FIELD EVALUATION OF SOME NON-CONVENTIONAL PESTICIDES ON FABA BEAN LEAF MINER AND ASSOCIATED PARASITOIDS

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Abstract

A field experiment was conducted to evaluate the efficiency of some non-conventional pesticides against the leaf miner, *Liriomyza trifolii* (Burgess) and its parasitoids on faba bean plants from November 2013 to March 2014. There were seven treatments *viz*, *Beauvaria bassiana* (biopower), diathane-M45, mineral oils (KZ and Kappi), (ethanol and ethyl acetate extracts of casuarina leaves) and untreated control.. The results showed that, amongest the pesticides tested, Biopower 1.15%wp significantly reduced larvae population of leafminer by 83.54 and 79.48% mean percent mortality after the first spray and the second spray, respectively. Followed by ethanol extract of casuarina (63.51 and 60.49%). The rest of the treatments *viz* diathane M-45 (64.62 and 18.30), KZ oil (26.9 and 7.48%), also effective in minimizing the pest population after the first and the second spray application, respectively. Parasitoid species reared from larvae of *L.trifoli werei*, *Diglyphus isaea* (Walk.), *D.crassinveris* (Erdos.), *Chrysocharis* sp., *Neochrysocharis* sp. and *Hemiptarsenus* sp. (Hymenoptera: Eulophidae). Significantly higher seed yields were recorded from biopower, Diathane and ethanol casuarina leaves extract plots as compared to yields from KZ oil, ethyl acetate extract, kappi oil and untreated control .

Key words: *L. trifolii*, mineral oils, casuarina extract, parasitoids, Faba bean.

INTRODUCTION

Faba bean, *Vicia faba* L. is considered the most important legume crop due to its high nutritive value it is primary source of protein for grown from seed in Egypt for the majority of people. Faba bean plants are attacked by several insect pests.

The leaf miners, *Liriomyza* spp. [Diptera: Agromyzidae] are among the most damaging insects of the many insects associated with field crops, the serious pests on field crops, vegetables and ornamental plants all over the world. The faba bean leaf miner, *L. trifolii* is basically an invasive pest to Egypt's agro-climate and recorded as a harmful and wide spread on faba bean (El-Hemaesy, *et al*. 1974, Aly and Makady, 1990). It is indigenous to the new world, but has extended its geographical range to Asia, Africa and Europe (Saito, 1997).

L. trifolii larvae cause direct injury for the leaves as tunneling into the soft plant tissue causing, the characteristic serpentine "leaf mines" which are externally visible as whitish grey trick up of variable shape as result of feeding on the mesophyll tissues between the epidermal layers of leaves and subsequently reduce photosynthesis potential (Ledieu and Helyer, 1985).

The different biocides control against the leaf miners *Liriomyza* spp., significantly, reduced the number of larvae such as the fungicide, diathane-M45 on faba bean (Ibrahim and Abd-El-Moiety 1997),. Likewise, the toxicity of *Casuarina equisetifolia* leaf extracts against the spiny bollworm *Earias insulana* (Boisd.) caused the highest reduction percentage (57.14%) in larval infestation (Zaki, 2012). In the same direction, the use of summer mineral oil (KZ 1%) against the citrus leaf miner, *Phyllocnists citrella* achieved the highest percentage reduction by the recommended rate.

Hymenopterous parasitoids reared from *L. trifolii* were, *Opius* sp. (Braconidae) El-Serwy (1993), *Chrysonotomyia sp.* (Eulophidae) also, *Halticoptera sp*. (Pteromalidae) Metwally (1991),El-Serwy (1993) and Shahin and El-Maghraby (1993) Extensive studies have been continuously encouraged and developed in the field of biological control of insect pests using many bio-control agents. Recent control strategies depend principally on knowing pest natural enemies relationship.

Use of insecticide is found one of the most effective ways to control leaf miner (Gerling 1986). But due to injudicious application, leaf miner had already acquired resistance to insecticides moreover, extensive chemical control often caused population resurgence due to a negative impact on natural enemies (Parrella and Jones, 1987).

The present work aimed to evaluate and throw light on the impact of the non-conventional pesticides against *L. triofolii*, and also their positive or negative efficiency on associated on *L. trifolii* parasitoids, in addition to determine the economic efficiency on the resultant yield.

