EFFECT OF PREY SPECIES ON THE BIOLOGY OF *AMBLYSEIUS GOSSIPI* EL BADRY (ACARI : MESOSTIGMATA : PHYTOSEIIDAE)

BY Abd el-tawab A. YOUSEF [1]
and M. E. EL-HALAWANY [1]

PREY-PREDATOR RELATIONSHIP INFLUENCE OF PREY ON PREDATOR

SUMMARY : The effect of prey species and stage on the life span, efficiency and fecundity of *A. gossipi*, was studied in an incubator at 25°C. The male usually emerged earlier than the female but, when fed on eggs of *T. urticae* and *E. orientalis*, both sexes emerged simultaneously. Female longevity and efficiency greatly exceeded that of the male. Mite eggs, especially those of *T. urticae*, induced shorter periods of predator development than did immatures ; presented the highest total average of egg production, but the highest daily mean was observed with immatures of *C. aonidum*. Adults consumed more than 90 % of the prey attacked during the predator life span. The female of *A. gossipi* was most efficient during the period of egg deposition. Both of *Lepidosaphes beckii* and *I. purchasi* presented the least number of preys, induced the shortest periods of the predator longevity and the least fecundity.

RELATION ENTRE PROIE ET PRÉDATEUR INFLUENCE DE LA PROIE SUR LE PRÉDATEUR

RÉSUMÉ : Nous avons étudié en nous servant d'un incubateur à 25°, l'influence de l'espèce et du stade de la proie sur la vie, l'efficience et la fécondité d'*A. gossipi*. Habituellement le mâle émerge plus précocement que la femelle, mais nourris avec les œufs de *T. arabicus* et *E. orientalis* les deux sexes ont émergé simultanément. La longévité et l'efficience des femelles a largement dépassé celles des mâles. Des œufs d'Acariens, spécialement ceux de *T. arabicus*, ont amené des périodes de développement plus courtes qu'avec des immatures, ainsi que les productions moyennes d'œufs les plus élevées, bien que la plus forte production d'œufs ait été obtenue avec les immatures de *C. ficus*. Les adultes ont, au cours de leur vie, consommé plus de 90 % des proies attaquées. C'est au cours de la période du dépôt des œufs que la femelle d'*A. gossipi* a été la plus efficiente. *Lepidosaphes beckii* et *I. purchasi* ont l'un et l'autre fourni le nombre de proies le plus faible, et ont engendré chez le prédateur les longévités les plus petites et la moindre fécondité.

INTRODUCTION

The food range of phytoseiid mites has been investigated by various authors such as HERBERT (1959), MCMURTRY and SCRIVEN (1964), SWIRSKI et *al.* (1967 a and b, 1970), SWIRSKI and DORZIA (1968, 1969), KAMATH (1968), KAMBUROV (1971), and KNISLEY and SWIFT (1971). In 1968, EL-

1. Plant Protection Department, Faculty of Agriculture, Mansoura University, Egypt.

BADRY et *al.* studied the effect of three tetranychid mites on the development and oviposition of his *Amblyseius gossipi*.

Field observations showed that *A. gossipi* was generally found in association with mite and scale insect infestations throughout Egypt. Thus, the effect of prey species and stage on its life span, efficiency and fecundity, has been become a matter of immediate concern.

MATERIALS AND METHODS

Amblyseius gossipi was reared on grapevine leaf discs of about 3 cm in diameter. Three such discs were placed on a 0.5 cm layer of cotton wool, which was housed in a 15 cc open petridish. Enough moisture in the cotton layer was maintained by adding about 40 drops of water once every day. Adult females and males of *A. gossipi* brought from a citrus field were used to establish pure culture in the laboratory. Individuals of *A. gossipi* were fed singly during their life span on eggs and immature stages of the spider mites *Tetranychus urticae* Koch and *Eutetranychus orientalis* (Klein), the scale insect *Chrysomphalus aonidum* (L.), *Aonidiella aurantii* (Mask), *Lepidosaphes beckii* (Newn) and the mealybug *Icerya purchasi* (Mask). All experiments were carried out in an incubator held at 25°C and inspected twice daily.

