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Effectiveness of Margosan-O and Jojoba on Some Reproductive Aspects of the House Fly, *Musca domestica* (Diptera: Muscidae)

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ABSTRACT

Plant extracts of Margosan-O and Jojoba concentrations had been given to the early third instar larvae of *M. domestica* through their feeding diet. The produced adult female flies were observed to investigate the effects of these plant extracts on the reproductive potential. Fecundity of the adult females suffered from an inhibitory action of Margosan-O at all concentration levels. Also, their fertility had been detrimentally redused and the sterility index increased parallely to the conc. levels. On the other hand, Jojoba exhibited only a slight effect on both fecundity and fertility. Different doses of Margosan-O and Jojoba had been topically applied onto the late third instar larvae. The smallest fecundity (171.8 ± 24.5 vs 231.3 ± 23.6 eggs/♀ of controls) was attained at the highest dose, while the smallest fertility (81.0 vs 88.3% of control congeners) was found at the lowest dose. Generally, fertility was more remarkably affected than the fecundity by Margosan-O. Again, Jojoba exhibited only a slight effect on fecundity but its highest dose considerably decreased the fertility.

Key Words: *Musca domestic*; Margosan-O; Jojoba; Fecundity; Fertility

INTRODUCTION

Extracts from the neem seeds (*Azadirachta indica* A. Juss, Meliaceae) have been reported to have a wide range of biological activites against insects (Isman *et al.,* 1990). These include feeding deterrence, oviposition retarding, etc. against several species (Barnby & Klock, 1990; Schmutterer, 1990; Ali Niazee *et al.,* 1997; Ghoneim *et al.,* 2000; Vatandoost & Vaziri, 2004; Zhou *et al.,* 2005). Because of the safety to insect parasites, predators and other non-target organisms, low mammalian toxicity and short persistence in the environment as compared to the synthetic insecticides, many investigators recommended the use of neem extracts as pest control agents (Jayary *et al.,* 1993; Srivastava *et al.,* 1997; Nathan *et al.*, 2005; Deota, *et al.*, 2005).

Margosan-O is a formulation of neem oil fractions (Azadirachin content is 0.3%) and reported to show repellent and growth activity to some insect species (Meisner *et al.,* 1990, 92; Ghoneim & Al-Dali, 2002). Also, Jojoba is a plant extract of *Simmondsia chinesis* shrubs, Buxaceae (Quiroga *et al.,* 1991). It exhibits some biological activites against various insect pests (Tanani, 2001). Amer *et al*. (2004) assessed the bioactivity of these plant extracts, Margosan-O and Jojoba against *Musca domestica*. The present paper deals with the possible effects of these two plant extracts, after larval treatments, on the major reproductive aspects of this house fly, which is a serious pest for the animal and human health.

MATERIALS AND METHODS

A culture of the house fly *Musca domestica* was maintained for several generations at the lab. of Entomology, Faculty of science, Al-Azhar University, Cairo, Egypt, under the conditions of 27 ± 2°C and 70 - 75% RH. Larvae were raised on an artificial diet suggested by Lewallen (1954) and ameliorated by Busivine (1962). The adult flies were provided with cotton pads soaked in 10% sucrose as food.

Four replicates (5 adults/rep.) of newly emerged adult females, treated and control, were housed in cages (30 x 30 x 30 cm) and fed on cotton pads saturated with a milky solution in Petri dishes to serve as ovipositing sites.

Margosan-O is an ethanolic neem extract (*Azadirachta indica*) concentrate having 0.3% azadirachtin content. Three conc. levels of Margosan-O were prepared: 1, 5 and 10 ppm. Jojoba is a non-volatile oil obtained from the seeds of the Jojoba bean (*Simmondsia chinesis*). It is reported as emulsifiable concentrate 96% obtained from Agricultural Research Centre, Laboratory of Pesticides, Doqqi, Giza. Six conc. levels of Jojoba: 312.5, 625, 1250, 2500, 5000 and 10000 ppm were prepared. The early third (last) instar larvae were continuously fed on an artificial diet treated with each of these conc. Levels, while the control correspondings were fed on un-treated diet. On the other hand, six dose levels of Margosan-O (0.01, 0.1, 1, 5, 10 & 50 µg/larva) and Jojoba (0.1, 1, 10, 50, 100 & 500 µg/larva) were topically applied onto the late third (last) instar larvae.

All treated and control replicates (10 larvae/rep.) were kept under the same laboratory conditions for obtaining the adults. Three replicates (10 larvae/rep.) of the newly emerged adult female flies had been housed in cages (30 x 30 x 30 cm) and mated with normal male adult flies. The deposited eggs were removed from the cotton pads and placed in clean dry jars for counting and estimating the hatching percentage.

