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Effect of Exposing Eggs of Uzi Fly, *Exorista bombycis* (Louis) (Diptera : Tachinidae) to Volatiles of *Allium sativum* L. (Liliaceae)

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ABSTRACT

Exposure of freshly laid eggs of *Exorista bombycis* (Louis) to volatiles emanating from bulbs of *Allium sativum* L. for different durations resulted in significant reduction in their hatchability. Maggots hatched from the eggs exposed for 64 h and 72 h were failed to emerge from host larvae. The duration of developmental stages of *E. bombycis* was prolonged besides reduction in rate of pupation and adult emergence as the egg exposure period increased. The findings are interpreted as the chronic effects of volatiles of garlic affecting maggots following developmental defects sustainable during embryonic development. The known major chemical components of *A. sativum* such as allicin, thioacrolein, ajoene, 2-propene sulfenic acid, 2-propene thiol and propylene were presumed to be responsible for the adverse consequences reported in this paper.

Key words : Egg exposure, Volatiles, *Allium sativum*, Growth and development, *Exorista bombycis*.

INTRODUCTION

The uzi fly, *Exorista bombycis* (Louis) is a serious endoparasitoid of the silkworm, *Bombyx mori* L. It has been known to inflict considerable loss to sericulture industry in India (Krishnaswami *et al.*, 1964). Ever since its introduction to South Indian Peninsula, the loss due to uzi infestation varied greatly from 9 to 40% during 1980~83 (Jolly, 1981) and 5 to 12% during 1991~93 (Kumar *et al.*, 1993).

The garlic, *Allium sativum* L. (Liliaceae) is cultivated for spice purpose worldwide. The volatiles emanating from the bulbs of garlic have long been known to display feeding inhibition, grwoth retardation and insecticidal activity in some insects. Qadri (1985) observed the growth inhibition in *Periplenata americana* (L.) and *Sitophilus oryzae* when exposed to garlic bulb volatiles. The bulb volatiles of *A. sativum* inhibit the growth of *Trogoderma granarium* Everts (Jood *et al.*, 1993), *Pieris brassicae* L. (Khan and Siddiqui, 1994, and *Aproaerema modicella* (Dev.) (Prabhakara and Rao, 1994). According to Flint *et al.* (1995), 10 per cent solution made from commercially chopped garlic bulbs provided control of whiteflies in both greenhouse and small field plots for several days. Exposure of freshly laid eggs (<24 h) of *Earias vitella* Fab. and *Dysdercus koenigii* (Fab.) to volatiles emanating from bulbs of *A. sativum* significantly reduced their hatchability. Eggs of *Spodoptera litura* (Fab.) treated likewise, failed to hatch, but the eggs of *Helicoverpa armigera* (Hubner) were more tolerent and showed only a slight decrease in mortality (Gurusubramanian and Krishna, 1996).

The present study, which forms a part of continuing programme of research aimed at using nartural plant products for effective management of uzi fly, was carried out to investigate the influence of volatiles emanating from the crushed bulbs of *A. sativum* on growth and development of *E. bombycis*.

MATERIAL AND METHODS

The uzi fly was cultured in the laboratory at 25± 2°C and 81±5% relative humidity. One day old

fifth instar *B. mori* larave were provided to the gravid females for oviposition. After the oviposition, the worms were carefully observed and the worms containing only one egg were selected for experimental purpose. The infested worms were divided into 20 replications of 25 worms each and were placed inside the inverted glass chamber (18" Length × 12" Diameter) in paper trays at the rate of two replications per chamber. A glass petri-dish (4.5 cm) containing 10 g of crushed cloves of garlic bulbs was placed inside the every glass chamber and which was renewed daily depending up on the exposure period. Two replications of infested worms were removed from the exposure chamber at an interval of 8 h from 0 to 72 h. A separate set of two replications of infested worms were maintained in the normal environment to serve as control. Both treated and untreated batches were reared separately in cages (30×30×30 cm) till maggot emergence. Maggots that emerged from treated and untreated worms were maintained separately in cages to enable them to complete their post-embryonic development. The observations on the duration of all developmental stages, rate of pupation and adult emergence were recorded treatmentwise. The data were analysed statistically for significance using ANOVA (Snedecor, 1956).

