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Effect of some plant extracts on the larvae of Pieris rapae L. (Lepidoptera: Pieridae)

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Abstract: *Effect of four plant extracts (vinca, ak, neem and chinaberry) were evaluated against 3rd instar larvae of the cabbage worm, Pieris rapae L. (Lepidoptera; Pieridae). The data proved positive correlation between mortality rates of 3rd instar larvae of P. rapae L. and concentration of each extract (vinca, ak, chinaberry and neem). Also, the results indicated that, ak was the most effective plant extracts to larvae of P. rapae L. with LC50: 600.52 and LC90: 6824.409 ppm, while LC50 of neem, vinca and chinaberry extracts were 2355.603, 2623.907 and 3153.93 ppm, respectively; and LC90: 6824.409, 11758.833, 19534.269 and 33813.166 ppm, respectively*

Key words: *Plant protection, Plant extracts, Lepidoptera, Pieris raprae, larvae*

I. Introduction

The cabbage worm, *Pieris rapae* L. (Lepidoptera; Pieridae) is the most important foliar pest of Cole crops, occurring occasionally wherever crucifers are grown. The cabbage leaf worm develops on cabbage, cauliflower, broccoli, radish and turnip greens. This economic importance is due to the larvae make the leaves riddled with large holes of irregular shape and size and also cause stunt head (Kamal ,1937; El- Zoheiry, 1954 and Kamel, 1989).

II. Materials and Methods

- Rearing of *Pieris rapae* L

Larvae and pupae were collected from open field which is known as free of insecticides, reared in the laboratory then adults were maintained under semi- condition of greenhouse (big cage "200 × 250 × 300" cm). The source of food was naturally represented in balm plant (*Ocimum basilicum*), geranium (*Pelargonium gerveolens*) and rose (*Rosa gallica*). Leaves of *Brassicae oleracea* Linn. plant with eggs were transferred to jars (250 cc) and covered with pieces of thin mesh fixed in place with a rubber band. The hatched larvae were provided with fresh cabbage leaves, in incubator of 27± 2 °C and 60 ± 5 R.H. (Mona 1992) .

- Preparation of plant samples and extraction:

Leaves of vinca, ak and chinaberry plants were left to dry at room temperature for one month then they were grinded into fine powder. Also, the seeds of neem were grinded into fine powder in an electric mill. Powder of each plant was soaked in a mixture of hexane, acetone and ethanol solvents of equal proportion (1:1:1) in a flask for about one week.

Finally, the flasks shake in a shaker and its contents were filtered. The solvents were evaporated under reduced pressure; the crude extracts were weighted and kept in deep freezer until use.

- Preparing the Stock Solution of the Tested Plant Extracts:

Convenient stock concentrations of each extract were prepared on basis of the tested plant weight and the volume of the distilled water (w/v) in the presence of tween 80 (0.1%) as emulsifier. The stock concentrations were kept in glass stoppered bottles and stored under refrigeration. Four diluted concentrations for each plant extract were used to draw the LC-P Lines. Three replicates were used for each concentration.

- Methods of application:

Under laboratory conditions, cabbage leaves were dipped in the tested concentration and left to dry. The 3rd instar larvae were allowed to feed on the leaves. Three replicates for each concentration were made. Mortality was recorded daily for 7 days after treatment and the living ones of the treatment were examined daily until final mortality, and this mortality was calculated and corrected by (Abbott´s formula 1925). Data were plotted on log dosage Probit Papers and statistically analysed according to (Finney 1952).

The same technique was used with water only and the emulsifier as a control.

III. Results and Discussions

1- Effect of some plant extracts against 3rd larval instar of the cabbage leaf worm, *Pieris rapae* L.:

The present study concerned mainly with determination of the effect of some plant extracts which were leaves of (vinca, ak and chinaberry and neem) seeds in different solvents, these solvents were a mixture of hexane, acetone and ethanol, on the cabbage leaf worm.

