TOXICITY OF SOME BOTANICAL MATERIALS FORMULATIONS AGAINST APHIDS INFESTED BEAN PLANTS

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ABSTRACT

Three plant materials :two synthetic botanical materials, camphour and citric acid and one fixed oil; castor been oil were formulated as concentrated emulsion: (EO) for castor and EW for camphor except citric acid formulated as soluble liquid (SL) formulation. Toxicity of the prepared formulations was determined against aphid, *Aphis craccivora* (Koch) using slide -dip technique and their efficiency was determined against sucking pierce pest infested bean plants, which was: Aphids *Aphis craccivora* under field conditions.

Results of the tested formulations against aphid, *A. craccivora* indicated that all the tested formulation showed suitable toxicity against aphid LC_{50}'s values: Citric acid showed the highest toxicity (16.41 p.p.m.) followed by (72.33 p.p.m.) and castor (321.14 p.p.m.). Semi-field experiment indicated that fixed oil, castor oil; synthetic botanical materials; camphor and citric acid at concentration 2% (v./v.) showed successful results against sucking-pierce pest: aphid *A. craccivora* and suitable initial and residual effects.

Keywords: bean plant – aphid – botanical material – toxicity - insecticidal efficiency.

INTRODUCTION

Bean (*Phaseoula vulgaris*) is considered one of the most important vegetable Crops for local consumption and export and food crops since it

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contain a high amount of protein and other food elements. Unfortunately, been infested with many pests which affects yield quantity and quality, between of those pests: sucking pierce pest such as aphid sucking the plant juice and transmitting several plant virus diseases also cause honey dew of upper surface of leaves that cause germination of toxic fungus black mold.

Use of botanical pesticides/natural plant products in an agroecosystem is now emerging as one of the prime means to protect crop production and the environment from Pesticidal pollution, which is global problem. Previous studies indicated that locally formulation of some plant oils (Fixed or volatile), also, synthetic botanical chemical proved high pesticidal efficiency against sucking pierce pests infested vegetable crops (Kazem, 2004; Genedy 2010 and 2016).

Neem, eucalyptus; aqueous extracts of neem, basil, and garlic leaves; and water were evaluated at field conditions for controlling aphids *Aphis craccivora* infested been lablab. The treatments were applied at 7 day intervals and aphid abundance per inflorescence was counted at 24, 48, and 72 h after treatment. All the plant materials reduced aphid abundance and flower infestation, ensuring a higher yield with larger and heavier pods. The neem oil treatment had the lowest abundance of aphid and consequently produced the highest marketable and gross yields. The plant materials have insecticidal potential against aphids, Ahmed *et al.*, (2019).

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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Therefore, this study was performed to investigate the effect of some environmentally safe botanical materials against pests infesting beans crop as local alternatives to traditional pesticides which are imported and environmentally harmful and expensive.

MATERIALS AND METHODS

Materials:

1.1- Plant oils (fixed oils):

a. Fixed oils: castor oil was obtained by cold

1.2 - Synthetic botanical material:

a. Camphor (99%):

- IUPAC name: (1,7,7-Tri methyl bicycle [2.2.1] heptan-2-One).
- Produced by: S.D. (Fine. Hem. limited), India. Supplied by: El-Goumhouria Co. Cairo, Egypt.

b. Citric acid

- IUPACname: 2-hydroxypropane-1,2,3-tricarboxylic acid.

Citric acid is a weak organic acid Produced by: El- Nasr-Pharmaceutical Chemicals Co. Egypt.

1.3- Emulsifying agent: SiSi 6 (Potassium sulphonate 10%). It is an anionic surfactant prepared by neutralization of sulphonic acid with suitable alkaline each litre contain 100g a. i. in water.

1.4- Preparation of botanical materials as suitable formulations

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Emulsifier sisi-6 (10% a.i in water) was used for preparation the following botanical materials as suitable Formulation stocks concentrated emulsion: camphour 25% and castor 75% (v./v.) while citric acid was prepared as soluble liquid 50 % (v./v.).