MATERIALS AND METHODS

I- Field preparation and foliar spray experiments:

The present experiment was carried out throughout growing season of faba bean 2013/2014 at Experimental farm Research Station of Faculty of Agriculture at Moshtohor, Benha University. An area of about ¼ feddan (4200m^2) was sown with common commercial variety seeds of faba bean, Giza 3 on November, 11th 2013. The area was divided into 28 plots, each of 2.5m×3m. The experimental plots were

arranged in complete randomized block design. Four replicates per treatment, four lines for each. All agricultural practices were followed without using any chemicals. Each of the following treatments and extracts were applied:

1. Biopower (1.15% WP), *Beauvaria bassiana* entomopathogenic fungus. (1×10^8CFU/gm).
2. KZ oil-mineral oil (95% E.C.).
3. Kappi oil-mineral oil (96.5% E.C.).
4. Dithane M45:Fungicide (Manganes ethylene bis) dithiocarbamate Polymeric complex with zinc salt
5. Extract of dried Casuarina leaves in ethanol 95% .
6. Extract of dried Casuarina leaves in ethyl acetate.
7. Untreated control .

Applications of the assayed materials took place by using five liters hand sprayer. The pesticides application were done twice on 25 November and on 25 December. There was non-treated buffer zone of 1m between each plots to prevent spay drift to adjacent plots. Faba bean plants were examined after two weeks from sowing then weekly until harvesting date. 25 leaflets for each replicate were randomly picked before spraying and after 7, 14 and 21 days from each application and transferred to the laboratory in paper bags for inspection by the aid of stereo-microscope and live larval counts were recorded.

II. Preparation of crude extracts:

Extractions were prepared as described by Afifi, *et al.* (1988). Fully grown green leaves of *Casuarina equisetifolia* were washed thoroughly by water and air dried in shade under laboratory conditions. The tested parts were ground in a high speed grinder. Every 50 gram of leaves powder was weighed, then put in (250 ml glass jar), to be extracted by different organic solvents (Ethyl alcohol 95% and ethyl acetate)The solvent was added at rate of 1 (gm powder): 2 (cm^3 solvent). Jars were tightly closed to prevent solvent evaporation ,then kept for 7 days in freezer, at – 4± 1°C. The glass jars were shacked for 10 min. before being filtered. Filtration took place through funnel containing a piece of muslin cloth. The Petri-dishes used for receiving the plant extract were weighed, then left until dryness,then peti-dishes were weighed. The crude extract was,then, prepared at concentration 8000 µg / ml for both solvents. The crude extract was kept in refrigerator at 4 $^\circ$C until time of application in the field.

III - Parasitoids on *L. trifolii* larvae:

To evaluate the effect of the previous treatments on the different parasitoids throughout experimental season, large number of *L. trifolii* larvae were collected from faba bean plants leaflets. The collected faba bean leaves per treatment were kept in

the laboratory in small glass containers (3 x 7cm^2) at 25± 2 °C and 60± 5% RH. Emerged parasitoids were kept in 70% alcohol and glycerin placed in glass vials. They were daily checked for the emerging leaf miners and their parasitoids .Its identified in the identification unit, Biological Control Research Department, Plant Protection Research Institute, ARC. The relationship between the tested treatments and the population density of parasitoids were recorded.

IV- Effect of assayed pesticides on values of yield:

At harvest time, 100 plants from each treatment were picked and the numbers of pods were

counted per plant, then 100 seed were weighed from each treatment. The obtained yield/ treatment was adjusted to find out the yield of seeds/ feddan.

V-Statistical analysis:

To evaluate the efficiency of tested pesticides and extracts against *L. trifolii*, the percentage of population density reduction was calculated according the formula given by Henderson and Tiliton (1955) as follow: Reduction %=100[1-(Ta×Cb)/(Tb×Ca)]

Where: Tb= pre-treatment count, Ta= Post-treatment count, Cb= count in the control before treatment and Ca= count in the control after treatment.

