TOXIC ACTIVITY OF SIX PLANT WATER EXTRACTS AGAINST *SPODOPTERA LITTORALIS* (LEP., NOCTUIDAE) IN THE LABORATORY

YACOUB, SH.S. AND AMANY S. EL-HEFNY

Plant Protection Research Institute, ARC,Dokki, Giza

(Manuscript received 1st August 2007)

Abstract

The effect of water extracts of six plants as a toxic activity on *Spodoptera littoralis* 2nd & 4th larvae was investigated under controlled laboratory condition of 27 °C and 55 – 65% R.H. These plants were leaves of Dodonaea, *Dodonaea viscoza*, (family: Sapindaceae), pulps and seeds of sour orange *Citrus aurantium* v. *amara* (family: Rutaceae), (midrib of cabbage leaf), *Brassica oleracea v. capitata*, (family: Cruciferae), (turnip), *Brassica rapa* v. *esculenta* (family: Cruciferae) and (Mango-singara) *Mangifera domestica* (family: Anacardiaceae).

Data obtained revealed that Dodonaea-water extract and pulp of sour orange water-extract caused the highest mortality and reduction percentages (80 & 75% than control in 2nd instar larvae and 80 & 81.3% than control in 4th instar larvae, respectively). In addition, pulp of sour orange extract manifested effects since it caused shorter mean of larval duration (13.5 days), longer mean of pupal duration (15 days) and lowest mean of pupal weight (0.1485 gm). Meanwhile, shorter mean of adult longevity (4.3 days) was due to Dodonaea leaves extract. Bioassay data were observable in which the shortest LT_{50} values (4.46 and 3.59 days) for 2nd and 4th instars larvae treated with Dodonaea extract at 10% concentration, respectively.

INTRODUCTION

The Egyptian cotton leaf worm, *Spodoptera littoralis* (Boisduval) (Lepidoptera, Noctuidae), is a major pest of cotton and other cultivated crops in Egypt as well as Mediterranean and Middle East countries (Nasr *et al.,* 1984, Ahmad, 1988, Campion *et al.,* 1997). This pest became resistant to different pesticides due to the repeated use of conventional chemical insecticides.

The use of natural products from plant origin is a new trend which may proof efficiency for pests' control. These natural products are mainly plant extracts which prove to have deleterious effects on target pests. These efficacies are manifested in several ways, including direct toxicity (Hiremath *et al.,* 1997) and suppression of calling behavior (Khan and Sexena, 1986).

The work outlined in this paper aimed to assay the efficacy of leaves, seeds, midrib, pulp and roots of different plants as a toxic activity against the 2nd and 4th instars of the cotton leaf worm *S. littoralis*.

RESULTS AND DISCUSSION

I. Effect of extracts on mortality percentages

a. on 2nd instar larvae:

Data presented in Table (1), show mortality percentages of 2nd instar larvae of *S. littoralis.* The higher mortality percentage was due to water-Dodonaea extract which caused 80% mortality representing 75% reduction than control, followed by water-midrib of cabbage which caused 70%, achieving reduction 71.4% than control. While, water-pulp & seed of sour orange and turnip extracts caused the same percentage of mortality 60% as represented 66.7% reduction than control. On the contrary, water-mango singara extract was the least effective treatment against 2nd instar larvae of *S. littoralis* causing 50% mortality and 60% reduction than control (20% mortality).

b. on 4th instar larvae:

In the same Table (1) data obtained clearly showed that the highest mortality percentages of 4th instar larvae of *S. littoralis* were 80 and 75% by water-pulp of sour orange and dodonaea extracts, respectively, representing 81.3 and 80% reduction than control. The remaining treatments could be classified in two groups, the first had an intermediate effect as seeds of sour orange water extract only with 70% mortality achieving 78.6% reduction than control, the second had the least efficacy including water-midrib of cabbage leaf, turnip and mango singara extracts, 50% mortality for each, causing 70% reductions than control (15% mortality), Table (1).