RESULTS AND DISCUSSION

■ Duration of developmental stages of *A. gossipi* :

Scale insects, especially *C. aonidum*, accelerated predator development more than did prey mites (Table I). MCMURTRY and SCRIVEN (1964), stated that when *A. hibisci* (Chant) was fed on crawlers of *Hemiberlesia latania* (Signoret), the rate of its development was lower than that obtained with prey mites. The duration of the active pre-female larva when fed on eggs of *C. aonidum* and *T. urticae* respectively, ranged from 0.90 to 1.03, the protonymph required from 0.80 to 1.07 and the deutonymphal period varied from 0.70 to 1.07 days. Duration periods varied from 0.60 to 1.77, from 0.60 to 1.90 and from 0.90 to 1.70 days when pre-female larvae were fed on immature stages of the two prey species. The female immature stages of *A. gossipi* lasted for 4.70 and 4.00 days on eggs and immatures of *C. aonidum*, but required 5.23 and 7.67 days on those of *T. urticae* (Table I). The male period of immature stages was generally shorter than that of the female but, when fed on eggs of *T. urticae* and *E. orientalis* the two sexes emerged simultaneously.

TABLE I : Effect of prey species and stage on the duration of immature stages of *A. gossipi* at 25°C.

	Predator sex	Average period in days							
		Larva		Protonymph		Deutonymph		Immature stages	
		A	Q	A	Q	A	Q	Active	Total
T. urticae Eggs	Female	1.03	0.70	1.07	0.73	1.07	0.63	3.17	5.23
	Male	1.10	0.70	1.00	0.60	1.20	0.60	3.30	5.20
T. urticae Immatures	Female	1.77	0.80	1.90	0.90	1.70	0.60	5.37	7.67
	Male	1.20	0.80	1.40	0.80	1.40	0.80	4.00	6.40
E. orientalis Eggs	Female	0.99	0.70	1.03	0.70	1.03	0.60	3.05	5.05
	Male	1.00	0.60	0.90	0.70	1.20	0.60	3.10	5.00
E. orientalis Immatures	Female	1.63	0.63	1.83	0.83	1.33	0.83	4.79	7.08
	Male	1.20	0.80	1.10	1.70	1.10	0.70	3.40	5.60
C. aonidum Eggs	Female	0.90	0.90	0.80	0.80	0.70	0.57	2.40	4.70
	Male	0.80	0.70	0.80	0.77	0.47	0.47	2.07	4.01
C. aonidum Immatures	Female	0.60	0.60	0.60	0.50	0.90	0.80	2.10	4.00
	Male	0.60	0.60	0.60	0.60	0.80	0.60	2.00	3.80
Ao. aurantii Immatures	Female	0.90	0.90	0.90	0.90	0.80	0.67	2,60	5.07
	Male	0.80	0.60	0.90	0.70	1.20	0.60	2.80	4.80

A = Active stage. Q = Quiescent stage.

Shorter longevity was noted when *A. gossipi* was fed on prey eggs (Table II). Immatures of *T. urticae* produced the greatest longevity, and those of *Ao. aurantii* produced the shortest. Similarly, ZAHER and SHEHATA (1971) reported that feeding on immatures of *T. cinnabarinus* (Boisd.), greatly extended the longevity of *Typhlodromus pyri* Scheuten. Longevity for *A. gossipi* females and males were 12.20 and 8.80 days on eggs of *C. aonidum*, while it averaged 25.97 and 13.00 days on eggs of *T. urticae*. Longevity values varied from 13.60 and 9.20 days to 35.97 and 17.40 days, for both sexes preying on immatures of the two prey species, respectively. Use of *L. beckii* and *I. purchasi* as prey species resulted in considerably shorter periods of longevity.

TABLE II : Effect of prey species and stages on the longevity of *A. gossipi* at 25°C.