Percentages of parasitism by parasitoids species associated with *L. trifolii* on faba bean plants were determined with their reduction percentages. Reduction percentages of parasitism were calculated as: % Reduction in parasitism = [(No. of parasitized larvae in treatment /No. of parasitized larva in control) ×100] -100

Also, the data of yield/ treatment obtained was statistically evaluated by analysis of variance (ANOVA) and the treatment were compared by least significant difference (L.S.D.) at 5% level.

RESULTS AND DISCUSSION

1-Effectiveness of assayed formulations and plant extracts against *L. trifolii* larvae infesting faba bean plants in the field.

1.1-First spray:

Data in Table (1) show the mean numbers and % reduction of the leaf miner *L. trifolii* larvae infesting faba bean plants during three weeks after application of seven treatments,. Biopower treatment achieved the highest efficacy and significantly to reduce the numbers of *L. trifalii* larvae by 71.01, 91.51 and 88.10% reduction after the first, second and third week, respectively being (83.54%) as mean reductions. This was followed by dithane M-45, Casuarina leaves extract in ethanol being (64.62 and63.51) as mean reduction. Mineral oils (KZ and Kappi) treatments had moderate

effects. (Table 1). KZ oil treatment gave the lowest effect on *L. trifolii* larval population (after second and third weeks of application). It gave 22.24 and 16.47% reduction after the second and third week of applications. While, kappi oil treatment caused 34.12 and 29.62% reductions during the same intervals, respectively.

Casuarina leaves extract in ethyl acetate had no detrimental effect against *L. trifolii* population. It gave lower than 50% reduction in leaf miner population (after first week of application). However, under conditions of the experiment biopower ,dithane M-45. Casuarina leaves extract in ethanol and Casuarina leaves extract in ethyl acetate considered effective for reducing leaf miner population (after second and third week of application) offering more than 50% reduction

Table 1. Effect non-conventional pesticides on the number of *L. trifolii* larvae in faba bean fields

Treatments	1st Spray							
	mean No. before treatment	After 1week	Reduction %	After 2week	Reduction %	After 3week	Reduction %	Mean Reduction %
Casuarina ext. in ethanol	90	45.83	57.93	31.25	68.06	35.25	64.53	63.51
KZ-oil	65.38	45.9	42.00	55.26	22.24	60.3	16.47	26.90
Casuarina ext. in ethyl acetate	70.69	66.6	22.17	33.69	56.15	30	61.56	46.63
Biopower	127.94	44.9	71.01	11.81	91.51	16.81	88.10	83.54
Kappi oil	65.47	45.8	42.21	46.88	34.12	50.88	29.62	35.32
Diathane M-45	75	55.8	38.54	17.86	78.09	18.86	77.23	64.62
Control	101.2	122.5		110		111.74		

The tested materials could be arranged descendingly according to their effect on leaf miner *L.trifolii* larvae population as: biopower ، dithane M-45، Casuarina leaves extract in ethanol ، Casuarina leaves extract in ethyl acetate ، Kappi oil ، KZ oil

1.2-Second spray

Regarding data in Table (2) Biopower and Casuarina leaves extract in ethanol treatments gave the highest efficacy on *L. trifotii* larval population. Biopower gave 80.32, 75.76 and 82.36% reductions after the first, second and third weeks of application ,respectively. While, Casuarina leaves extract in ethanol treatment ranked the second, with percentage reduction 55.19, 58.00 and 68.27% reduction during the

same weeks, respectively (Table, 2). In this respect, the present results are in accordance with that of Jacob *et al*., (2007) who studied the influence of casuarina leaf extract on growth, yield and insect pests in vegetables. The Recommendation that spraying with casuarina reduced fruit borer infestation. In the same side,

Zaki (2012) found that leaf extract caused reduction percentage of 57.14 and 42.25% in larval infestation of the pink bollworm after one and two weeks from sprays, respectively. Also, it caused reduction in the number of Jassids and white fly after 3, 7 and 10 days after spray. The same result was obtained by Ibrahim and Abd-El-Moiety (1997) found that spraying of dithane-M45 against leaf miner every two weeks on faba bean plant achieved 60% reduction than control as general mean for two study seasons 94/95 and 95/96. While, Kappi oil, KZ oil, Casuarina leaves extract in ethyl acetate and dithane M-45 treatments caused lower effect than 50% reduction of leaf miner larvae after first, second and third week of application, respectively.

