EFFECT OF SOME WILD PLANTS ON SOME BIOLOGICAL ASPECTS OF *AGROTIS IPSILON* HUFN.

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INTRODUCTION

In the continuous search for new pest control agents, plants are considered one of the richest sources. Plants may act as repellents or attractants (Su and Harvort, 1982) or as antifeedants (Meisner *et al.*, 1981). Plants may also act as insect toxicants, or inhibitors (Jacobson and Crosby, 1971; Feeny, 1976; Kubo and Nakanishi, 1979; Finch, 1980; Jacobson, 1981 and 1982; and Smith and Secoy, 1981).

Current public concern about the possible adverse effects of agricultural chemicals on health and environment has generated interest in reducing chemical inputs in the main crops which are subjected to attack by the black cutworm, *Agrotis ipsilon*. Control options for this pest reviewed here includes use of wild plants.

MATERIAL AND METHODS

A standard culture of the black cutworm was reared under laboratory conditions (25±2 °C, 50-60% R.H. with normal day photoperiod). Larvae were fed on castor leaves and from 4th instar were reared individually to avoid cannibalistic behavior (Abdel-Hadi, 1968). Adults were paired in glass jars (2L-volume) with a sex ratio of (1:1) and fed on (20%) honey solution.

Some selected wild plants illustrated in table (1) were used in both of laboratory and field experiments. Castor plant and clover were used as control in laboratory and field experiments, respectively.

The experimental design was a randomized complete block with 5 replications. Seedlings of the chosen plants were cultivated randomly in plots (2m x 3m) replicated 5 times.

TABLE (I)

Name and families of plants used for application

Symbol	English name	Scientific name	Family
A	Lambaqarters	*Chenopodium botrys*	Chenopodiaceae
B	Bind weed	*Convolvulus arvensis*	Convolvulaceae
C	Prastrate cinquefoil	*Potentilla supina*	Rosaceae
D	Common mallow	*Malva sylvestris*	Malvaceae
E	Celery	*Apium graveolens*	Umbelliferae
F	Ryegrass	*Lolium pernae*	Poaceae
G	Rosy-flowered garlic	*Allium ampeloprasum*	Aliaceae
H	Basil	*Ocimum basilicum*	Lamiaceae
I	Sowthistle	*Sonchus oleraceus*	Asteraceae
J	Red radish	*Raphanus sativus*	Cruciferae
K (control)	Castor	*Ricinus communis*	Euphorbiaceae
L	Quince	*Cydonia vulgaris*	Rosaceae
Z(control)	Clover	*Trifolium alexandrium*	Leguminosae

Numbers of healthy *A. ipsilon* third instar larvae were chosen and collected from stock culture. Each plot was artificially infested with 500 of collected larvae and used as a replicate. Seedlings of wild plants were left as the only source of food for 48 hours and then, number of attracted and settled larvae on each plant was counted per plot.

Mean number of settled black cutworm larvae on each species of tested plants and standard error were calculated.

To evaluate the toxicity and biological activity of chosen plants, five replicates of newly hatched *A. ipsilon* larvae (25 larvae each) were fed on fresh leaves of plants till pupation. Reaching to 3^{rd} instar, larvae were reared individually to avoid cannibalism. Number of dead larvae in each instar, dead pre-pupae and dead pupae was counted. Corrected percentage mortality was calculated using Abbott's formula.

Larval, pre-pupal and pupal duration at non-toxic plants and control were counted, also longevity of emerged adults (♂& ♀) and sex ratio were recorded. Alive pupae resulted from all experiments were weighed in treatments and control. Emerged adults from some experiments were paired in glass jars with sex ratio (1:1) to identify the female fecundity in comparison with control.

Data were subjected to statistical analysis using analysis of variance (F- test).

RESULTS AND DISCUSSION

Attractant and repellent effect of chosen wild plants and Clover as control was evaluated and data are tabulated in table (2).

Control plant highly attracted to the 3rd instar of *A. ipsilon* larvae (57.0 larvae) but it was not the most attractive plants because seedlings of Sowthistle (I) and Common mallow (D) attracted 73.0 and 70.6 larvae, respectively. Prostrate cinquefoil (C) and ryegrass (F) were found to be the most repellent plants, 19.0 and 19.8 larvae were recorded, respectively.

No significant differences were found between the number of attracted and settled 3rd instar larvae to seedlings of plants coded (A) and (J), which recorded 39.2 and 37.4 larvae, respectively. Same trend was observed between plants coded (B), (E) and (H) in numbers of attracted larvae.