The female fecundity was measured as the average number of deposited eggs/♀ but the fecundity inhibition

was calculated as: [a - A/A] x 100, where a: No. of eggs laid/♀ in the treatment and A: No. of eggs laid/♀ in the controls. The hatching % of eggs usually denotes the fertility but sterility index was calculated according to Saxena *et al.* (1993) as: 100 - ab/AB x 100, where a: No. of eggs laid/♀ in the treatment, b: hatching % in the treatment, A: No. of eggs laid/♀ in the controls and B: hatching % in the controls.

Statestics. Data obtained was analysed by the Student's *t* - distribution and refined by Bessel correction (Moroney, 1956) to test the significance of difference between the means.

RESULTS

The concentration levels: 1, 5 and 10 ppm of Margosan-O and 312.5, 625, 1250, 2500, 5000 and 10000 ppm of Jojoba had been used among a wide range after continuous feeding of the early third instar larvae of *M. domestica* on treated diet, because some adult flies could emerge. For the same reason, the following doses had been topically applied onto the late third instar larvae. Margosan-O: 0.01, 0.1, 1, 5, 10 and 50 µg/larva and Jojoba: 0.1, 1, 10, 50, 100 and 500 µg/larva.

Treatment of the early third instar larvae. Depending on the distributed data in Table I, adult females, at all conc. levels of Margosan-O, deposited few eggs, because their fecundity suffered from an inhibitory action of this extract. The fecundity inhibition was 35.3, 29.4 and 29.3% at the descending conc. levels of Margosan-O. Also, another inhibitory action of it was detrimentally achieved on the fertility (80.5 ± 1.2, 80.6 ± 2.7 & 84.0 ± 3.9, at 10, 5 & 1 ppm, respectively vs 86.1 ± 2.1% of control females). In addition, the sterility index increased consecutively with the increasing conc. level.

Data in Table II, generally, indicated only a slight effect of Jojoba on the adult fecundity (lowest fecundity was 141.0 ± 34.1 eggs/♀ at 2500 ppm vs 171.1 ± 41.2 eggs/♀ of control congeners). The uppermost inhibition of fecundity (17.6%) was estimated at the conc. level. Also, only a slight effect of Jojoba on fertility could be detected. The sterility index ranged from 19.7 (at 2500 ppm) to 14.01 (at 625 ppm).

Treatment of the late third instar larvae. As shown in Table III, it is quite clear that Margosan-O affected the female fecundity. Whereas the smallest fecundity (171.8 ± 24.5 vs 231.3 ± 23.6 eggs/♀ of control) was attained at the highest dose (50 µg/larva), the smallest fertility (81.0 vs 88.3% of control) was found at the lowest dose (0.01 µg/larva). In other words, the highest dose of Margosan-O caused the largest fecundity inhibition (25.7%) but the largest sterility index (30.5) had been resulted by the lowest dose. Generally, although both fecundity and fertility had been reduced by Margosan-O, the fertility was more rigorously affected than the fecundity.

Table IV showed only a slight effect of Jojoba on the

Table I. Adult reproductivity of *Musca domestica* as affected by continuously feeding of the early 3rd instar larvae on Margosan-O-treated diet

Conc. Levels (ppm)	No. of adult females	Reproductivity			
		Fecundity	Fecundity Inhibition %	Fertility	Sterility index
1	10	73.3 ± 22.6 a	29.3	84.0 ± 3.9 a	31.0
5	11	73.2 ± 20.3 a	29.4	80.6 ± 2.7 b	32.9
10	9	66.7 ± 15.3 b	35.3	80.5 ± 1.2 b	39.5
Control	12	103.1 ± 17.1 a	- - -	86.1 ± 2.1 a	- - -

Table II. Adult reproductivity of *Musca domestica* as affected by continuously feeding of the early 3rd instar larvae on Jojoba-treated diet

Conc. Levels (ppm)	No. of adult females	Fecundity	Fecundity inhibition %	Fertility	Sterility index
312.5	11	146.4 ± 16.6 a	14.4	79.2 ± 3.2 a	17.2
625.0	10	150.6 ± 29.2 a	12.0	79.8 ± 2.8 a	14.1
1250.0	11	146.1 ± 29.0 a	14.6	79.2 ± 3.6 a	17.3
2500.0	10	141.0 ± 34.1 a	17.6	79.7 ± 4.8 a	19.7
5000.0	14	147.7 ± 40.7 a	13.7	79.6 ± 5.2 a	16.0
10000.0	10	145.4 ± 23.2 a	15.0	79.4 ± 1.9 a	17.5
Control	11	171.1 ± 41.2 a	- - -	81.8 ± 4.2 a	- - -

Conc. Levels: Concentration Levels; mean ± SD followed with the same letter (a): is not significantly different (P>0.01), (b): significantly different (P < 0.05), Fecundity: No. of eggs / ♀. Fertility: percentage of hatching eggs. Sterility index: was calculated according to Sexena *et. al.* (1993)

fecundity. The smallest fecundity was 111.7 ± 26.8 eggs/♀ (at 500 µg/larva) compared to 131.9 ± 22.9 eggs/♀ of controls. The uppermost inhibition % had been measured at the highest dose, while the downmost one had been measured at 1.0 mg/larva. The highest dose of Jojoba led to a considerble decrease of fertility (81.5 ± 3.6 vs 89.3 ± 3.2 of controls), where the sterility index was calculated as 22.7. At other dose levels, Jojoba did not significantly effectuate the fertility. However, the sterility index for females ranged from 15.0 (at 10 µg/larva) to 6.9 (at 0.1 µg/larva).