Prey species		Average period in days				
		Female				Male
		Pre-oviposition period	Oviposition period	Post-oviposition period	Longevity	Longevity
T. urticae	Eggs	2.80	11.10	12.7	25.97	13.00
	Immatures	2.90	15.80	17.27	35.97	17.40
E. orientalis	Eggs	2.30	10.50	4.60	17.40	11.80
	Immatures	2.80	14.20	5.90	22.90	14.60
C. aonidum	Eggs	1.90	9.20	1.10	12.20	8.80
	Immatures	1.80	10.40	1.40	13.60	9.20
Ao. aurantii	Immatures	1.10	10.70	1.40	13.20	8.40
L. beckii	Eggs	2.70	2.90	1,10	6.70	4.40
	Immatures	2.70	2.70	1.70	7.10	5.40
I. purchasi	Eggs	1.20	1.50	1.60	4.30	2.80
	Immatures	1.10	1.07	1.13	3.30	1.80

■ Efficiency of different stages of *A. gossipi* :

A. gossipi tended to destroy more prey mite eggs than immatures, but the opposite was noted with *C. aonidum* (Table III and IV). The pre-female larva, protonymph, and deutonymph consumed 6.80 and 8.60, 8.80 and 19.30, 13.30 and 32.60 eggs and immatures of *C. aonidum*, while it attacked 7.20 and 3.90, 25.20 and 14.70 and 34.90 and 21.90 eggs and immatures of *T. urticae* (Table III). During the period of immature development the predator female fed on 28.90 eggs and 60.50 immatures of *C. aonidum* as comared to 67.30 eggs and 40.50 immatures of *T. urticae*. *Aonidiella aurantii* and *E. orientalis* presented the least number of devoured prey immatures (24.40 individuals each).

TABLE III : Feeding capacity of the immature stages of *A. gossipi* at 25°C.

Prey species	Predator sex	Average no. of consumed prey by *A. gossipi*				
		Larva	Protonymph	Deutonymph	Immature Stages	
					Total average	Daily mean
T. urticae	Eggs Female	7.20	25.20	34.90	67.30	21.23
	Eggs Male	6.20	10.00	19.20	35.40	10.73
	Immatures Female	3.90	14.70	21.90	40.50	7.54
	Immatures Male	2.40	7.80	12,80	23.00	5.75
E. orientalis	Eggs Female	4.90	20.70	30.90	56.60	18.55
	Eggs Male	3.20	9.00	16.80	29.00	9.35
	Immatures Female	2.4	7.60	14.40	24.40	5.09
	Immatures Male	1.60	3.80	7,40	12.80	3,76
C. aonidum	Eggs Female	6.80	8.80	13.30	28.90	12.04
	Eggs Male	4.20	5.80	7.80	17.80	8.59
	Immatures Female	8.60	19.30	32.60	60.50	28.8
	Immatures Male	6.20	12.60	20.40	39.20	19.6
Ao. aurantii	Immatures Female	5.20	7.40	11.80	24.40	9.38
	Immatures Male	3.60	5.40	7.00	16.00	5.52

Adult *A. gossipi* were able to destroy more than 90 % of the total prey attacked during their entire life span (Table IV). Similar conclusions were reached by ZAHER et *al.* (1969) and ZAHER and SHEHATA (1971), who found that most of the prey were attacked during the adult stages of *Phytoseius plumifer* and *T. pyri*. Adult female *A. gossipi* attacked a total average and daily mean ranging from 307.10 and 25.30 to 1143.90 and 44.10 eggs, while it devoured 613.10 and 45.10 to 875.90 and 24.40 immatures of *C. aoni-*

dum and *T. urticae*, repectively. The adult female feeding capacity was generally more than three times as much as that of the male (Table IV). Similar results were obtained by ELBADRY and ZAHER (1961), ZAHER et *al.* (1969), and ZAHER and SHEHATA (1971) for *T. (A.) cucumeris, P. plumifer* and *T. pyri.*

TABLE IV : Feeding capacity of *A. gossipi*, during its adult stage and life span at 25°C.