II. Effect of extracts on instar durations and pupal weight:

a: on larval duration

As shown in Table (1), all treatments shortened the mean of larval duration when compared with that in the control. The shortest mean of larval duration period resulted from water-pulp of sour orange extract (13.5 days) indicating the severe effect of this extract, followed, by water-Dodonaea, midrib of cabbage leaf and turnip extracts caused 14, 15 and 15 days as mean of larval duration, respectively. The remaining treatments water-seeds of sour orange and mango-singara extracts led to 15.5 and 17 days of larval duration, respectively.

b: on pupal duration

All treatments caused prolongation effect and an increasing in pupal duration especially, that of water-pulp of sour orange extract (15 days as the average) compared with the control (9.5 days). On the contrary, water-mango singara extract led to 11 days, while, the remaining treatments could be fairly arranged in descending order according to the longevity of duration as, water-seeds of sour orange and turnip

extracts (14 days average for each), water midrib of cabbage leaf extract (13.5 days) and finally water-Dodonaea extract (13 days), Table (1).

c: on pupal weight

All treatments caused reduction in the pupal weight averaged 0.148 to 0.203 gm only / pupa opposed to 0.285 gm in the control. The highest efficacy on pupal weight was that achieved by water-pulp of sour orange extract 0.148 gm / pupa, followed by midrib of cabbage leaf extract, seeds of sour orange extract, turnip root extract, water-Dodonaea extract and finally the lowest effect on pupal weight was due to mango singara extract. Their values were 0.180, 0.188, 0.194, 0.197 and 0.203 mg / pupa, respectively, Table (1).

d: on adult longevity:

Results achieved concerning adult longevity after treatment with different extracts indicated that the highest efficacy caused by water-Dodonaea extract (4.3 days as average) when compared with that in the control (8.3 days). While, the remaining treatments averaged from 5.3 days after treated by pulp sour orange extract to 6.3 days after treatment with water mango-singara extract as shown Table (1).

The pervious results are considered very important to clear the role of extracts in reducing of the numbers of insects without any environmental pollution, and there are also, considered in harmouny with the tradition of farmers when cultivated Dodonaea plant surrounding by gardensand fields.

III. Laboratory bioassay:

Responses of 2^{nd} and 4^{th} instars of *S. littoralis* larvae to different plant extracts are show in Table (2) and illustrated in Figs (1&2).

III.a. Effect of 2^{nd} instars treatments:

Data in Table (2) show LT_{50} values after feeding *S. littoralis* 2^{nd} instar larvae of *S. littoralis* on castor oil leaves treated with different plant extracts. The shortest value was obtained from treatment by pulp of sour orange water extract (4.46 days), while, intermediate LT_{50} values occurred by Dodonaea, seeds of sour orange and mid-rib of cabbage leaf extracts (5.14, 5.51 and 6.32 days, respectively). Finally, the longer values occurred by turnip and mango-singara extracts (7.40 and 7.68 days, respectively).

III.b. Effect of 4^{th} instar treatments

Data in Table (2) indicated that shorter LT_{50} values occurred from pulp of sour orange and Dodonaea extracts, being (3.59 and 4.35 days, respectively), while the longer LT_{50} values (6.37 and 6.38 days) were recorded from mango-singara leaves and seeds of sour orange extracts, respectively.

LT_{50}'s resulted from the remaining treatments ranked intermediate site as (5.64 and 5.99 days) recorded from midrib of cabbage leaf and turnip extracts, respectively.

The previous results are considered important for controlling *S. littoralis* by Dodonaea and pulp of sour orange water extracts, for this reason the farmers cultivate Dodonaea around their gardens and the important role for pulp of sour orange extract obviously in this results which caused 80 & 75 and 60 & 80% mortality in 2^{nd} and 4^{th} instars of *S. littoralis* larvae, respectively.