Data showed a positive correlation between mortality rates of 3rd instar larvae of *P. rapae* L. and concentration of each extract (vinca, ak, chinaberry and neem) , whereas increasing of concentration for each extract caused increasing mortality rates. Calculated data after 1 day, 3 days and 7 days and in most cases, mortality rates were high in the 7th day.

Table (1) and **Fig. (1)** showed that after one day of the treatment, the increase in the used concentrations caused low mortality percentage among the treated larvae; the corrected mortality percentage after one day of vinca treatment ranged from 13.33 and 6.67 % by using the concentration (10000 and 15000 ppm.) and the plant extracts of ak and neem treatments (6.67and 13.33%) by using the concentration (5000 ppm.). The results revealed that the plant extracts of ak and chinabery had the highest larval mortality

reached 73.33% followed by neem 60% at concentration (10000ppm.) and the plant extract of vinca caused mortality 60% at concentration (5000 ppm.) after seven days from treatment. The cumulative mortality and malformations recorded during larval stages. For the tested plant extracts (vinca, ak, chinaberry and neem), the scores of larval mortality and malformations were positive correlation with increased concentration and mortality total of the seven days after treatment to reach (26.67 , 66.67 , 80 and 86.67%); (46.67,60.0,86.67 and 93.33%); (26.67, 60.0, 73.33 and 80%) and (26.67,53.33,73.33 and 86.67%) for the various plant extracts respectively, at the four concentrations.

Malformations occurred in the larvae treated with different concentrations of different plant extracts were illustrated in **Figs. (2 and 3**.)

2- Determination of LC_{50} of some plant extracts against 3rd instar larvae of the cabbage leaf worm *Pieris rapae* L.:

Data in **(Table: 2)** showed the efficiency of the plant extracts to larvae of *P. rapae* L.

Results indicated that, ak was the most effective plant extracts to larvae of *P. rapae* L. with LC_{50}: 600.52 and LC_{90}: 6824.409 ppm, while LC_{50} of neem, vinca and chinaberry extracts were 2355.603, 2623.907 and 3153.93 ppm, respectively, LC_{90}: 6824.409, 11758.833, 19534.269 and 33813.166 ppm, respectively.

Slope values indicated that, neem extract had a highest value 1.835 while vinca, chinaberry and ak had slope values: 1.47, 1.244 and 1.214, respectively.

Data also showed that the toxicity index (Ti= 100) at LC_{50} and LC_{90} which were: 100% and 100% for ak extract, respectively, while it recorded 25.493 & 58.036, 22.886 & 34.93 and 19.04 & 20.18% for neem, vinca and chinaberry, respectively.

Also, in the same table, data showed that, the mortality percentage recorded highest value in case of ak leaves extract which was 93.33% at concentration (10000 ppm) and 46.67% at concentration (500 ppm).

Neem seed extract recorded 86.67% at 10000 ppm and 26.67% at 1125 ppm. Vinca leaves extract recorded 86.67% at 15000 ppm and 26.67 % at 1000 ppm. While chinaberry leaves extract recorded 80% at 15000 ppm and 26.67% at 1000 ppm.

The LC_{90}/ LC_{50} confirm the value of this criterion recorded11.364, 10.721, 7.445 and 4.992 for ak, chinaberry, vinca and neem, respectively. Thus, the highest slope value or the lowest ratio LC_{90}/ LC_{50} means the steepest toxicity line.

3- Effect of some plant extracts at 5000 and 10000 ppm concentrations on the biological aspects of 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L.:

When the larvae treated with 5000 ppm of the tested extracts, the results in **Table (3)** and **Fig. (4)** showed that, ak extract increased the 3th larval duration followed by neem , vinca and chinaberry extracts to 3±0.4, 2.5±0.5, 2.5±0.5 and 2.17±0.44, respectively, compared with 2.05±0.05 for control. There was a significant difference between the treated larvae with ak extract and untreated.