A significant difference was found between number of attracted 3rd instar larvae (46.8) to Rosy-flowered garlic leaves and all other tested plants (Table 2).

TABLE (II)

Orientation experiment for the 3rd instar larvae of *Agrotis ipsilon*

Treatments	Number of attracted larvae
	Mean ± SE
A	39.2 ± 1.068 d
B	27.6 ± 0.509 e
C	19.0 ± 0.707 f
D	70.6 ± 1.288 a
E	29.4 ± 0.509 e
F	19.8 ± 0.735 f
G	46.8 ± 0.735 c
H	29.0 ± 0.548 e
I	73.0 ± 3.178 a
J	37.4 ± 0.927 d
Z (control)	57.0 ± 1.789 b
F-value	204.382**
L.S.D. at 5%	3.78

Means followed with the same litter (s) are not significantly at 5% level of probability

Toxicity to larvae, pre-pupae and pupae:

Both of Ryegrass and Basil plants were highly toxic to larvae of the black cutworm especially at the period from 1st to 4th instar, and mortality reached 100% during this period. Toxicity was fluctuated at different larval instars, 4th instar was the most susceptible one, while the 6th instar was the lowest affected instar (Table 3).

The lowest total larval mortality was 24% at plant-coded (A) and (G), while in control recorded mortality was 8%only.

Rosy-flowered garlic plant, which coded (G) exhibited latent toxicity effect, observed clearly at pre-pupal stage. Larvae fed on fresh leaves of this plant resulted in 24% mortality at larval stage increased to 100% at pre-pupal stage, (Table 3).

Latent effect of some plants at pre-pupal stage was not completely observed as shown at plants coded (E) which induced 14.29% mortality at pupal stage, followed by plants coded (L) which gave no latent toxicity at pupal stage.

More than 60% mortality was recorded at pupal stage in treatment with Lambsquarters (A), larvae fed on this plant resulted in 24% mortality followed by 15.8% at pre-pupal stage. The experiment was ended when mortality reached 100% at pupal stage. On the other hand, some plants such as Prostrate cinquefoil (C), Red radish (J) and Quince (L) resulted in zero mortality at pupal stage (Table 3).

TABLE (III)

Percent mortality of immature stages of black cutworm, *Agrotis ipsilon* which feeding with wild plants

Treatments	Stages								
	Larval instars							Prepupa	Pupa
	1st	2nd	3rd	4th	5th	6th	Total		
A	16	4	0	4	0	0	24	15.8	60.2
B	0	28	4	0	4	0	36	13.3	38.5
C	12	12	0	0	4	8	36	2.5	0
D	0	16	12	0	8	0	36	6.25	6.67
E	20	8	8	8	0	0	44	0	14.29
F	12	4	0	84	--	--	100	--	--
G	0	0	16	8	0	0	24	76	--
H	0	0	16	84	--	-	100	--	--
I	0	12	0	12	4	4	32	11.76	6.67
J	0	12	0	16	0	12	40	13.3	
L	12	0	0	24	0	4	40	0	0
K (control)	0	0	0	0	8	0	8	8.69	0

Effect on Larval, Pre-pupal and pupal duration:

Some tested plants like that coded (A), (L) and (I) resulted in significant shortage in larval duration followed by highly significant increase of pre-pupal and pupal duration, while all other tested plants except red radish resulted in highly significant prolongation of larval duration in comparison to control as shown in table (4).

Between red radish and control no significant difference was found at larval duration while pre-pupal and pupal duration increased significantly compared to control.

Common mallow (D) was the most effective plant followed by Bindweed (B), they recorded 25.5 and 21.8 days in average, respectively, at larval duration compared to 19.1 days in control.

Effect on Adult longevity, Sex Ratio and Female fecundity:

Longevity of *A. ipsilon* males emerged from larvae reared on fresh leaves of Prostrate cinquefoil or celery increased significantly while the opposite was found in female longevity in comparison to control, as shown in Table (4).

Longevity of emerged adults (♂ & ♀) from experiments of coded plants (I,J and L) significantly decreased when compared to control.

Larvae fed on common mallow resulted in non significant difference in male longevity (11.4 days) while female longevity highly significantly decreased (7.1 days) in comparison to control (♂ longevity =11.8 days & ♀ longevity = 14.5 days), (Table 4).