The results obtained in this study is in agreement with that of Abdel-Aziz *et al.*, (1995) in which they found that the aqueous extract of Dodonae gave the highest larval mortality and reduction in pupation and fecundity when it was tested on the Egyptian cotton leafworm, *Spodoptera littoralis*. This is, also, supported by the finding of El-Din, M.M. and El-Gengaihi, S.E. (2000) evaluated extract of Dodonaea plants in the laboratory against *S. littoralis,* and stated that the mortality at the end of the larval stage was 90% at concentration 5% and gave 100% pupal mortality. Also, Mogahed and Gesraha (2005) found that *D. viscose* leaf extract reduced the infestation of cotton seedlings by *Aphis gossypii* and *Bemisia gossypiperda* (*B. tabaci)* and exhibited repellent effects on *B. tabaci*.

Table 1. Percentages mortality for the 2nd & 4th instar of *Spodoptera littoralis* larvae and averages of larval duration, pupal duration, pupal weight and adult longevity after treatment with different plant water extracts in the laboratory.

Treatments (water -extract)	2nd instar		4th instar		Mean of larval duration (days)	Mean of pupal duration (days)	Mean of pupal weight (gm)	Mean of adult longevity (days)
	% Mortality	% Reduction	% Mortality	% Reduction				
1. Leaf of dedonia	80	75	75	80	14	13	0.1979	4.3
2. Pulp of sour orange	60	66.7	80	81.3	13.5	15	0.1485	5.3
3. Seed of sour orange	60	66.7	70	78.6	15.5	14	0.1889	5.5
4. Midrib of cabbage leaf	70	71.4	50	70	15	13.5	0.1802	6.0
5. Root of turnip	60	66.7	50	70	15	14	0.1942	5.5
6. Leaf of mango-singara	50	60	50	70	17	11	0.2039	6.3
7. Control	20	-	15	-	19.5	9.5	0.2852	8.3

Table 2. LT_{50} values calculated after feeding *Spodoptera littoralis* 2^{nd} & 4^{th} instar larvae on castor oil, *Ricinnus communus* leaves treated with different materials.

Treatments (water -extract)	LT_{50} days With Concentration 10%		Slope		Confidence limits (Po 0.05)			
					LT_{50}		Slope	
	2^{nd}	4^{th}	2^{nd}	4^{th}	2^{nd}	4^{th}	2^{nd}	4^{th}
1. Leaf of dedonia	5.14	4.348	2.954	1.935	4.37 - 5.79	3.402 – 5.114	± 0.346	± 0.323
2. Pulp of sour orange	4.46	3.59	2.938	2.3356	3.63 – 5.11	1.64 – 3.137	± 0.454	± 0.341
3. Seed of sour orange	5.51	6.381	2.34	1.584	4.54 – 6.34	-	± 0.326	± 0.32
4. Midrib of cabbage leaf	6.32	5.645	2.52	4.352	5.44 – 7.25	5.184 – 6.151	± 0.426	± 0.494
5. Root of turnip	7.4	5.996	2.58	4.773	6.51 – 8.31	5.564 – 6.422	± 0.328	± 0.436
6. Leaf of mango-singara	7.68	6.369	4.371	3.775	-	5.847 – 6.92	± 0.358	± 0.394