The 4th larval duration averaged 4±1 ,2.75± 0.25, 2.5±0.5 and 2.17±0.44days for ak, vinca, neem and chinaberry, respectively compared with 2.05 days for the control. There were significant difference between the treated larvae with ak and vinca extracts and the untreated larvae.

The duration of 5th larval instar averaged 15.33±3.76, 9±1, 4±2 and 2.67±0.88 days for vinca, ak, chinaberry and neem extracts, respectively, compared with 2.05±0.05 days for control. The treated larvae with vinca and ak extracts had high significant values but they had significant value with chinaberry extract compared with untreated larvae.

Pre-pupal duration averaged 0.75±0.25 and 0.4±0.2 days for chinaberry and neem, respectively compared with 0.35±0.15 days for control , so there was a significant difference between the treated larvae with chinaberry extract and the untreated larvae, while the pupal duration averaged 10.5±1.5 and 4.67±2.03 days for neem and chinaberry extracts, respectively, compared with 4.25±0.25 days for control. Also, there was a significant difference between the treated larvae with neem extract and the untreated larvae.

When the larvae treated with 10000 ppm of the tested extracts, the results represented in **Table (4)** and **Fig. (5)** indicated that, chinaberry extract increased the 3th larval duration followed by ak , neem and vinca extracts to 2.75±0.25, 2.5±0.5, 2.25±0.25 and 2.25±0.25 compared with 2.05± 0.05 for control.

The duration of 4th instar averaged 5±1.41, 2.75±0.25, 2.5±0.5 and 2.25±0.25 days for ak, chinaberry, vinca and neem, respectively, compared with 2.5±0.5 days for control. There was a significant difference between the treated larvae with ak extract and the untreated larvae.

The duration of 5th larval instar averaged 9.67±1.45, 5.33±1.47 and 5±1 days for vinca, chinaberry and neem extracts, respectively, compared with 2.75±0.25 days for the control.

There were high significant difference between the treated larvae with vinca and chinaberry extracts and the untreated larvae but there was a significant difference between the treated larvae with neem and untreated.

Discussions

1- Toxicity of some plant extracts against 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L.

The results indicated that, ak was the most toxic plant extracts to larvae of *P. rapae* followed by neem, vinca and chinaberry.

These results, agreement with **Meisner *et al.* (1981)** who investigated vinca leaves extract which had significant effect on larvae of *Spodoptera littoralis*. **Chaudhry (1992)** reported that ak, neem and chinaberry extracts had significant mortality against *Plecoptera reflexa*. Also, **Meadow *et al.* (1999)** reported that neem extract had significant effects on larvae of *P. rapae* L

The results in contrast with results of **Khan and Siddiqui (1994)** who observed that neem seeds and chinaberry leaves were effective against larvae of *Pieris brassicae* than whole plant of ak extract. Our results proved that LC_{50} for neem was 2355.603 ppm and for chinaberry was 3153.93 ppm while LC_{50} of ak extract was 600.52 ppm.

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2- Effect of some plant extracts on biological aspects of cabbage leaf worm, *Pieris rapae* L.

The immature stages (4th, 5th pre- pupa and pupa) periods increased as the result of treatment of 3rd instar with 5000 ppm of vinca, ak, chinaberry and neem extracts to 2.75, 15.33, - , - days, 4, 9, -, - days, 2.17, 4, 0.75, 4.67 days and 2.5, 2.67, 0.4, 10.5 days, respectively, compared to 2.05, 2.05, 0.35, 4.25 days in the control for 4th instar,5th instar, pre-pupa and pupa. While the immature stages (4th & 5th instars) periods varied when the 3rd instar larvae treated with 10000 ppm of the extract. In the 4th instar, vinca extract did not affect this period which was 2.5 days but neem extract decreased this period to 2.25 days while ak and chinaberry extracts increased this period to 5 and 2.75 days compared with 2.5 days for control. The 5th instar period increased when 3rd instar larvae treated with vinca, chinaberry and neem extracts to 9.67, 5.33 and 5 days , respectively, compared with 2.75 days for control.