The treatments could be arranged descending according to their average of leaf miner as percentage of total reduction as follows: biopower ، Casuarina leaves extract in ethanol ، dithane M-45 ، Casuarina leaves extract in ethyl acetate ، KZ oil ، Kappi oil.

2-Common parasitoid species attacking *L. trifolli* :

Five parasitoid species were collected from larvae and pupae of *L. trifolii* belonging to one order (Hymenoptera) and one family (Eulophidae). The secured parasitoids were (1) *Diglyphus isaea* (Walk), (2) *D. crassinerviun* (Erdos.), (3) *Chrysocharis* sp.,(4) *Neochrysocharis* sp. and (5) *Hemiptarsenus* sp. Several authors recorded the mentioned parasitoids from *L. trifolii* such as, El-Serwy (1993),Shahin and El-Maghraby (1993) and AbulFadl and El-Khawas (2009).

2.1. Effect of different treatments on parasitism and percentages of parasitism reduction:

The mean percentages of reduction in parasitism on *L. trifolii* as compared to untreated control were, 10.3, 51.5, 54.4, 58.8,63.2 and 66.8% by KZ oil , Kappi oil, Casuarina leaves extract in ethanol, Casuarina leaves extract in ethyl acetate , Biopower and dithane M-45, respectively (Table 3). The mean numbers of parasitized *L. trifolii* (IS) were, 30.5, 16.5, 15.5,14, 12.5, 11.5 and 34 individuals for KZ oil, Kappi oil, Casuarina leaves extract in ethanol, Casuarina leaves extract in ethyl acetate, Biopower, dithane M-45, and untreated controls, respectively.The means of *L. trifolii* percentages of parasitism were, 35.9, 16.3, 14.5, 10.6, 10.3, 9.8 and 10.8% for KZ oil, Casuarina leaves extract in ethanol, Kappi oil, dithane M-45 , Biopower,Casuarina leaves extract in ethyl acetate and untreated control, respectively (Table 3). Obtained results showed that KZ oil and Casuarina leaves extract in ethyl acetate had the

highest and the lowest efficacies on parasitism %, respectively Also, the obtained data showed that dithane M-45 and KZ oil were correlated with the highest and the lowest percentages reduction of parasitism, respectively (Table 3).

Table 2. Effect of non-convential pesticides on the numbers of *L. trifolii* larvae on faba bean plants.

Treatments	2nd Spray							
	mean No. before treatment	After 1week	Reduction %	After 2weeks	Reduction %	After 3weeks	Reduction %	Mean Reduction %
Casuarina ext. in ethanol	190.38	52.08	55.19	46.86	58.00	40.7	68.27	60.49
KZ-oil	177.27	97.22	10.17	95.18	14.69	85.8	28.15	17.67
Casuarina ext. in ethyl acetate	171.2	87.5	16.29	87.56	12.74	85.51	25.86	18.30
Biopower	208.03	25	80.32	29.56	75.76	24.72	82.36	79.48
Kappi oil	158.04	91.07	5.61	92.24	0.42	89	16.40	7.48
Diathane M-45	179.69	78.57	28.38	87.5	16.92	78	35.56	26.95
Control	245.69	150		144		165.51		

2.2. Effect of assayed formulations and plant extracts on the average yield and number of pods per plant:

Data in Table (4) show the effect of foliar spray of faba bean plants with the assayed formulations and extracts on the average weight of 100- seeds, number of pods/ plant and seed yield/ feddan. There were significant differences between the different treatments of bio-insecticides and mineral oils.

All treatments caused increasing in the weight of seed yield, especially those of biopower which achieved the highest yield (112.28 Kg seeds/ feddan, respectively), followed by treatments with dithane M-45 and Casuarina leaves extract in ethanol which showed significant differences than the remaining treatments which achieved 103.04 and 99.12 kg/ feddan, respectively.. Likewise, the highest mean number of pods/ plant were obtained by dithane M-45 .Followed by biopower, KZ oil and Casuarina leaves extract in ethanol, respectively Table (4).

