived 16 and 18 days, respectively, without having molted. Six second-instar nymphs refused to feed on eggs of *Lema trilineata* and all were dead after five days. Four second-instar nymphs fed slightly on eggs of *Leptinotarsa decemlineata* from potato, three dying in molt after six days, and one individual completing development and emerging as an adult after 18 days of feeding on eggs. In another set nine second-instar nymphs fed slightly on eggs of *L. decemlineata* from *Solanum dulcamara*, eight nymphs dying after 11 days and the last after 23 days.

The rate of development of the predator nymphs appear to correspond to the rate of development of the hosts fed upon. The body fluids of host larvae having a short larval period, as does *Plutella maculipennis*, appear to be more nourishing than larvae of *Leptinotarsa decemlineata*, having a much longer larval period. Nymphs reared on larvae of *Plutella maculipennis*, *Crioceris asparagi*, *Lema trilineata*, and *Leptinotarsa decemlineata* completed development in that order (Table I).

The species or stages of hosts causing the most rapid development of the predator nymphs did not produce the greatest number of adult predators. However, where the rate of nymphal development was relatively slow the mortality occurring among the nymphs was extremely high in most cases (Table I).

The rate of development and the mortality of the nymphs occurring in sets reared on plant-conditioned larvae of *Lepti-*

TABLE I

Length of the four predatory instars and the percent of nymphal mortality of *Podisus maculiventris* Say, reared in the insectary on several different host insects and plant-conditioned insects of the same species.

Host Insect	Stage	Host Plant	No. of Nymphs	Length of Instars in Days				Days 2nd Instar to Adults	Percent of Mortality
				2nd	3rd	4th	5th		
Lema trilineata	Larval	*Solanum arboreum*	8	3.7	3.0	4.2	9.0	19.9	14.3
Crioceris asparagi	"	Asparagus	6	2.8	4.3	4.3	7.3	18.7	33.3
Leptinotarsa decemlineata	"	Tomato	6	5.3	4.3	5.0	7.8	22.4	33.3
" "	"	Potato	10	5.0	4.1	4.6	7.3	21.0	50.0
Plutella maculipennis	"	Cabbage	4	3.0	3.5	3.5	6.0	16.0	50.0
Leptinotarsa decemlineata	"	Eggplant	8	4.9	3.7	4.3	6.5	19.4	50.0
Epilachna varivestis	"	Beans	54	*	*	*	*	*	56.6
Leptinotarsa decemlineata	"	*Solanum dulcamara*	33	5.1	4.9	5.1	7.5	22.6	69.7
Lema trilineata	"	*Datura cornucopia*	12	3.3	4.6	4.4	8.0	20.3	75.0
Hyphantria cunea	"	Mulberry	14	*	*	*	*	*	78.6
Leptinotarsa decemlineata	Egg	Potato	9	4.0	3.0	4.0	7.0	18.0	88.9
" "	Larval	*Solanum atropurpureum*	9	4.5	4.0	4.5	7.0	20.0	88.9
" "	"	*Solanum carolinense*	28	5.9	5.3	5.8	7.0	24.0	89.3

* Sets of nymphs not run at comparable temperature.

notarsa decemlineata are apparently affected in some instances by toxic substances obtained indirectly from the host plants. Nymphs reared on larvae which fed on *Solanum carolinense* developed more slowly (24 days) and greater numbers died (89.3 percent) than was the case among sets of nymphs reared on other plant-conditioned larvae of the same species (Table I). *Solanum atropurpureum* was extremely toxic to nymphs of *Podisus maculiventris*, but was much less so to nymphs of *Perillus bioculatus* (Table III). Nymphs of *Podisus maculiventris* developed slowly on larvae reared on *Solanum dulcamara* and the nymphal mortality was slightly higher than among sets of nymphs reared on larvae from potato, tomato, and eggplant.

Perillus bioculatus F.

The eggs of *Leptinotarsa decemlineata* constitute a large part of the food of *Perillus bioculatus* when these are available. Twenty-one nymphs reared in the insectary consumed an average of 231.5 eggs during the four predacious instars (Table II).

Eggs of *Lema trilineata* are fed upon in the field but the small size of the eggs and the few individuals to the mass make them of little value in nymphal development. Seven nymphs reared in the insectary on eggs developed more slowly and the adult bugs were much smaller than comparable nymphs reared on larvae of *Lema trilineata*. The average number of eggs consumed during the four predacious instars was 451.7 eggs (Table III).

Nymphs of *Perillus bioculatus* developed more rapidly and there was less mortality when they were reared on larvae of *Lema trilineata* or *Crioceris asparagi* than on larvae of *Leptinotarsa decemlineata* (Table IV). On host-conditioned larvae of *Leptinotarsa decemlineata* the development of the nymphs was most rapid when feeding occurred on larvae reared on *Solanum dulcamara*, and most prolonged on larvae reared on *Solanum carolinense*. As was the case with *Podisus maculiventris*, the greatest amount of nymphal mortality of *Perillus bioculatus* occurred among nymphs feeding on larvae from *Solanum carolinense*.

