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Efficacy of Some Compounds for Controlling Peach Fruit Fly *Bactrocera zonata* (Saunders) Larvae

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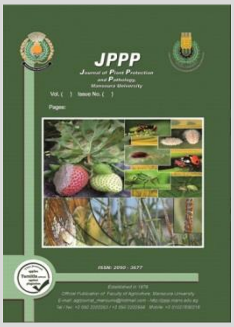

ABSTRACT

The present study was carried out to evaluate the toxicity of Syotin 25% (Pyrethroid) Solar (petroleum product) or diesel fuel and plant ash to *Bactrocera. zonata* (Saunders), full grown larvae in three different soil types sandy, clay and mixed soil (mixture of sandy and clay (1:1) by volume), and the effect of different soil depths and types on the emergence rate of *B. zonata* pupae. The results proved that, Solar in sandy soil recorded the highest mean of mortality 71.044% followed by Syotin in clay soil recording 68.89% and there is no significant differences in means of mortality for Syotin and Solar in all soil types while there is a significance in means of mortality for ash treatments. Syotin recorded the lowest LC_{50} value 0.925 ml/L while Solar recorded the lowest LC_{90} value 8.541 ml/l., comparing the efficacy of the three compounds on the mean percentage of mortality regardless to the soil type. Syotin cause the highest mean of mortality 60.9% followed by Solar recorded 55.2%. There is no effect of the type of soil used on the mean percentage of mortality. The highest rate of emerged flies was obtained at the lowest soil depth. At 16 cm depth no emergence was observed in dry clay soil while 3.33% emergence was observed in dry mixed soil at 14 and 16 cm depth. The results cleared that soil's type and depth of burying pupae has an influence of the rate of emergence of *B. zonata* adults.

Keywords: *Bactrocera zonata*, Syotin 25%, Solar, plant ash and soil depths.

INTRODUCTION

The peach fruit fly. *Bactrocera zonata* (Saunder) considered one of the most serious insect pests in several region of the world ((Drew, 1989). It is recorded in several governorates in Egypt due to it is wide host rang, high mobility and adaptability to climate. Control of this pest depends largely on insecticidal applications, and the intensity of their treatments has resulted in development of more resistant populations of insects (Ortego et al., 2005). To reduce hazards of their use great emphasis has been placed to search for less or non-harmful alterative for pest control.

Syotin 25% (Cypermethrin) a pyrethroid compound is widely used due to its high insecticidal potential and is considered less toxic for human use because of poor dermal absorption, rapid metabolism, less tissue accumulation and environmental persistence. Ash is the residue of burned plant parts like, bark, wood debris, leaves and other plant debris.

Ash has been used for traditional pest control to some crawling pests Stoll (2000), it is a source of phosphorus for plants, also acts as a physical poison usually causing abrasion of epicuticular waxes through desiccation. One of the most effective factors in IPM program for fruit flies is burying the fallen fruits in the soil this may affect emergence of adults either by causing direct mortality by impact of soil pressure on pupae or in direct by preventing the emerged adults from reaching to the soil surface.

Soil treatment has resulted in less or no residues on fruits, so the aimed of this study attempted to investigate the toxicological effects of treating soil with Syotin 25%, Solar (diesel fuel) and plant ash on *B. zonata* larvae that had immediately poped in the soil to pupate, and to study the effect of different soil types and different depths of burying pupae on the emergence rate of flies.

MATERIALS AND METHODS

Insects

Larvae of *B. zonata* were obtained from stock colony reared in the Horticultural Insects Department, plant protection Research Institute (PPRI) Giza, Egypt. Larvae were reared using artificial larval rearing medium according to Tanaka et al., (1969). Full grown larvae used here were collected immediately after they had poped from the larval rearing medium to pupate. Larvae were put in fine sand till pupation.

The tested materials:

- Soytin 25% (Cypermethrin)
- Solar (diesel fuel)
- Plant ash was obtained from burned plant parts:
- Soils:

Three types of soil were used: sandy, clay and mixed soil (mixture of sandy and clay (1:1) by volume).