Prey species		No. of prey consumed by *A. gossipi*													
		Female										Male			
		Pre-oviposition period		Oviposition period		Post-oviposition period		Longevity		Life span		Longevity		Life span	
		T	D	T	D	T	D	T	D	T	D	T	D	T	D
T. urticae	Eggs	156.60	55.74	573.30	52.40	414.00	34.60	1143.90	44.10	1211.20	39.30	289.0	22.64	324.40	17.90
	Immatures	124.90	13.20	510.10	32.30	241.60	14.80	875.90	24.40	916.30	21.00	236.20	13.70	259.20	10.90
E. orientalis	Eggs	115.30	52.40	449.10	44.00	89.70	18.40	654.10	37.90	710.70	32.00	196.80	16.70	225.80	19.30
	Immatures	108.30	38.40	414.00	29.60	89.30	15.20	611.50	27.00	635.90	21.30	189.00	12.90	201.80	10.10
C. aonidum	Eggs	45.10	24.80	238.10	25.90	23.90	21.73	307.10	25.30	336.10	19.20	112.60	13.30	130.40	10.20
	Immatures	89.50	49.50	487.10	46.90	38.50	25.70	613.10	45.10	673.70	37.90	245.80	26.60	285.00	21.90
Ao. aurantii	Immatures	25.40	22.20	264.60	24.60	23.20	16.80	317.90	24.10	342.30	18.80	105.40	15.40	121.40	9.20
L. beckii	Eggs	8.70	2.90	8.10	2.80	1.30	1.10	17.50	2.50	—	—	6.20	1.40	—	—
	Immatures	12.10	4.40	11.00	4.10	3.70	2.30	26.90	3.80	—	—	9.40	1.70	—	—
I. purchasi	Eggs	10.10	9.00	8.80	5.60	3.30	2.10	22.20	5.30	—	—	6.80	2.10	—	—
	Immatures	4.50	4.03	8.50	8.00	1.70	1.60	14.70	4.50	—	—	3.60	1.70	—	—

T = Total average. D = Daily mean.

During both the pre-oviposition and oviposition periods, female *A. gossipi* consumed about 1.5 times as many prey as devoured during the post-oviposition period. LAING (1968) and MA and LAING (1973) found that the females of *P. persimilis* Athias-Henriot and *A. chilenensis* (Dosse) were efficient during the oviposition period. *Lepidosaphes beckii* and *I. purchasi* presented the least number of devoured preys (Table IV). The adult female fed on a total average and daily mean ranging from 17.50 and 2.50 eggs of *L. beckii* to 22.20 and 5.30 eggs of *I. purchasi*, while it attacked 26.90 and 3.80 or 14.70 and 4.50 immatures of the previous prey species, respectively.

■ Egg-laying as influenced by prey consumption :

Feeding on immatures of *T. urticae* and *E. orientalis* by *A. gossipi* resulted in a considerably greater number of eggs deposited, but eggs of *T. urticae* and immatures of *C. aonidum* produced the highest daily mean (Table V). This phenomenon could be attributed to the extension of the oviposition period where high number of eggs were produced. *A. gossipi* female fed on 573.30 eggs and 510.10 immatures of *T. urticae* and laid 23.50 and 31.30 eggs over 11.10 and 15.80 days, while it attacked 238.10 eggs and 487.10 immatures of *C. ficus* and deposited 15.60 and 23.60 eggs over 9.20 and 10.40 days respectively (Tables II, IV and V).

Both *L. beckii* and *I. purchasi* induced shorter periods of ovipositon in *A. gossipi* during which the predator female consumed few prey individuals and laid few eggs (Tables II, IV and V).

TABLE V : Effect of prey species and stage on the fecundity of *A. gossipi* at 25°C.

	No. of eggs deposited when *A. gossipi* was fed on										
	T. urticae		*E. orientalis*		*C. aonidum*		*Ao. aurantii*	*L. beckii*		*I. purchasi*	
	Eggs	Immatures	Eggs	Immatures	Eggs	Immatures	Immatures	Eggs	Immatures	Eggs	Immatures
Total average	23.60	31.30	17.90	29.20	15.60	23.60	11.80	3.30	6.20	1.70	1.20
Daily mean	2.20	2.00	1.80	2.10	1.70	2.30	1.10	1.10	2.30	1.10	1.10

REFERENCES

EL-BADRY (E. A.), AFIFY (M. A.), ISSA (G. I.) and EL-BENHAWY (E. Z.), 1968. — Effect of different prey species on the development and fecundity of the predaceous mite *Amblyseius gossipi* (Acarina : Phytoseiidae). — Z. angew. Ent. **62** (3) : 247-51.