TABLE II

Length of the four predatory instars of *Perillus bioculatus* and the number of eggs of *Leptinotarsa decemlineata* eaten in the insectary

Nymph No.	Days in 2nd Instar	Eggs Eaten	Days in 3rd Instar	Eggs Eaten	Days in 4th Instar	Eggs Eaten	Days in 5th Instar	Eggs Eaten	TOTAL		
									Days of Development	Eggs Eaten	Sex of Predator
1	3	7	4	18	3	42	6	101	17	168	Female
2	2	9	3	19	4	38	7	137	18	203	Male
3	2	9	3	20	3	36	6	108	16	173	"
4	3	6	2	21	4	48	6	127	17	202	.....
5	2	7	3	25	3	35	7	137	18	204	Male
6	2	5	4	25	6	23	7	117	18	170	Female
7	3	7	2	20	3	35	7	133	18	195	"
8	2	5	3	17	3	29	6	98	16	149	Male
9	2	5	4	27	3	40	7	129	18	201	Female
10	2	6	3	34	3	46	6	108	16	194	"
11	2	11	4	19	3	21	6	108	18	159	Male
12	3	9	2	13	3	62	7	192	17	276	"
13	3	7	2	12	3	51	7	208	17	278	"
14	3	7	3	23	2	35	7	182	17	247	"
15	3	7	3	27	2	35	7	253	17	322	Female
16	3	9	2	9	3	56	7	218	17	292	Male
17	3	10	5	24	2	45	8	189	18	268	"
18	4	9	3	34	3	51	7	213	19	307	"
19	3	8	3	22	2	47	7	208	17	285	"
20	4	8	3	15	5	69	6	159	21	251	"
21	3	8	3	16	2	41	7	253	17	318	Female
Average	2.7	7.6	3.0	21.0	3.1	42.1	6.7	160.9	17.5	231.5	

TABLE III

Length of the four predatory instars of *Perillus bioculatus* and the number of eggs of *Lema trilineata* eaten in the insectary

Nymph No.	Days in 2nd Instar	Eggs Eaten	Days in 3rd Instar	Eggs Eaten	Days in 4th Instar	Eggs Eaten	Days in 5th Instar	Eggs Eaten	Total	
									Days of Development	Eggs Eaten
1.....	3	15	4	67	7	129	12	301	26	512
2.....	3	29	5	52	7	115	13	225	28	421
3.....	4	38	5	42	6	163	14	170	29	413
4.....	4	19	5	60	8	166	13	254	30	499
5.....	4	18	4	48	7	152	11	348	26	566
6.....	4	19	4	38	7	145	12	188	27	390
7.....	5	21	5	50	7	176	15	107	32	361
Average.....	3.9	22.7	4.6	51.0	7.0	149.4	12.9	227.6	28.3	451.7

TABLE IV

Length of the four predatory instars and the percent of nymphal mortality of *Perillus bioculatus* Fabr., reared in the insectary on several different host insects and plant-conditioned insects of the same species.

Host Insect	Stage	Host Plant	No. of Nymphs	Length of Instars in Days				Days 2nd Instar to Adult	Percent of Mortality
				2nd	3rd	4th	5th		
Leptinotarsa decemlineata	Egg	Potato	13	2.9	3.7	3.7	5.3	15.6	30.8
Lema trilineata	Larval	*Datura stramonium*	23	3.7	3.8	3.8	5.8	17.1	34.8
" "	"	*Physalis francheti*	22	4.3	3.1	3.4	6.3	17.1	36.4
Crioceris asparagi	"	Asparagus	19	3.0	4.3	4.0	6.0	17.3	36.8
Lema trilineata	"	*Datura cornucopia*	8	3.5	4.2	4.2	6.2	18.1	37.5
Disonycha xanthomelaena	"	Spinach, beet	7	*	*	*	*	*	42.9
Lema trilineata	"	*Solanum arboreum*	8	4.0	4.7	4.3	6.3	19.3	50.0
Leptinotarsa decemlineata	"	*Solanum atropurpureum*	6	6.0	5.5	4.3	7.0	22.8	50.0
" "	"	*Nicotiana affinis*	23	6.3	4.3	5.6	6.5	22.7	56.5
Lema trilineata	Egg	*Datura stramonium*	18	*	*	*	*	*	61.1
Leptinotarsa decemlineata	Larval	Potato	11	4.2	4.4	3.8	6.5	18.9	63.8
" "	"	Tomato	31	4.1	4.3	4.1	6.9	19.4	67.7
Autographa brassicae	"	Cabbage	10	*	*	*	*	*	70.0
Leptinotarsa decemlineata	*	*Solanum dulcamara*	35	3.5	3.5	4.6	6.8	18.4	74.3
" "	"	Eggplant	28	5.3	5.1	3.8	7.0	21.2	78.6
" "	"	*Solanum carolinense*	22	5.3	4.1	5.3	8.0	22.7	90.9

* Sets of nymphs not run at comparable temperature.

SUMMARY AND CONCLUSIONS

The rate of development and the amount of mortality among sets of nymphs of *Podisus maculiventris* and *Perillus bioculatus* reared on several hosts and under comparable conditions in the insectary appeared to depend upon the kind of food taken. Insect eggs, when acceptable, were most nourishing and were followed in the order of their value by larvae of hosts, depending upon their metabolic rate. Furthermore, hosts of the same species, but reared on different food plants, caused considerable variation in the rate of development and the relative mortality of the predator nymphs. Nymphs died more rapidly when the rate of development was slow. It appears that certain substances transmitted from the plant through the host to the predator caused large numbers of nymphs to die, yet in some cases did not affect the rate of development of those that survived.