2.1-Toxicity of the prepared formulations against aphids, *Aphis craccivora* under laboratory condition:

The adults of aphid, *Aphis craccivora* were exposed to different concentrations (1, 0.1, 0.01 and .001%) of the formulations under laboratory conditions using slide dipping technique described *by* Stirbly, *et al.*, (1983). By means of a stereomicroscope and moisted fine Bruch (30) adult females were affixed to double faced scotch tape stuck tightly to side on the dorsal part, the slides were then dipped into the solution for 10 seconds and the excess was blotted of with filter paper. Each formulated material was tested by four different concentrations and three replicates for each concentration, the same technique was used with the control treatment using water. The average percent mortality was recorded four hours after treatment. The percentage mortalities were corrected by using Abbott, Formula (1925). The mortality was subjected to statistical analysis.

$$\text{Corrected mortality \% } = x\ 100\ \frac{\text{Observed mortality \% } - \text{Control mortality \%}}{100 - \text{Control mortalty\%}}$$

Computed percent mortalities were plotted versus the corresponding concentrations on logarithmic probability paper to obtain the corresponding log-concentration Probit (LC-p) lines were drawn up. LC_{50}'s, LC_{90}'s were

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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calculated, slope was determined from the established regression lines. Toxicity indexes was calculated according to Sun (1950) equations:

$$\text{Toxicity index} = \frac{LC_{50} \text{ of the most toxic material}}{LC_{50} \text{ of tested material}} \times 100$$

2.3- Efficiency of the tested formulated against piercing and sucking aphid infested bean plants in field:

Field experiments was carried out to evaluate the efficacy of formulated botanical martials against aphids infesting bean plants, *Phaseolus vulgaris* (Emy) during 25/10/ 2019 growing season at, Agricultural Research Center (A.R.C.), (Dokki- Giza). The experimental area was divided according to the complete randomized block design including three replicates for each concentration and each replicate have 3 rows with 5 meter long. The experiment was carried out according to Ministry of Agriculture Protocols (1993) but at small scale, concentrations of 0.5, 1.0, 1.5 and 2 % (V/V) in addition control were applied to each formulation.

All treatments were applied by knapsack sprayer one litter capacity equipped with one nozzle. the applicat1ions started when the infestation reached about 10 pests/ leaf. Pre and post treatments populations of *Aphis craccivora* Koch determined on 10 leaves picked up at random before spraying and after 1, 3, 5 and 7days of treatment. Population reductions were estimated according to Henderson and Tilton (1955).

$$\% \textbf{ reduction in infestation} = I00 \times \left[1 - \frac{Ta \times Cb}{Tb \times Ca}\right]$$

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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Whereas:

Tb = the number of alive individual pests recorded before treatment for treated.

Ta = the number of alive individual pests recorded after treatment.

Ca = the number of alive individual pests recorded from the check control after treatment.

Cb = the number of alive individual pests recorded from the check control before treatment.

2.4 Statistical analysis: Obtained data were statistically analyzed as the method of Finney, (1971).

RESULTS AND DISCUSSION

Toxicity of the different formulation against aphid, *Aphis craccivora*:

Toxicity of formulated botanical materials against leguminous aphid, *Aphis craccivora* using slide-dip technique, was shown in tables (1) and figures (1) and (2).

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Table (1): Mortality percentage of the prepared botanical materials against aphid, *Aphis craccivora*

Treatment	Concentration ppm	Mortality%
Camphour 25%	2500	73.33
	250	56.66
	25	43.33
	2.5	30
Citric acid 50%	5000	71
	500	66
	50	63.3
	5	39
Castor 75%	7500	73.33
	750	46.66
	75	43.33
	7.5	30

Data in table (1) showed suitable toxicity against aphids as indicated by LC_{50}'s values LC_{50} and LC_{90} at camphor were 72.38% and 198.58. The lethal concentration recorded 16.41 p.p.m. and 137.14 p.p.m at citric acid. While LC_{50} and LC_{90} were 321 p.p.m and 155.66 p.p.m. at castor oil. The toxicity against aphid 100 followed by camphor 22.67 and castor oil 5.1.