A- Toxicological study:

Bioassays:

Experiment (1):

The toxicological effect of the insecticide Syotin 25%. On *B. zonata* larvae in soil was tested separately in three different types of soil (sandy, clay and mixed) in glass jars of 9cm in diameter containing 100 ml of each soil. Five different concentrations of Syotin 0.625, 1.25, 2.5, 5 and 10 ml/L with water were made and applied separately to each soil type. Each concentration was replicated three times and three with water only as control, then full grown larvae were introduced on the soil surface. The experiment was kept at

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25±2°C and 65-70% RH. Numbers of emerged adults were recorded and mortality percentages were calculated

Experiment (2)

Toxicological effect of Solar to *B. zonata* larvae in the soil was studied by the same concentrations and the same steps used in the upper experiment.

Experiment (3)

Toxicological effect of plant ash on *B. zonata* larvae was tested also in the three different soil types and in the glass jars used above. Five different rates from plant ash 5, 10, 20, 30 and 40 mg/100 gm soil were spread separately on the surface of each soil type. Three replicates per each rat of the ash were made for each soil type and three replicates without ash were made as control. The experiment was mentioned also at 25°C ± 2 and 65-70 RH. Number of emerged adults was recorded and mortality percentage was calculated.

B- Effect of soil types and depth on the rate of emergence.

Effect of depth of pupation on adult emergence was studied also in the same glass gars using the three soil types used above (dry and irrigated (10ml water / 100 gm soil). Ten pupae were place at the bottom of each jar. The jars were filled with the soil to 1, 2, 4, 6, 8, 10, 12, 14 and 16cm height. The jars were covered by muslin tied and rubber band. Three replicates were made for each soil depth and for each soil type (dry and irrigated), thirty pupae were placed in three jars (10 for each) without soil as control. Numbers of emerged adults were recorded and percentages of emergence were calculated.

Statistical analysis

Percentages of mortality were corrected according to Abott's formula (Abbott, 1925). LC_{50} and LC_{90}values, the slope of regression lines and the toxicity index were calculated by Probit analysis (Finney, 1971). Analysis of variance. (ANOVA) (SAS Institute, 1988) was also used to determined differences between means.

RESULTS AND DISCUSSION

A-Toxicological study:

The results obtained in Table (1) showed that when the insecticide. Syotin was applied to the three soil types sand, clay and mixed soil, the highest percentages of larval mortality were 68.98, 88.89 and 90% obtained at the highest concentration 10 ml/L and there is no significant difference in the mean percentages of mortality for the three soil types used while when Solar was applied, 100 % and 90% mortality was recorded at the concentration 5ml/L in sandy and mixed soil, respectively. At a concentration 10 ml/L, 100% mortality percentages were recorded in all soil types used. When plant ash was applied to the three soils, the highest mortality percent recorded was in clay soil and equal to 62.69% at the highest concentration 40 mg/100 gm soil, and there is no significant difference in the mean percentages of mortality in clay and mixed soil while there is a significance between the two and sandy soil. Comparing the effect of the three compounds in the three soil types the data show that, Solar in sandy recorded the highest mean of mortality 71.044 followed by Syotine in clay soil, so it can be arranged descendingly as follow according to their effect: Solar in sandy >Syotin in clay >Syotin in mixed soil > Solar in mixed soil >Syotin in sandy > Solar in clay > Ash in clay > Ash in mixed soil > Ash in sandy soil. There is no significant difference in means of mortality for Syotin and Solar in all soil types (LSD = 16.93 Pr> 0.0001) while there is a significance in means of mortality for Ash treatments.

Table 1. Mortality percentages of *Bactrocera zonata*, full grown larvae after exposure to different concentrations of Syotin, Solara and plant ash in sandy, clay and mixed soils.