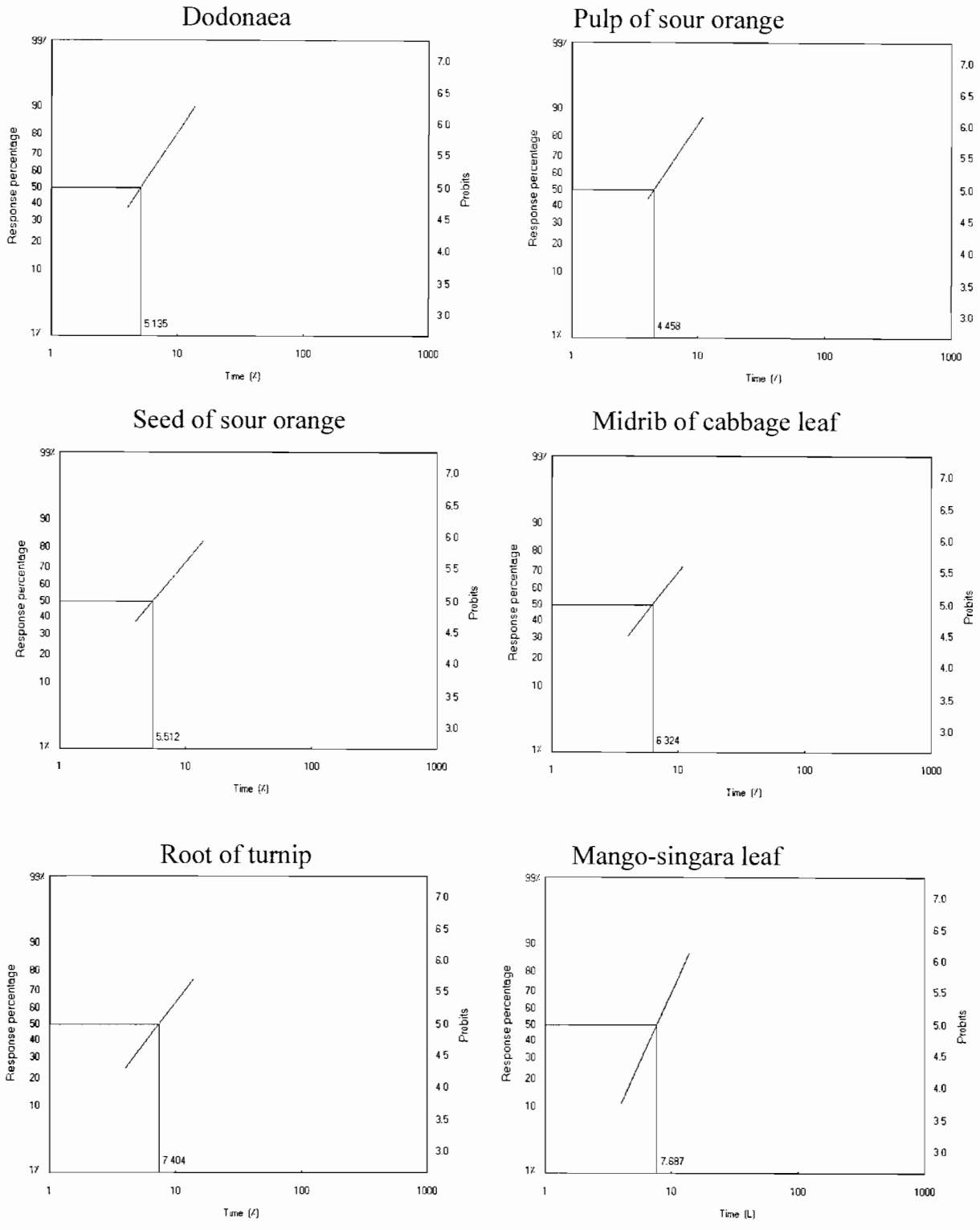

Fig 1. Probit-regression-time showing response of 2nd instar *S. littoralis* larvae fed on castor oil leaves treated with different plant extracts.