Results of botanical materials were agreed with kazem (2004) Genedy (2010) and Genedy (2016) findings against aphids. Also, comply with Lee *et al.* (2001 a, b) on their studying fumigant toxicity of nature products against stored grain pests.

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

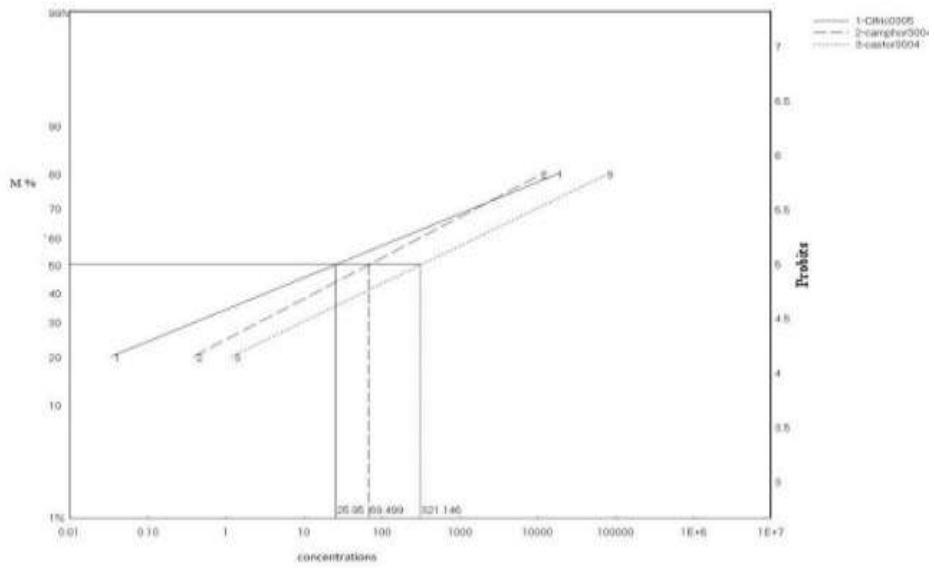

Fig (1): Toxicity lines of the tested materials against aphid, *Aphis craccivora*

Table (2): Toxicity of formulation botanical materials against aphid, *Aphis craccivora*

Treatment	LC50	LC90	Slope	Toxicity Index
Camphor	72.38	198.58	0.37	22.67
Citric acid	16.41	137.14	0.26	100
castor	321.14	155.66	0.34	5.1

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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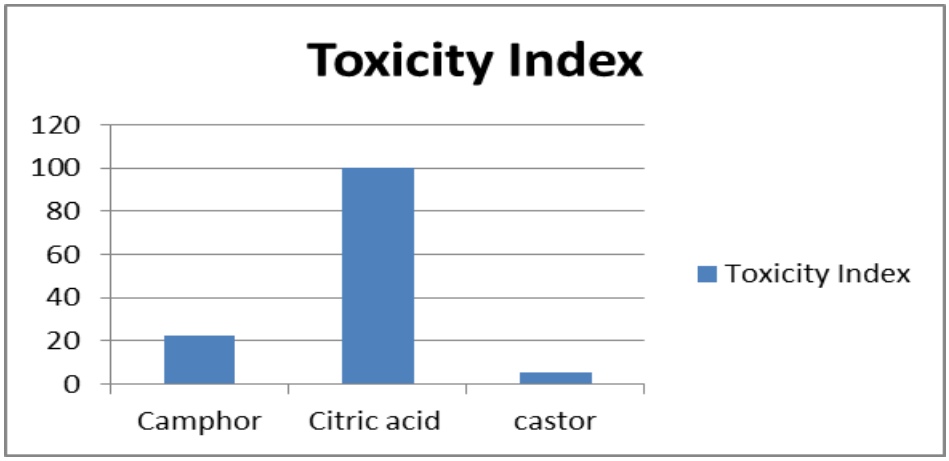

Fig (2): Toxicity index of the locally formulation botanical materials against aphid, *Aphis craccivora***Efficiency of three tested formulations aphid, *A. craccivora* infested bean plant in field:**