EL-BADRY (E. A.) and ZAHER (M. A.), 1961. — Life-History of the predator Mite *Typhlodromus (Amblyseius) cucumeris* Oudemans (Acarina : Phytoseiidae). — Bull. Soc. ent. Egypt **14** : 427-33.

HERBERT (H. J.), 1959. — Note on feeding ranges of six species of predaceous mites (Acarina : Phytoseiidae) in the laboratory. — Can. Ent. **91** (12) : 812.

KAMATH (S. M.), 1968. — Studies on the feeding habits, development and reproduction of the predaceous mite *Phytoseiulus persimilis* Athias-Henriot (Acarina : Phytoseiidae) on some phytophagous mites in India. — Tech. Bull. Commonw. Inst. Biol. Control **10** : 49-56.

KAMBUROV (S. S.), 1971. — Feeding, development and reproduction of *Amblyseius largoensis* on various food substances. — J. Econ. Ent. **64** (3) : 643-48.

KNISLEY (C. B.) and SWIFT (F. C.), 1971. — Biological studies of *Amblyseius umbraticus* (Acarina : Phytoseiidae). — Ann. Ent. Soc. Am. **64** (4) : 813-22.

LAING (J. E.), 1968. — Life history and life table of *Phytoseiulus persimilis* Athias-Henriot. — Acarologia **10** (4) : 578-88.

MA (Wei-Lan) and LAING (J. E.), 1973. — Biology, potential for increase and prey consumption of *Amblyseius chilenensis* (Dosse) (Acarina : Phytoseiidae). — Entomophaga **18** (1) : 47-60.

MCMURTRY (J. A.) and SCRIVEN (G. T.), 1964. — Studies on the feeding, reproduction and development of *Amblyseius hibisci* (Acarina : Phytoseiidae) on various food substances. — Ann. Ent. Soc. Am. **57** (5) : 649-55.

SWIRSKI (E.), AMITAI (S.) and DORZIA (N.), 1967 *a*. — Laboratory studies on the feeding, development and oviposition of the predaceous mite *Typhlodromus athiasae* P. and S. (Acarina : Phytoseiidae) on various kinds of food substances. — Israel J. agric. Res. **17** (4) : 213-18.

SWIRSKI (E.), AMITAI (S.) and DORZIA (N.), 1967 *b*. — Laboratory studies on the feeding, development and reproduction of predaceous mites *Amblyseius rubini* Swirski and Amitai and *Amblyseius swirskii* Athias-Henriot on various kinds of food substances. — Ibid. **17** (2) : 101-19.

SWIRSKI (E.), AMITAI (S.) and DORZIA (N.), 1970. — Laboratory studies on the feeding habits, post-embryonic survival and oviposition of the predaceous mites *Amblyseius chilenensis* (Dosse) and *Amblyseius hibisci* Chant (Acarina : Phytoseiidae) on various kinds of substances. — Entomophaga **15** (1) : 93-106.

SWIRSKI (E.) and DORZIA (N.), 1968. — Studies on the feeding development and oviposition of predaceous mite *Amblyseius limonicus* Garman and McGregor, on various kinds of food substances. — Israel J. agric. Res. **18** (2) : 71-75.

SWIRSKI (E.) and DORZIA (N.), 1969. — Laboratory on the feeding, development and fecundity of the predaceous mite *Typhlodromus occidentalis* (Nesbitt), on various kinds of food substances. — Ibid. **19** (3) : 143-45.

ZAHER (M. A.) and SHEHATA (K. K.), 1971. — Biological studies on the predator mite *Typhlodromus pyri* Scheuten (Acarina : Phytoseiidae) with the effect of prey and non prey substances. — Z. angew. Ent. **67** (4) : 389-94.

ZAHER (M. A.), WAFA (A. K.) and SHEHATA (K. K.), 1969. — Life history of the predatory mite *Phytoseius plumifer* and the effect of nutrition on its biology (Acarina : Phytoseiidae). — Ent. exp. appl. **12** (4) : 383-88.

Paru en juillet 1982.