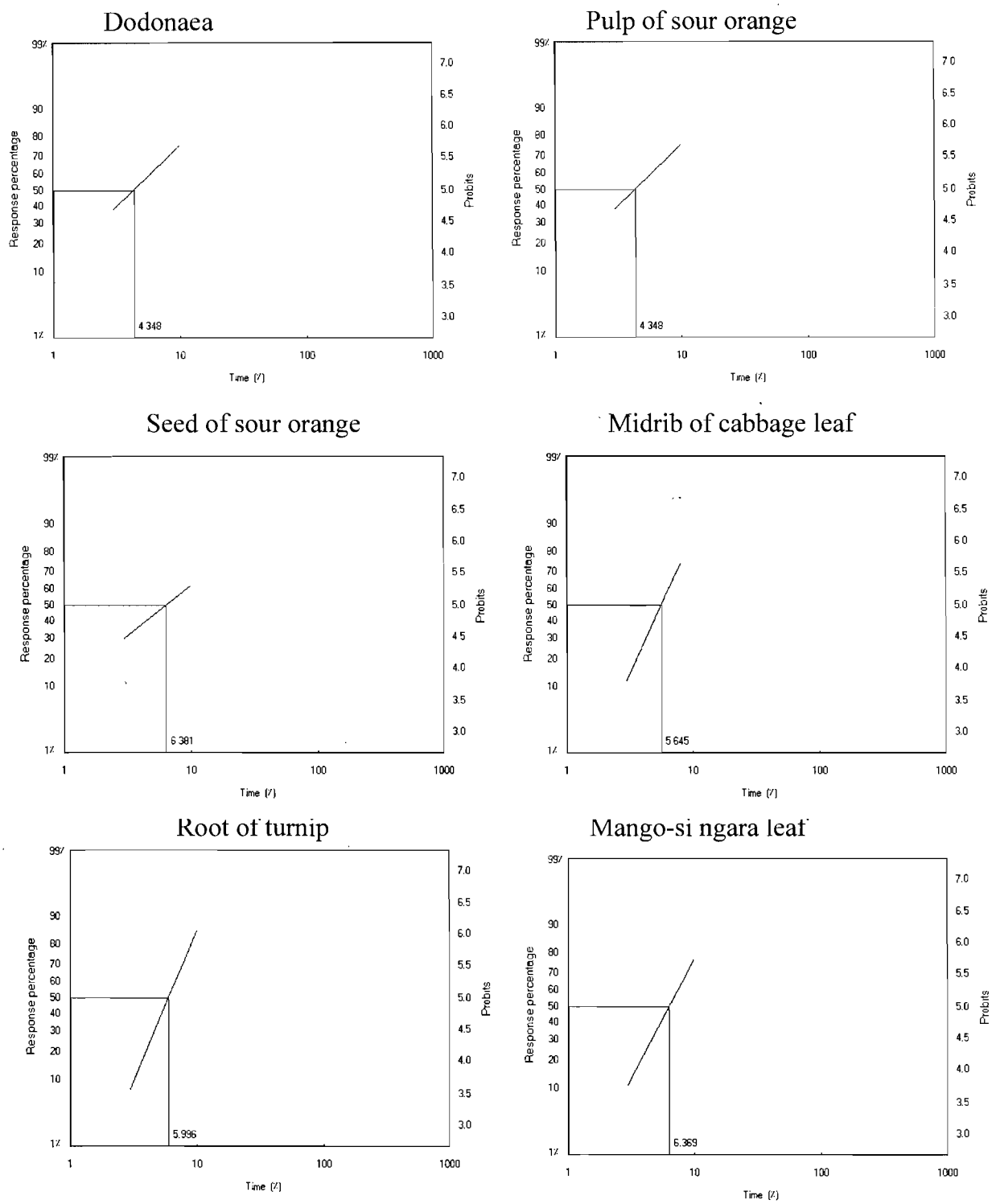

Fig 2. Probit-regression-time showing response of 4th instar *S. littoralis* larvae fed on castor oil leaves treated with different plant extracts.