Data in table (2) showed that camphor formulation 2% V.V cause 77% reduction in aphid population after one day reach to mean 94% at residual effect after 7 days. The residual effect records 89.8% and 74.63 reeducation percent at 1.5% and 1% camphor concentration. Concentration of citric acid 2% V.V. gave 72% in population reduction at initial effect and the main reduction of residual were 90.33% after 7 days. while the concentration 1.5% and 1% gave 61.3 and 41.3% reduction percent. In the end concentration of castor oil 2%, 1.5% and 1% recorded mortality percent (75.0%, 35.94 and 30.8) and (88.67%, 49.3% and 43.07%) at the initial effect and residual effect. The highest effect of all camphor concentration recorded after five

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

days from treatment in residual effect compare with concentrations of citric acid and castor oil formulation recorded after seven days.

According to Ministry of Agriculture recommendations for natural materials, the successful material should give initial effect ≥ 70 % mean and residual effect ≥ 40 %. Since the tested materials considered as a natural material, therefore the obtained results will be discussed according to this rule.

About the Pesticidal efficiency against aphid indicated that the effect increased as both concentrations and period after application increased, all tested materials at concentration 2% gave suitable initial effect, as they gave ≥ 70% reduction and all materials at 1.5 % and 2% gave suitable residual effect since they gave residual effect ≥ 40% as recommended by Ministry of Agriculture.

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
ONLINE ISSN 2636 - 3178

Table (3): Efficiency of formulated material against aphids under field

Treatment	Conc.% (v./v.)	Initial after 1 day %R	Residual (%R)			Total % R	Mean % R
			after 3 days	after 5 days	after 7 days		
Camphour	0.50	12.55	19.49	40.65	38.88	99.02	33.01
	1.00	31.20	60.90	87.67	75.27	223.85	74.62
	1.50	37.08	80.86	97.17	89.23	267.25	89.08
	2.00	77.00	90.00	97.00	95.00	282.00	94.00
Citric acid	0.50	25.05	36.26	38.13	43.85	118.24	39.41
	1.00	27.82	37.01	40.96	45.93	123.90	41.30
	1.50	32.18	49.68	55.06	79.14	183.89	61.30
	2.00	72.00	89.00	90.00	92.00	271.00	90.33
Castor	0.50	22.67	38.71	41.99	44.82	125.52	41.84
	1.00	30.18	39.99	43.70	45.52	129.21	43.07
	1.50	35.94	45.28	47.84	54.89	148.01	49.34
	2.00	75.00	85.00	87.00	94.00	266.00	88.67

R= reduction percentage according to Henderson and Tilton (1955) equation

The results obtained agree with Mousa and El-Sisi, (2001) findings for citric acid against piercing and sucking pests, urticae infested squash crop. The results indicated that citric acid showed high initial effect against eggs and moving stages of *T. urticae.*

The pervious data are also in agreement with Kazem (2004) who evaluated some fixed oils such as linseed alone and castor oil at 3.5% in the field against aphid, *Aphis gossypii*, infested squash seedlings. The results

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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indicated that the residual toxicity of linseed oil at 3.5% was100% after 1 day and significantly reduced the number of cotton aphids adults up to 7.

Also, results agree with Nerio *et al.* (2007) on their studying the repellent effect of essential oils.

On the other hand, the obtained results are in agreement with Gnedy, (2010) who determined the pestecidal efficiency of formulated essential oils (clove, onion, chamomile, citronella and lemongrass) against several insects. The data showed that the concentration of 1.5% considered the best for controlling thrips, mites and aphids on bean plants since it gave initial effect ≥ 70% and residual effect ≥ 40% reduction. So, the onion oil was the most effect than the other oils alone against thrips and mites since it gave (98.9 and 94.8%) reduction, respectively.

Finally, the results comply with Ahmed *et al*. (2019) in their studying the effect of plant materials against aphid on bean fields.