Table 3. Effect of non-convential pesticides on the number of parasitized *L. trifolii* larvae, % parasitism and % reduction of parasitism on faba bean plants .

Treatments	Mean number of parasitized larvae	% parasitism	%reduction parasitism
Casuarina ext. in ethanol	15.5	16.3	54.4
KZ-oil	30.5	35.9	10.3
Casuarina ext. in ethyl acetate	14	9.8	58.8
Biopower	12.5	10.3	63.2
Kappi oil	16.5	14.5	51.5
diathane M-45	11.5	10.6	66.8
Control	34	10.8	

Table 4. Effect of non-conventional pesticides on the average weights yield .

Treatments	Average weight of 100-seeds (gm)	Mean No. of pods/ Plant	Mean seed yield /fed (Kg)
Casuarina ext. in ethanol	0.08^{a}	1.67^{ab}	99.12
KZ-oil	0.07^{a}	1.78^{ab}	78.4
Casuarina ext. in ethyl acetate	0.08^{a}	1.09^{c}	70
biopower	0.09^{a}	1.86^{a}	112.28
Kappi oil	0.08^{a}	1.47^{ab}	63
dithane M-45	0.08^{a}	2.25^{a}	103.04
Control	0.07^{a}	1.11^{b}	61.6
L.S.D. $_{0.05\%}$	0.003^{a}	0.18	12.48

These results agree with those of Ibrahim and Abd-El-Moiety (1997) who studied the effects of *L. trifolii* larval damage on yield of celery in Florida. The authors indicated highly significant negative simple correlation between the infested leaflets by the leaf miners and the yield.

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التقييم الحقلي لبعض المبيدات غير التقليدية علي صانعة انفاق أوراق نباتات الفول البلدي وعلي بعض الطفيلات المصاحبة لها

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تم اجراء تجربة في حقول الفول البلدي لتقييم كفاءة بعض المبيدات غير التقليدية في مكافحة صانعات انفاق الأوراق التي تصيب نباتات الفول البلدي في الفترة من نوفمبر ٢٠١٣ الي مارس ٢٠١٤وذلك باستخدام المبيد الفطري (دياثين- م ٤٥) والفطر الممرض للحشرات (بايو باور)، والزيوت المعدنية (كزد، وكابي) و(مستخلصي اوراق الكازورينا بالايثانول والايثيل أسيتات) وتأثيراتهم علي أعداد طفيلات اليرقات .وأوضحت النتائج ان المبيد الحيوي بيوباور حقق اعلي نسبة خفض كلية في تعداد صانعات الانفاق عن المقارنة بعد الرشة الاولي و بعد الرشة الثانية وبلغت (٧٩.٤٨،٨٣.٥٤%) على الترتيب، يلية المعاملة بالمستخلص الايثانولي لأوراق الكازورينا (٦٣.٥١ و٦٠.٤٩ %) بعد الرشة الاولي و الرشة الثانية على التوالي ، وما تبقى من معاملات كان المبيد الفطري دياثين – م ٤٥ (٦٤.٦٢ ،٢٦.٩٥) بينما كانت كفاءة التأثير متوسطه بعد المعاملة بالإيثيل أسيتات لأوراق الكازورينا بنسبة (٤٦.٦٣ ،١٨.٣٠%) ، يليه الزيت المعدني كزد (٢٦.٩٥ و٧.٤٨%)، وكان التأثير ضعيف علي أفراد حشرة صانعات الأنفاق بعد الرشة الأولى والثانية على التوالي. ومن ناحية آخرى ، كانت أنواع الطفيلات التي ربيت على اليرقات ، *Diglyphusisaea* (Walk), *D.crassinveris* (Wlalk.), *Chrysocharis sp.*, *Neochrysocharis sp.* and *Hemiptarsenus sp.* (Hymenoptera: Eulophidae) خلال فترة الدراسة .واخيرا تم الحصول على محصول بذور مرتفع معنويا بعد معاملات المبيد بيوباور، الدياثيين–م٤٥، والمستخلص الأيثانولي لأوراق الكازورينا مقارنة بمحصول البذور بعد المعاملة بزيت كزد ومستخلص الأستيل أسيتات لأوراق الكازورينا وزيت الكابي والمقارنة .