DISCUSION

Adult fecundity and fertility of several insects have been affected by the larval treatment with azadirachtin preparations (Saxena, 1989; Shalaby *et al.,* 1997; Mohamed *et al.,* 2000; El-Shiekh, 2002; Hewady *et al.,* 2002). In the present study, Margosan-O detrimentally prohibited the fecundity and fertility of *M. domestica* at different concentration against the early third instar larvae. Also, the suppressing action on these reproductive parameters was found more powerfull in Margosan-O than Jojoba. Generally, fertility was more rigorously affected the fecundity.

To a great extent, similar results for fecundity and fertility were recorded by azadirachtin and azadirachtin preparations or derivatives on *Pieris brassicae* (Kippal-

Table III. Adult reproductivity of *Musca domestica* as affected by topical application of Margosan-O onto the late 3rd instar larvae

Dose (µg/larva)	No. of adult females	Fecundity	Fecundity inhibition %	Fertility	Sterility index
0.01	11	215.3 ± 35.2a	6.9	81.0 ± 2.4b	14.6
0.10	12	206.8 ± 34.3a	10.6	83.5 ± 0.9b	15.4
1.00	11	208.8 ± 29.6a	9.7	81.6 ± 3.2b	16.6
5.00	10	204.2 ± 20.0a	11.7	80.5 ± 3.9b	19.5
10.00	11	210.0 ± 31.8a	9.2	80.5 ± 3.5b	17.2
50.00	10	171.8 ± 24.5b	25.7	82.6 ± 2.7b	30.5
Control	13	231.3 ± 23.6a	- - -	88.3 ± 2.3a	- - -

a, b, Fecundity, Fertility, Sterility index: See footnote of Table I

Table IV. Adult reproductivity of *Musca domestica* as affected by topical application of Jojoba onto the late 3rd instar larvae

Dose (µg/larva)	No. of adult females	Fecundity	Fecundity inhibition %	Fertility	Sterility index
0.1	12	128.1 ± 42.1 a	2.8	85.6 ± 2.8 a	6.9
1.0	17	130.2 ± 11.7 a	1.3	83.7 ± 3.4 a	7.5
10.0	11	115.8 ± 37.4 a	12.2	86.5 ± 3.9 a	15.0
50.0	10	119.6 ± 19.8 a	9.3	88.4 ± 5.9 a	10.2
100.0	10	120.8 ± 31.9 a	8.4	86.4 ± 4.4 a	11.4
500.0	13	111.7 ± 26.8 a	15.3	81.5 ± 3.6 b	22.7
Control	14	131.9 ± 22.9 a	- - -	89.3 ± 3.2 a	- - -

a, b, Fecundity, Fertility, Sterility index: See footnote of Table I

Singh & Sharma, 1987), *Liriomyza trifolii* (Parkman & pienkowki, 1990), *Spodoptera litura* (Ayyangar & Rao, 1991; Dai *et al.,* 2005; Senthil *et al.,* 2005), *Heliothis armigera* (Gu - Yanfang *et al.,* 1998), *Spodoptera littoralis* (Mohamed *et al.,* 2000; Hassan, 2002). Also, Ghoneim and Al-Dali (2002) observed drastically reduced fecundity of adult female flies of *Muscina stabulans* as a response to feeding of first or third instar larvae on 1, 5 or 100 ppm Margosan-O. This reduction was increased as the concentration was increased. On the other hand, a reverse correlation was detected for the fertility.

To explicate the reducing effects of Margosan-O and Jojoba on the fecundity and fertility of *M. domestica* in the present investigation, the suggestions of Adams and Hintz (1969) for the same species or of Arias and Mulla (1975) for *Culex tarsalis,* about the disturbance of juvenile hormone titer during the ovarian maturation, can be appreciated here. However, the mode of action of Margosan-O or Jojoba on the fecundity or fertility of the present dipteran does not fully understood rightnow, because they may affect the oocyte production (oogenesis or vitellogenesis) in the ovaries, ovulation or the ability to lay eggs or even to lay fertilized eggs or some of these affected events together. In respect to the fertility, the plant extracts used in the present investigation may affected the survival of the developing embryoes at certain embryonic stages causing some death and subsequently reduced hatching percentages.

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