These results agreement with results of **El- Sayed (1982 a)** which showed that the treatment of larvae of Spodoptera littoralis with Azadirachta indica caused high mortality rate of larvae, pupal mortality and malformed adult emergence. **Parbhaker *et al*. (1986)** found that neem seed extract caused prolongation in the development, larval mortality and no pupation of *S. exigua* and *Trichoplusia ni.*

IV. CONCLUSIONS

In conclusion, the results obtained in this investigations may encourage further research of practical nature for cabbage leaf worm control in future. Ak extract was recommended in control of this pest. Similar conclusion was previously reported by Chaudhry (1992) & Ibrahim (2001)

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(Tables and figures are shown in next pages)

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Table (1): Corrected mortality % of 3rd instar larvae of the cabbage leaf worm, *Pieris rapae* L. treated with some plant extracts under laboratory conditions 27±2C°and 65±5%RH.

No.	Treatments	Conc. ppm.	Mortality after treatment. %			Total Mortality%
			One day	Three days	Seven days	
1-	Vinca.	1000	---------	13.33	13.33	26.67
		5000	---------	6.67	60.00	66.67
		10000	13.33	13.33	53.33	80.00
		15000	6.67	26.67	53.33	86.67
2-	Ak	500	----------	13.33	33.33	46.67
		1000	----------	33.33	26.67	60.00
		5000	6.67	26.67	53.33	86.67
		10000	----------	20.00	73.33	93.33
3-	Chinaberry	1000	----------	13.33	13.33	26.67
		5000	----------	----------	60.00	60.00
		10000	----------	----------	73.33	73.33
		15000	----------	13.33	66.67	80.00
4-	Neem	1125	----------	----------	26.67	26.67
		2500	----------	26.67	26.67	53.33
		5000	13.33	33.33	26.67	73.33
		10000	----------	26.67	60.00	86.67

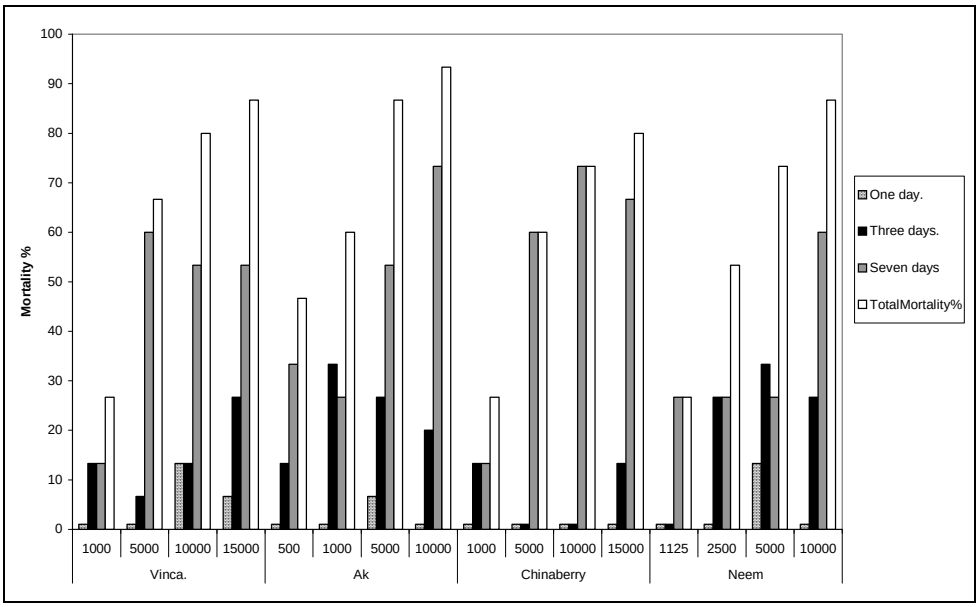

Fig (1): Corrected mortality% of 3rd instar larvae of the cabbage leaf worm, *Pieris rapae* L. treated with some plant extracts under laboratory conditions 27±2C°and65±5%RH