Tested compounds	Soil type	Conc. in ml/L					
		0.625ml	1.25 ml	2.5 ml	5 ml	10ml	Mean
Syotin	Sandy	27.61	55.22	58.63	68.95	68.95	55.88[a]
	Clay	33.33	66.67	77.78	77.78	88.89	68.89[a]
	Mixed	30.00	50.00	60.00	60.00	90.00	58.00[a]
	Mean	30.31	57.3	65.47	68.92	82.62	
Solar	Sandy	27.61	48.29	79.32	100.00	100.0	71.04[a]
	Clay	0.00	0.0	25.89	66.67	100.0	38.55[b]
	Mixed	20.0	20.0	50.0	90.0	100.0	56.0[a]
	Mean	15.87	22.76	51.74	85.56	100.0	
	Soil type	Conc. in mg/100 gm. soil					
		5 gm	10 gm	20 gm	30 gm	40 gm	Mean
Ash	Sandy	0.0	10.37	20.7	20.71	27.61	15.88[C]
	Clay	0.0	14.80	33.33	33.33	62.96	28.88[b]
	Mixed	0.0	10.0	30.00	43.33	60.00	28.67[b]
	Mean	0.0	11.72	28.02	32.46	50.1	

Means with the same letter are not significantly different

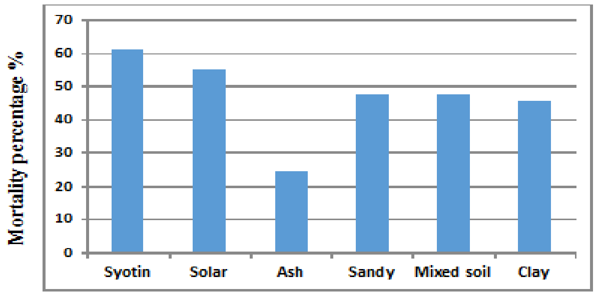

Fig. 1. Effect of the three compounds (Syotin, Solar and ash) and soil types (sandy, clay and mixed soil) on mortality percentages of *B.zonata* full- grown larvae.

Data presented in table (1) and illustrated in Fig. (1), showed that, the effect of the compounds and soil types used on the mean percentages of mortality. the Syotin compound give the highest mean of mortality, 60.9% followed by Solar recorded 55.2%, and the data statistics showed there is no significance between them while there is a significant (Pr<0.0001) between the two compounds and Ash recording 24.48% mean of mortality in the three soil types at all concentration used. The data also show that there is no effect of the type of soil used on the mean percentage of mortality as there is no significant difference (Pr= 0.875) in the mean percentage of mortality recorded in the, sandy, mixed and clay soil recording 47.603, 47.555 and 45.429, respectively (LSD = 9.778). The effect of the compounds on mortality percentages was higher than the effect of soil types. On the other hand the effect of the three compounds (Syotin, Solar and ash) and soil types (sandy, clay and mixed soil) on mortality percentages of *B. zonata* full- grown larvae.

From the obtained results it can be concluded that Solar (diesel fuel) is effective for causing death for *B. zonata* full-grown larvae, so it has insecticidal properties and this agree with that obtained by Hindy *et al*., (1995) who used Solar in thermal fog technique for controlling Mediterranean fruit fly in Mango or chards, and Badr *et al*., (1999) who used Solar for controlling cotton leafworm larvae on clover plants.

The obtained results showed that although plant ash recorded the lowest mortality percentage, it has some insecticidal properties, this has been proved by several authors like Mochiah et al, (2011) who concluded that, botanical such as wood ash could be effectively considered as pest management options and wood ash successfully controlled *Sitophilus zeamais* in stored maize (Wine et al. 2015). Wood ash proved to be more effective in protecting the vegetables against insect pests, since it recorded a significant minimum activities of insect pests, so it could be considered as an effective as alternative method of pest management (Alexander, 2017). So from the obtained results it can be concluded that plant ash can be spread under and around the fruit trees and this will share in the control of fruit flies larvae which jump from the fruits to pupate in the ground.

Data arranged in Table (2) and Fig. (2) showed that in case of LC_{50} values, Syotin (pyrethroide) record the lowest value 0.925 ml/L and so it is more toxic than the other two compounds (Solar and ash) recording 1.709 and 44.097 ml/L, respectively. While in case of LC_{90} values, Solar recording the lowest value, 8.541 ml/L, so it is more effective than Syotin and ash which recording 29.9 and 216.4 ml/L, respectively.