Normal sex ratio of *A. ipsilon* as obtained from control data was (1♂: 1.2 ♀). In our experiment, treated plants were divided mainly into two groups, 1st one, plants gave more males like prostrate cinquefoil, common mallow and celery (1: 0.9), (1: 0.6) and (1: 0.8), respectively. The opposite (more females) was found in the 2nd group, which included, Sowthistle, red radish and quince with sex ratio (1: 1.7), (1: 1.3) and (1: 1.3) respectively. (Table 4).

Fecundity of adult females was highly affected in our study. Larvae reared on fresh leaves of Sowthistle or red-radish produced adult females which laid an average of 221.0 eggs and 79.0 eggs, respectively, while the mean number in control was 482.58 eggs, (Table 5).

At other tested plants such as prostrate cinquefoil, common mallow, celery and quince, resulted adult females were completely sterile as shown in Table (5).

Effect of chosen wild plants on pupal weight of *A. ipsilon:*

Insignificant difference was found in pupal weight of pupated larvae fed on tested plants coded (B), (C), (D), (E), (I), and (J) in comparison to control. Pupae resulted from treated larvae fed on lambsquarters or quince significantly decreased in weight, they recorded 0.1843 and 0.1799 gm, respectively, while in control pupal weight was 0.3737 gm in average. Weight of pupae in some cases like treatments with plants coded B (0.4378gm.), I (0.3917gm.) and J (0.4884gm.) insignificantly increased than control (0.3737gm.), (Table 5).

Insect repellent or antifeedant plants retarded the feeding activities of pests reducing the damage. Extraction of such plants rendering the treated plants un-attractive, non-palatable and therefore offers a novel approach in pest management, (Jacobson *et. al.*, 1978). Wild plants are potential candidates for crop development and commercialization for sources of insect attractants, repellants or toxicants.

TABLE (IV)

Duration of different pf the black cutworm *Agrotis ipsilon* reared on wild plants

Treatments	Duration (in days)					Sex ratio
	Stages			Adult longevity		
	Larvae	Prepupae	Pupae	Male	Female	Male: Female
A	18.0±0.153 e	5.2±0.101 f	8.9±0.165 b	--	--	--
B	21.8±0.306 b	6.0±0.277 ed	8.0±0.522 c	--	14.0±0.316 ab	--
C	21.1±0.266 c	7.0±0.426 c	8.8±0.411 b	15.4±0.369 b	13.6±0.245 b	1 : 0.9
D	25.5±0.256 a	6.3±0.126 d	9.7±0.125 a	11.4±0.429 c	7.1±0.261 e	1 : 0.6
E	21.0±0.234 c	5.6±0.133 ef	5.0±0.246 e	17.0±0.577 a	13.7±0.184 b	1 : 0.8
G	15.8±0.145 g	--	--	--	--	--
I	17.3±0.114 f	5.3±0.118 f	9.7±0.125 a	6.2±0.200 e	10.3±0.167 d	1 : 1.7
J	19.6±0.335 d	10.6±0.140 a	9.2±0.222 ab	9.5±0.224 d	12.3±0.184 c	1 : 1.3
L	16.7±0.258 f	4.1±0.168 g	6.9±0.176 d	11.8±0.147 c	14.5±0.230 a	1 : 1.3
K (control)	19.1±0.316 d	7.7±0.252 b	7.5±0.133 cd	5.7±0.211 e	7.4±0.176 e	1 : 1.2
F – value	331.803**	86.343**	36.541**	160.217**	185.375**	
L.S.D. at 5%	0.69	0.57	0.69	0.88	0.63	

Means followed with the same litter (s) are not significantly at 5% level of probability

The most repellant tested plants were, Prostrate cinquefoil, rye grass, Basil and Celery, that agree with obtained results by Koehler *et al.*, (1983b), who found that, mean number of *Pieris rapae* larvae on cabbage was significantly reduced when basil planted as companion crop to protect the main crop.

TABLE (V)

Effect of type of host on pupal weight and fecundity of the emerged females

Treatments	Pupal weight (mg)	Female fecundity (no. of deposited eggs)
A	0.1843 ± 0.01 d	
B	0.4378 ± 0.12 ab	--
C	0.2348 ± 0.02 cd	--
D	0.3224 ± 0.08 abcd	--
E	0.2946 ± 0.01 bcd	--
I	0.3917 ± 0.01 abc	221.00 ± 6.40 b
J	0.4884 ± 0.01 ab	79.00 ± 1.98 c
K	0.3737 ± 0.02 abc	482.58 ± 13.69 a
L	0.1799 ± 0.01 d	--
Z	0.4634 ± 0.10 a	486.67 ± 10.69 a
F – value	3.250*	317.450**
L.S.D. at 5%	0.16	31.28

Means followed with the same litter (s) are not significantly at 5% level of probability.