RESULTS AND DISCUSSION

The data on the growth and development of uzi fly as influenced by exposure of eggs to volatiles of *A. sativum* for different durations are presented in Table 1.

The incubation period was found to be significantly maximum (3.60 days) when eggs exposed to volatiles of garlic for 72 h. Whereas it was non-significant among 8, 16, 24, 32, 40, 48 and 56 h of exposure period and were on a par with the control (3.25 days). A significant reduction in egg hatchability occurred when eggs exposed to volatiles of garlic bulbs for 72 h (4.42%) and 64 h (6.62%), which differ significantly from each other and also from rest of the exposure periods. There was a inverse relationship between the hatchability and the period of exposure. Probably, some of the main chemical ingradients of *A. sativum* such as allicin, thioacrolein, ajoene, 2-propene sulfenic acid, 2-propene thiol and propylene (Jain and Apitz-Castro, 1993) were presumed to be difused into eggs and affected vital physiological and biochemical processes associated with embryonic development in eggs that failed to hatch. These findings, in broad sense, agree with the earlier findings of Gurusubramanian and Krishna (1996), who observed 36, 50, 73 and 100 per cent egg mortality in *E. vitella, D. koenigii, H. armigera* and *S. litura*, respectively following exposure of their eggs to volatiles of *A. sativum.*

The duration of maggot did not differ significantly among 8 h (6.20 days), 16 h (6.20 days), 24 h (6.31 days) and 32 h (7.30 days)of egg exposure to volatiles of garlic compared to control (6.00 days). Whereas the maggot duration was significantly longer (7.80 to 7.90 days) in 40, 48 and 58 h of exposure periods. But, no maggots of *E. bombycis* emerged from host larvae follwing 64 h and 72 h egg exposure. The current findings are in close confirmity with those of Jood *et al.* (1993), who reported the larval growth inhibition in *T. granarium* follwing egg exposure to garlic bulb volatiles. The garlic bulb volatiles also inhibited the growth of *P. brassicae* (Khan and Siddiqui, 1994) and *A. modicella* (Prabhakara and Rao, 1994). Gurusubramanian and Krishna (1996) reported the significant increase in larval duration to the extent of 1.00 and 1.30 days respectively in *H. armigera* and *E. vitella* compared to controls following their egg exposure to volatiles of bulbs of *A. sativum*. The post-parasitic maggot duration of *E. bombycis* did not differ significantly between treated and untreated batches.

The rate of pupation was significantly low (28. 22%) in 56 h of egg exposure and it was 46.11, 60. 22, 73.21 and 84.20 per cent in 48, 40, 32 and 24 h exposure periods, resectively, which differ significantly from each other. However, the rate of pupation in 8 h (96.70%) and 16 h (95.20%) exposure periods did not differ significantly from the control (97.29%). The pupal period was significantly maximum (16.21 days) in 56 h of egg exposure period compared to control (13.20 days). But, the pupal period did not differ significantly among 8, 16, 24 and 32 h exposure periods. The pupal weight was sig-

Table 1. *Growth and development of Exorista bombycis (Louis) as influenced by different periods of egg exposure to volatiles of Allium sativum L.*

Egg exposure period (h)	Incubation period (days)	Hatchability (%)	Maggot period (days)	Post-parasitic maggot period (days)	Rate of pupation (%)	Pupal period (days)	Total developmental period (days)	Adult emergence (%)
8	3.25	88.30	6.20	0.47	96.70	13.00	22.92	83.28
16	3.26	74.26	6.20	0.48	95.20	13.80	23.74	81.14
24	3.26	63.27	6.31	0.47	84.20	14.00	24.04	78.61
32	3.32	56.30	7.30	0.49	73.21	14.00	25.11	75.30
40	3.36	41.22	7.80	0.46	60.22	14.70	26.36	68.70
48	3.38	27.50	7.86	0.48	46.11	15.00	26.82	56.70
56	3.38	12.99	7.90	0.49	28.22	16.21	28.14	22.00
64	3.46	6.62						
72	3.60	4.42	–			–		–
Control	3.25	95.52	6.00	0.47	97.20	13.20	22.87	84.27
Sem±	0.07	3.24	0.16	NS	2.11	0.47	0.87	1.21
C.D. 5%	0.13	6.35	0.31	-	4.79	1.08	1.97	2.75