Table 2. Toxicity of Syotin, Solar and plant ash against *Bactrocera zonata* full-grown larvae

Tested compounds	LC_{50}	LC_{90}	Slope	Toxicity index
Syotin 25%	0.925	29.916	0.849	100
Solar	1.709	8.541	1.834	54.125
Plant ash	44.97	216.41	1.855	2.098

As shown in Table (2) and Fig. (1), the slope values of the tested compounds were, 0.84, 1.834 and 1.855 for Syotin, Solar and ash, respectively. For the toxicity index, Syotin was the standard recording 100% efficiency, while efficiency of Solar and ash was lower than Syotin recording 54.125 and 2.098, respectively. The present results agree with that obtained by Stark and Vargas (2009) who reported that, the synthetic pyrethroids, Warrior and Force were the most effective soil insecticides evaluated for control of three species of fruit flies compared to diazinon, and Stark et al., (2013) who proved that warrior I and two formulations of Force (CS and 3G) were very effective in reducing adult emergence of the Mediterranean fruit fly, *Ceratitis capitata*, (Wiedemann) the melon fly, *Bactrocera cucurbitae* (Coquillett) and the oriental fruit fly, *B. dorsalis* after exposure as third instar larvae.

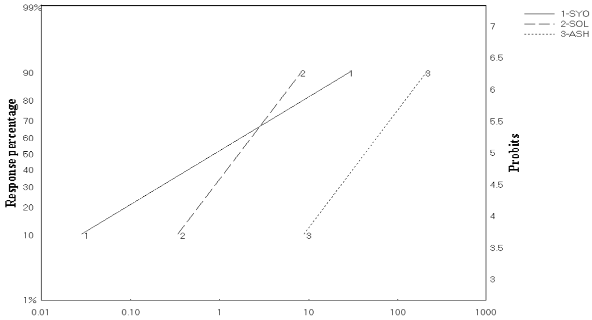

Fig. 2. LC-P lines of Syotin, Solar and plant ash against *Bactrocera zonata* full- grown larvae

B- Effect of soil type and depth of pupae on the rate of emergence:

The obtained data in Table (3) showed that, in dry soil the highest percentages of emergence 100, 90 and 76.66% were obtained at the lowest depth 1 cm in sandy, clay and mixed soil, respectively while in irrigated soil 100% rate of emergence was obtained in mixed soil at the first three depths and 93.33% rate of emergence were obtained at the lowest depth (1 cm) for sandy and clay soils, respectively, it is clear from the results that as the soil depth increase, the rate of emergence decrease as the highest rate of emergence was obtained at the lowest depth, At 16cm depth no emergence was observed in dry clay soil while 3.33% was observed in dry mixed soil at 14 and 16 cm depth. In case of irrigated soil the lowest percentage of emergence 20% was observed in dry sandy soil at the highest depth (16cm). The results agree with Delmas and Termes (1953) who reported that the pupae of *Ceratitis capitata* artificially buried at 25 cm in the soil gave birth to adults. And Ali et al., (2007) who proved that the highest rate of emergence of *C. capitata* (69.3%) was recorded at 2cm depth. Also Risk *et al*., (2013) proved that soil depth negatively correlated with the emergence of zizyphus fruit fly (ZFF) adults, the highest rate of emergence (100-80%) were observed at the lowest depths (1-15 cm).

Table 3. Rate of emergence of *B. zonata* pupae in sandy, clay and mixed soil (dry and irrigated) at different soil depths.