REFERENCES

1. Abdel-Aziz, Shadia and E.A. Omer. 1995. Bio-evaluation of Dodonaeaa viscoza L. Jacq. extracts on the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) as indicated by life table parameters. Annals of Agric. Sci. Cairo, 40(2): 891 – 900.
2. Ahmad, T.R., 1988. Field studies on pheromone trapping of cotton leafworm *Spodoptera littoralis* (Boisd.) (Lep., Noctuidae). J. Appl. Ent. 105, 212 – 215.
3. Campion, D.G., B.W., Bettany, J.B., McGinnigle, L.R. Tailor. 1997. The distribution and migration of *Spodoptera littoralis* (Boisduval) (Lepidoptera, Noctuidae), in relation on Cyprus, interpreted from maps of pheromone trapa samples, Bull. Ent. Res. 67, 501 – 522.
4. El-Din, M.M. and S.E. El-Gengaihi. 2000. Joint of some botanical extracts against the Egyptian cotton leafworm *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae), Egyptian Journal of biological Society for Biological Control of pests, 10(1/2): 51 – 56.
5. Emara, M.M., A.G. El-Sisi and S.A. Mahmoud. 1994. Formulation and evaluation certain local natural products against Varroa a mites infesting Bee colonies. J. Agric. Sci. Mansoura Univ., 19(5): 1843 – 1850.
6. Hirmath, I.G., Y.J. Abn and S.I. Kim. 1997. Insecticidal activity of Indian plant extracts against *Nilaparvata lugens* (Homoptera: Delphacidae). Appl. Entomol. Zoll., (32): 159 – 166.
7. Khan, Z.R. and R.C. Saxena. 1986. Effect of steam distillate extracts of resistant and susceptible rice cultivars on behavior of *Sogatella furcifera* (Homoptera: Delphacidae). J. Econ. Entomol., 79: 928 – 935.
8. Litchfield, J.T. and F. Willcoxan. 1949. A simplified method of evaluating dose – effect experiment. J. Phamacol. And Exp. Therap. 96: 99 – 113.
9. Mogahed, M.I. and M.A. Gesraha. 2005. Efficacy of *Dodonaea viscoza* plant extrcact on some pests infesting cotton plants under field conditions.
10. Nasr, E.A., M.R. Tucker, D.G. Campion. 1984. Distribution of moths of the Egyptian leafworm *Spodoptera littoralis* (Boisduval) (Lepidoptera, Noctuidae) in the Nile Delta interpreted from catches in a pheromone trap network in relation to meteorological factors. Bull. Ent. Res. 74, 487 – 494.
11. Omar, A.M, A.H. El-Sherbiny, A.G. El-Sisi, M. Abdel-Moaty and A.A. Abdel-Hafez. 1994. Natural botanical extracts as repellents for the house sparrow, *Passer domesticus*. Annals of Agric. Sc. Moshtohor, Vol 32(2): 1043 – 1051.
12. Sadek, M.M. 2003. Antifeedant and toxic activity of *Adhatoda vasica* leaf extract against *Spodoptera littoralis* (Lep.: Noctuidae) J. Appl. Ent., 127(1): 396 – 404.
13. Yacoub, S.S. 2006. Efficacy of some plant extracts in controlling *Sesamia cretica* Led. and *Ostrinia nubilalis* (Hubn.) in maize fields. Phd, Fac. of Agric., Benha Univ.

سمية ستة مستخلصات نباتية مائية ضد دودة ورق القطن فى المعمل

شنـــوده سيـــد يعقـــوب و أمـــاني ســـامي الحفنى

معهد بحوث وقـــاية النباتات – مركز البحـــوث الزراعيـــة – الدقى – جيزة

اختبرت سمية ٦ مستخلصات نباتية مائية على العمرين الثاني والرابع ليرقات دودة ورق القطن تحت ظروف المعمل على درجة حرارة ٢٧ °م، ٥٥-٦٥% رطوبة نســبية، وهـــى أوراق نبـــات الدودونيا، لب وبذور ثمرة اللارنج، العرق الوسطى لأوراق الكـــرنب، وجذور اللفت، وأوراق شجرة المانجو صنف سنجارة. وحقق المستخلص المائى لكل من أوراق نبات الدودونيا ولب ثمرة اللارنج أعلى نسبة موت(٨٠ ، ٧٥%) في العمر اليرقى الثانى والرابع على الترتيب ونســبة نقــص ٧٥، ٨٠% عن المقارنة فى نفس العمرين .بالإضافة إلى ذلك أظهر المستخلص المائي للب ثمرة اللارنج تأثيرا أدى إلى تقصير فترة العمر اليرقى (١٣,٥ يوم)، وأدى أيضا إلى إطالة فترة العمـــر العـــذرى (١٥ يوم). بينما ايضا سجل أقل متوسط لوزن العذراى ٠,١٤٨٥ جم. وكانت أقل مدة لفتـــرة عمـــر الفراشة ٤,٣ يـــوم عند المعاملة بالمستخلص المائي لأوراق الدودونيا.

وأكدت نتائج الاختبارات الحيوية النتائج السابقة حيث كانت أقل فترة زمنية لازمة لقتل نصـــف تعداد اليرقات المعاملة ٤,٤٦، ٣,٥٩ يوم للعمر اليرقى الثاني والرابع على الترتيب كنتيجة للمعاملـــة بالمستخلص المائي لنبات الدودونيا ١٠%.