NS=Non-significant

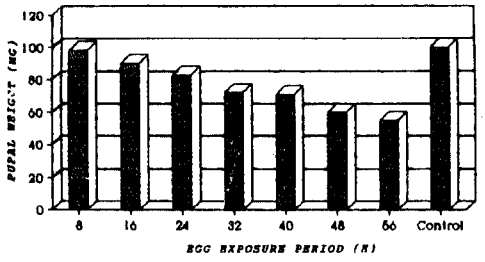

Fig. 1. *Pupal weight of E. bombycis as influenced by different periods of egg exposure to volatiles of A. sativum.*

nificantly reduced as the egg exposure period increased (Fig. 1).

E. bombycis completed its total developmental period in 28.14, 26.82, 26.36 and 25.11 days by 56, 48, 40 and 32 h of egg exposure to garlic bulb volatiles, respectively, which differ significantly from control (22.87 days). The rate of adult emergence was significantly low (22.00%) when eggs exposed to volatiles of *A. sativum* for 56 h compared to control (84.27%). However, the rate of adult emergence was 56.70, 68.70, 75.30, 78.61, 81.14 and 83.28 per cent in 48, 46, 32, 24, 16 and 8 h egg exposure periods, which differ significantly from each other. On the other hand, no adults of *D. koenigii* and *H. armigera* emeged from the eggs exposed to volatiles of *A. sativum* as a result of high mortality during the pupal stages (Gurusubramanian and Krishna, 1996).

From the persent findings it is concluded that the *E. bombycis* took longer time for completion of developmental stages, besides reduction in egg hatchability, rate of pupation and adult emergence in respect of longer egg exposure periods to volatiles emanating from crushed bulbs of garlic. The current findings are corroborate with the results of Amonkar and Banerji (1971), who reported that the volatiles of garic are highly effective against mosquitoes and house flies. It is likely that these chronic effects resulted from the volatile compounds of *A. sativum* acting on the developing embryo or the neonate larvae inside the egg, rather than being carried itself and subsequently disrupting the processes of post-embryonic development (Gurusubramanian and Krishna, 1996). As shown in Fig. 1, the pupal weights were also significantly reduced when eggs exposed for longer periods compared to control suggesting that the treatment may also have affected the centres that control larval feeding and metabolism (Barnby and Klocke, 1987).

This study suggest that it might be worthwhile investigating the possible use of the components of garlic as natural products for the control of uzi fly. Further tests would be required to establish the relative potency of the active fractions, their toxicity to silkworm and environmental safety.

적 요

누에의 등에 산란된 누에등 기생파리 알을 산란직후 부터 마늘을 넣어둔 밀폐된 유리상자 속에 일정기간 넣어두면, 누에등 기생파리 알의 부화비율이 떨어지고, 특히 64시간 이상 마늘 휘발성 물질에 접촉시킨 알에서 부화한 누에등 기생파리의 유충은 숙주인 누에 유충의 체내에 잠입한 후 소정기간이 경과한 후에도 숙주의 몸 밖으로 탈출하지 못하였다.

마늘의 휘발성 물질에 접촉시키는 시간이 길어질수록 누에등 기생파리의 발육경과 일수는 길어지고 용화율과 성화율도 저하하였다. 이러한 현상은 마늘의 휘발성 물질(알리신의 몇가지 주요성분)에 의해 초래된 누에등 기생파리의 배자발육 장애에 따른 만성적 효과 때문인 것으로 생각된다.

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