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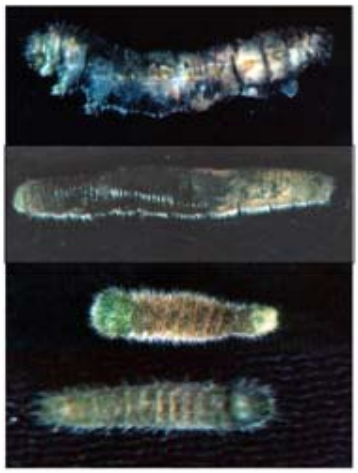

Fig (2): Malformations in the 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L. treated with ak extract.

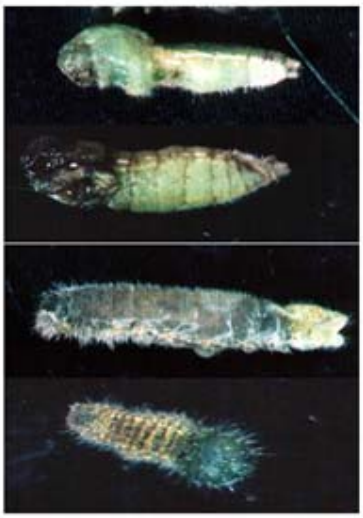

Fig (3) Malformations in the 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L. treated with neem extract.

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Table (2): Efficiency of some plant extracts against 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L . R: Regression, P: Probability

Treatment	Conc.	Corrected mortality %	Lc_{50}	Lc_{90}	Slope +S.D.	Toxicity Index		Lc_{50}/Lc_{90}	R	P
						Lc_{50}	Lc_{90}			
Vinca	1000	26.67	2623.907	19534.269	1.47± 0.157	22.886	34.93	7.445	1	0.983
	5000	66.67								
	10000	80.00								
	15000	86.67								
Ak	500	46.67	600.52	6824.409	1.214± 0.148	100	100	11.364	1	0.982
	1000	60.00								
	5000	86.67								
	10000	93.33								
Chinaberry	1000	26.67	3153.93	33813.166	1.244± 0.152	19.04	20.18	10.721	1	0.9993
	5000	60.00								
	10000	73.33								
	15000	80.00								
Neem	1125	26.67	2355.603	11758.833	1.835± 0.205	25.493	58.036	4.992	0.999	0.883
	2500	53.33								
	5000	73.33								
	10000	86.67								

Table (3): Effect of some plant extracts on biological aspects of 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L.

Developmental stages	Control	Duration of different stages at 5000 ppm in (days)				L.S.D.
		Vinca	Ak	Chinaberry	Neem	
3rd instar	2.05± 0.05	2.5 ± 0.5	3* ±0.4	2.17 ± 0.44	2.5± 0.5	0. 678
4th instar	2.05± 0.05	2.75*± 0.25	4* ± 1	2.17± 0.44	2.5± 0.5	0. 538
5th instar	2.05± 0.05	15.33**± 3.76	9* *±1	4*± 2	2.67±0. 88	0. 621
Pre-pupa	0.35± 0.15	-	-	0.75*± 0.25	0.4± 0.2	0. 196
Pupa	4.25± 0.25	-	-	4.67± 2.03	10.5** ±1.5	1. 22