The mode of action of camphor may be due to one or more of the following:

The mood of action of camphor maybe due to respiration effect and inhibition of acetyl choline esterase (put the name of the researchers). Beside this repellent affect as mentioned by Nerio *et al.* (2007)

While citric acid may cause death to both egg and other stages as a result of making the spray solution acidic then the nutrient medium of pests

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becomes acidic and making the target media unsuitable for pest surviving (Abou-Lila *et al*., 1992).

Castor oil is considered a physical poison that interfere with insect respiration then cause death as a result of suffocation effect (De Ong *et al*., 1922), also as a result of causing cell membrane disruption (Hedgson and Kuhr, 1990) and for its containing the toxicant ricinic acid (Rubatzky and Yamagucbi, 1997).

Table (4): The result of analysis of variance (SPSS program of Statistical analysis)

Tests of Between-Subjects Effects					
Dependent Variable: reduction					
Source	**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
Corrected Model	22347.457[a]	11	2031.587	9.999	.000
Intercept	153716.549	1	153716.549	756.595	.000
Compounds	1464.462	2	732.231	3.604	.037
Conc	18505.770	3	6168.590	30.362	.000
compounds * conc	2377.224	6	396.204	1.950	.099
Error	7314.083	36	203.169		
Total	183378.089	48			
Corrected Total	29661.540	47			

Table (4) showed that there was significance between the tested materials (F value is 3.604 comparing with the tabulate F (0.03)). Also, when comparing the concentrations of each compound gave high significant (F value is 30.362 comparing with the tabulate F 0.00). Otherwise there was no significant for the interaction between compounds and concentration under test of (F value is 1.95 comparing with the tabulate F 0.099).

Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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As a general conclusion, all tested materials at concentration 2% (v. / v.) were succeeded against aphid infested been plants without showing any phytotoxic effect on treated With the possibility using it was natural pesticide that one effect on aphid and reduce the manufacture pesticides to protect the environment.

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Vol. (51); Iss. (2); No. (7); Feb. 2022
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Vol. (51); Iss. (2); No. (7); Feb. 2022
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Vol. (51); Iss. (2); No. (7); Feb. 2022
ISSN 1110-0826
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النشاط الابادى لبعض المواد النباتية المجهزة على صورة مستحضرات ضد المن التى تصيب نباتات الفاصوليا

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المستخلص

تم تحضير ثلاث مواد نباتية: اثنين من اصل نباتي مخلقة صناعيا وهى الكامفور وحمض الستريك، وزيت نباتى ثابت هو زيت الخروع على صورة مستحضرات حيث تم تحضير كل المواد فيما عدا حمض الستريك على صوره مستحلبات مركزه فى حين ان حمض الستريك تم تجهيزه على صوره سائل قابل للذوبان فى الماء .تم تقدير سمية المواد معمليا ضد من البقوليات وتم حساب النسبة المئوية للموت ورسم خطوط السمية وحساب كل من التركيز القاتل ٥٠% من الافراد وكذلك مدلول السمية لكل المواد كما تم تقدير كفائتها الابادية حقليا ضد من البقوليات على محصول الفاصوليا طبقا لبرتوكول وزاره الزراعة لكن على نطاق اصغر.

دلت نتائج السمية على ان كل المواد النباتية المجهره على صوره مستحضرات اظهرت سمية مناسبة ضد المن كما هو موضح من قيم التركيز القاتل لنصف الافراد المختبره وقد اظهر حمض الستريك اعلى قيمية للسمية ضد المن يلية كامفور، الخروع. دلت نتائج التجربة المشابهة للحقل على ان الزيت الثابت زيت الخروع والمواد النباتية المخلقة: الكامفور وحمض الستريك عند تركيز ٢% (حجم/حجم) اظهرت تاثير ناجح ضد المنْ كافة ثاقبة الماصة الموجوده على الفاصوليا حيث اظهرت تاثير اولى وتاثير متبقى مطابق لتوصيات وزاره الزراعة وبدون ان يظهر اى سمية نباتية على الفاصوليا.

الكلمات الدالة: الفاصوليا – المنْ – المستخلصات النباتية – السمية – كفاءة الابادة.

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