Soil type		Soil depth in cm										LSD	Pr	DF	Control
		1	2	4	6	8	10	12	14	16	Mean				
Dry soil	Sandy	100	93.33	90.6	90	90	83.33	83.33	40	40	78.88^{a}	12.401	<0.0001	8	100
	Clay	90	86.66	80	56.60	53.33	50	0	0	0	46.29^{b}				100
	Mixed	76.66	70	63.33	63.33	56.33	33.33	13.33	3.33	3.33	42.58^{b}				100
	Mean	88.89^{a}	83.33^{a}	77.78^{b}	70.0^{b}	66.66^{b}	55.55^{c}	32.22^{d}	14.44^{d}	14.44^{d}					
	LSD	21.48													
	Pr	<0.0001													
	DF	2													
Irrigated soil	Sandy	93.33	93.33	86.66	86.66	76.66	63.33	60	43.33	20	59.25^{c}	6.101	<0.0001	8	100
	Clay	96.66	93.33	90	90	90	80	70	60	43.33	79.26^{b}				100
	Mixed	100	100	100	93.33	86.66	86.66	86.66	70	56.66	86.66^{a}				100
	Mean	96.66^{a}	95.55^{a}	92.22^{a}	89.97^{b}	84.44^{b}	76.66^{d}	72.22^{d}	57.77^{e}	39.99^{f}					
	LSD	10.568													
	Pr	<0.0001													
	DF	2													

Means with the same letter are not significantly different

The results also showed that the soil's type has an influence on the rate of emergence, it is clear from the results that in dry soil the sandy soil recorded the highest mean rate of emergence 78.89% and there is a significant difference comparing with the other two soils (clay and mixed) while in irrigated one, mixed soil recorded the highest mean rate of emergence (86.66%) showing a highly significant difference comparing with the other two soils which recording 69.256 and 79.258% for sandy and clay, respectively. Our results are supported by Seguy (1950) who reported that, the nature of the soil and its chemical composition has a great importance in dipteran's development.

Comparing dry and irrigated soils, it was obvious that the mean rate of emergence of *B. zonata* adults from irrigated soil was higher than that from dry one regardless of sandy soil and this may be due to presence of water between soils particles facilitate exiting of flies for arriving to the soil surface.

From the above results it can be concluded that the depth of burying of the pupae has a significant effect on the mean rate of emergence of the adult flies and the lowest depths permitted a high rate of emergence, and clay soil reduces the rate of emergence this may be due to the size of the clay particles which prevent adults from arriving to the surface.

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كفاءة بعض المركبات لمكافحة يرقات ذبابة الخوخ Bactrocera zonata (Saunders)

عصام فؤاد جازية ، غادة محمد عبد المنعم و سنية رشاد محمد فرج

معهد بحوث وقاية النباتات – مركز البحوث الزراعية – الدقي – الجيزة

تم عمل هذه الدراسة لتقييم سمية مبيد سيوتين 25% بيروثرويد والسولار أحد مشتقات البترول أو وقود الديزل والرماد النباتي ليرقات ذبابة الخوخ وذلك في ثلاث أنوع من التربة هي : الرملية والطينية والمختلطة بنسبة 1:1 من الطينية والرملية وأيضاً دراسة تأثير أنواع التربة والأعماق والمختلفة لوضع العذاري على معدل خروج الذباب واثبتت النتائج أن السولار في التربة الرملية أعطى اعلى متوسط نسبة موت وهي 71.44% يليه مبيد السيوتين في التربة الطينية وسجل 68.89% ، كما أنه لا يوجد فروق معنوية في متوسطات نسب الموت لكل من السيوتين والسولار في كل أنواع التربة المعاملة بينما يوجد فرق معنوي في متوسطات نسب الموت بالنسبة لمعاملات الرماد .السيوتين سجل اقل قيمة بالنسبة للجرعة نصف المميتة وهي 5.925 بينما السولار سجل اقل قيمة بالنسبة للجرعة المميتة لـ 90% من الحشرات وهي 8.541بمقارنة كفاءة الثلاث مركبات بالنسبة لمتوسط نسبة الموت بغض النظر عن نوع التربة سجل السيوتين أعلى متوسط لنسبة الموت وهي 60.9% يلية السولار 55.2 %ولا يوجد تاثير لنوع التربة على متوسط نسبة الموت . وكان اعلى معدل لخروج الذباب كان في أقل عمق للتربة 1 سم . عند عمق 16 سم لا يوجد خروج للذباب وذلك في التربة الطينية الجافة بينما لوحظ 3.33% خروج للذباب في التربة المختلطة الجافة عند عمق 16.14 سم . وأثبتت الدراسة أن نوع التربة وعمق وضع العذاري له تاثير على معدل خروج ذباب الخوخ .