*** Significant, ** High significant**

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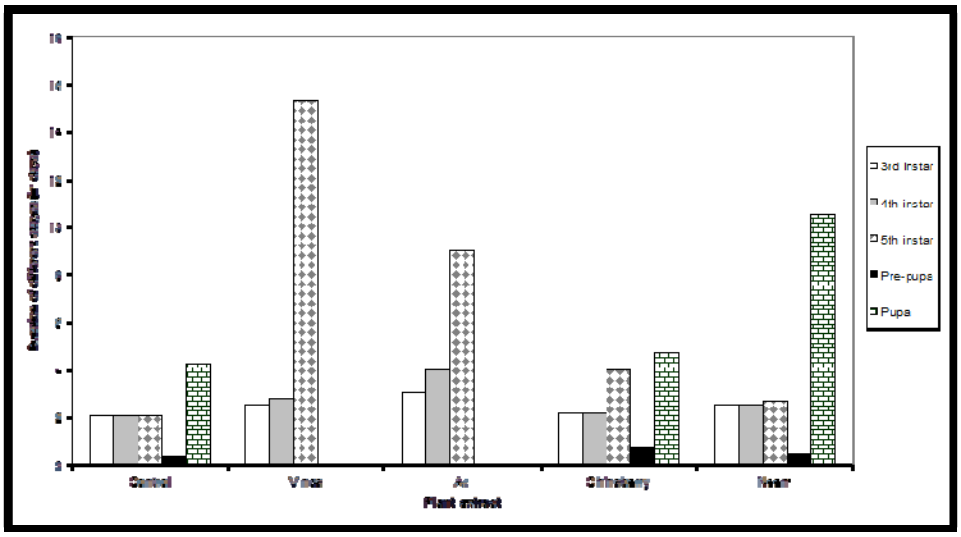

Fig (4): Effect of some plant extracts on the biological aspects of 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L. (5000 ppm).

Table (4): Effect of some plant extracts on the biological aspects of 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L.

Developmental stages	Control	Duration of different stages at 10000 ppm in (days)				L.S.D.
		Vinca	Ak	Chinaberry	Neem	
3rd instar	2.05±0.05	2.25± 0.25	2.5±0.5	2.75± 0.25	2.25±0.5	0.862
4th instar	2.5±0.5	2.5±0.5	5*±1.41	2.75± 0.25	2.25±0.5	1.037
5th instar	2.75±0.25	9.67**±1.45	-	5.33**±1.47	5*± 1	1.085

***Significant, ** High significant**

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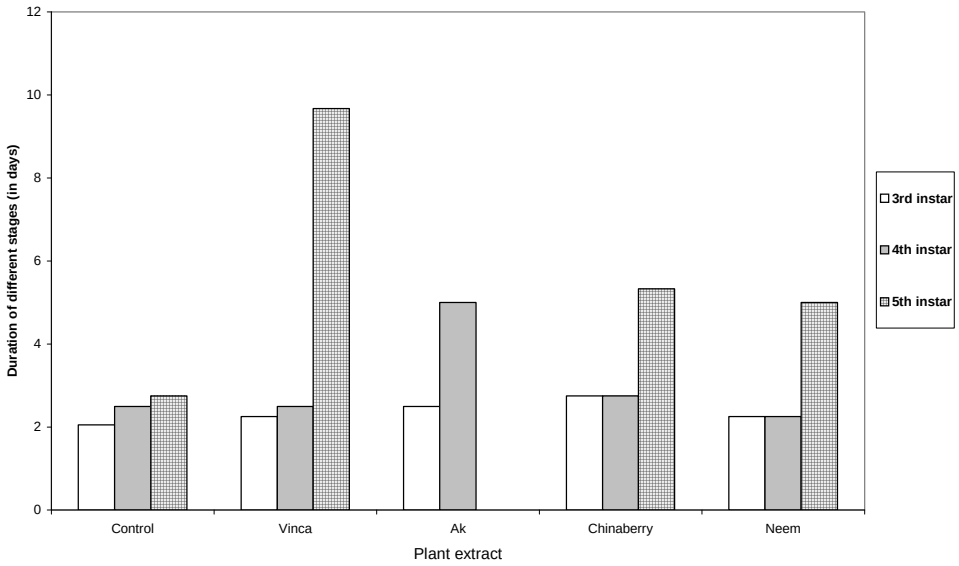

Fig. (5): Effect of some plant extracts on the biological aspects of 3rd instar larvae of cabbage leaf worm, *Pieris rapae* L (10000 ppm).

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