Previous results agree also with that stated by Kenny and Chapman (1988), who recorded celery as an insect repelling plant. Leaf extract and oil of basil were reported as repellant to Colorado beetle (McIndoo, 1982). On the other hand, the attractant plants to 3rd instar larvae of *A. ipsilon* were sowthistle and common mallow. Thompson *et al.* (1970) stated that essential oils of several Malvaceae family plants (i.e., common mallow) were attractive to the cotton boll weevil.

Chosen wild plants exhibited different levels of toxicity against larval instars, pre-pupae and pupae of the black cutworm. Percentage of mortality reached 100% at the 4th instar larvae by feeding newly hatched larvae on ryegrass or basil. This result agree with that found by Aassen *et al.* (1969), who reported that, extract of Ryegrass possesses an alkaloid named "halostachine" which showed insecticidal activity against locusts. Chavan & Nikam (1982) and Rathore (1978) stated that basil oil is an excellent repellent and larvicide for almost all species of mosquitoes, mites and aphids. Basil seed extract was found to show toxicity to the 5th instar larvae of potato tuber moth (Pandy *et al.*, 1982).

Latent toxicity of tested plants was clearly observed in pre-pupal stage at treated larvae with bindweed (25% mortality) and lambsquarters (15.8% mortality). Usher (1973) and McIndoo (1982) reported that, several plants which belong to Family Chenopodiaceae (i.e., Pigweed genus or Mexican tea) showed insecticidal and antifeedant activity when tested against different agricultural insect pests like, Japanese beetle, groundnut beetle and angoumois grain moth.

Toxicity at pupal stage of *A. ipsilon* reached 60.2% in larvae treated with Lambsquarters and 38.5% in treatment with bindweed. These results may be due to the antifeedant effect of tested plants and that agree with that found by Usher (1973) and McIndoo (1982) as described before.

Non-toxic tested plants gave significant prolongation in larval duration except, lambsquarters, sowthistle and quince which resulted in significant shortage or decrease, close effect was also observed in pre-pupal and pupal duration. Longevity of emerged adults from treated larvae was fluctuated between increase and decrease significantly different according to sex of adult and tested plant. Biological activity of tested plants may be due to antifeeding or hormonal effect.

Insect growth regulators, including analogs and antagonists of endogenous hormones, have also been identified in plants. Prominent among these is the analogs of two insect hormones (molting and juvenile hormone) and the antagonist for juvenile hormone. Chemicals structurally similar or identical to the molting hormone have been found in many plants, such as, herbs, weeds and several species of aromatic plants (Nakanishi, 1977).

Pupal weight was significantly affected in treatment with lambsquarters and quince, while fecundity of emerged adult females was greatly affected in all tested plants.

Ahmed *et al.*, (1997) reported that, pupal weight of *Agrotis ipsilon* was gradually affected according to concentration of *Melia azedarach* methanolic extract and feeding period of 3rd instar larvae. They found also that, other biological parameters of target insect, such as oviposition period, adult longevity and number of laid eggs were greatly affected, particularly after long periods of feeding on treated food.

As a general conclusion, plants that showed repellent effect against Agrotis larvae can be used in inter cropping system to protect the main crop, while others may be useful when used as traps in IPM programs. Toxicity or bioactivity of other plants can be extracted and followed by further studies to identify the active components, mode of action, safety and finally to be used as a natural safe product in a control program of our target pest.

SUMMARY

Number of wild plants were collected from different locations of Giza Governorate to evaluate their fresh leaves as attractant, repellent, toxicity and bioactivity against the black cutworm, *Agrotis ipsilon* Hufn. which is one of the main insect pests on several field crops and vegetables in Egypt. Prostrate cinquefoil, Ryegrass, Bindweed, Basil, and Celery were the most repellant plants, respectively. Sowthistle followed by Common mallow showed the highest attractive effect to newly hatched *Agrotis* larvae. Mortality reached 100% at 4th larval instar when fed on fresh leaves of Ryegrass or Basil and at pupal stages when larvae feeding with Lambsquarters. Bindweed, Prostrate cinquefoil, Common mallow and Celery plants caused significant prolongation in larval duration while Lambsquarters, Sowthistle and Quince gave an opposite effect. Weight of the resulted pupae was significantly affected at Lambsquarters and Quince treatments. Fertility of emerged adult females was highly affected at all tested plants

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