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Field Evaluation of Some Eco-Friendly Formulations against Strawberry White grubs in Egypt

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Abstract: *Field evaluation of Imidacloprid and bio-formulations was carried out with irrigation water against the white grubs, Pentodon algerinum at El-Behera Governorate, Egypt. The results revealed that Imidacloprid was the highest effective followed by bio-catch and nimbecidine was the lowest effective .The first application revealed that the effective all formulations were did not significantly after the 1st week from application. While, the 2nd week from application, Imidacloprid, Metarhizium anisopliae formulation and Nimbecidine achieved 78.0, 75.0 and 67.2 % reduction in live white grub larvae, respectively. The second application clearly confirmed the efficiency of these compounds. Although, the biocompounds are slower effective than the chemical insecticide against the white grubs but these are the safest for humans and the environment. I think that used another ways with biocompounds through an integrated pest program that would be lead to the better control against the white grubs.*

Keywords: *Strawberry, White grubs, Pentodon algerinum, the rigid back beetle, Imidacloprid, nimbecidine, Metarhizium anisopliae, Eco-friendly Formulations.*

INTRODUCTION

Strawberry (*Fragaria x ananassa* Duch.) is the major economic vegetable crops and considered the foremost hard cash crop for strawberry growers in Egypt. In the present time, it is tasty fruits and the demand has been increased for local consumption and exportation. Strawberry production is increasing annually, the world production exceeding 9.118336 million ton, (Faostat, 2016). The harvested area of strawberry in the world was reached 401862 ha. Egypt was occupied the fourth position of strawberries production after USA, Turkey and Spain. The area harvested of Strawberry orchards in Egypt was 23773.8 feddans (9985ha.) with an approximate production 464958 ton. Egypt was exported 164740 ton during 2016 season according to the statistics of Faostate, (2016). In Egypt, strawberry plantings can be affected by many pests and the severity of problems associated with the pests increases with increase of plant age. Insects (whitefly, thrips, aphids, white grubs), mites, soilborne pathogens, weeds, and nematodes can limit yields and result in the loss of the field productions (Cooley and Schloemann, 1994; LaMondia, 2002; McKee *et al.*, 2009; Łabanowska *et al.*, 2015; Lacey *et al.*, 2015). In the recent year, the white grub larvae had become to cause losses in the strawberry productions (In the previous decade, this insect was the minor insect).White grubs are a polyphagous and the adult stage is named the rigid back beetle, (the waste organic manure larvae) *Pentodon algerinum* (Coleoptera: Scarabaeidae). The larvae head is a brown color and the body has thick and large in size, arched and yellowish in color (Abd-Rabou & Saadia, 2006). The larvae live in the soil and feed on organic matter and plant roots. The larvae go up to or near the soil surface, looking for any roots or tubers to feed on. These larvae found to cluster around the roots when soil is removed. The infection leads to plant wilt and

death rapidly due to feeding on a large part of the roots. This insect spread in sandy soil (newly reclaimed area). White grubs are a basic pest of different agricultural crops and the most damaging group for the turfgrass, nurseries and ornamentals in the worldwide. Strawberry producers are experienced problems with decline the efficacy of the chemical insecticides that used in controlling the insect. It is likely, the developmental resistant of the insect as resulting for prolonged cyclical applications of the chemical insecticides (Sato *et al*., 2005). In addition, the use of chemical pesticides increases the many health problems for farm workers and contamination of the environmental (Abd El-Salam *et al*., 2013; Parra, 2014). Soil fumigation by chemical pesticides had been used for root pests control in strawberry (Wolfe *et al*., 1990; Caylor *et al*., 1991; Yuen *et al*., 1991; LaMondia, 2002). An alternative to chemical pesticides is biocontrol, such as the use of neem formulations, entomopathogenic fungi and others in integrated pest management (Łabanowska *et al*., 2015; Lacey *et al*., 2015; Castro *et al*., 2016).
The current work was aimed to studied the efficiency of two bio-pesticide compared to a conventional chemical pesticide against the white grubs in the strawberry plants.

Materials and Methods

Field experiment was conducted at the exporting farm for the strawberry at El-Behera Governorate, Bader center during 2017/2018 season.
The area was planting with the winterstar variety (export variety) at 1st September. The percentage infestation of the white grubs was 40.0% at 19/4/2018 before the applications were conducted. The selected area was 3450 m^2 for treatments. The area is divided five terraces. Each terrace for one treatment and it was divided 5 plots; each plot represented as one replicate (plot area was 160 m^2). Two biocompounds and one chemical insecticide and one untreated as control. The irrigation system was drip. The compounds were used in subsurface drip irrigation system.

The compounds used.

Bio-Magic is a biological insecticide based on a selective strain of naturally-occurring entomopathogenic fungus *Metarhizium anisopliae*. It contains spores and mycelial fragments of *M. anisopliae*. It is liquid (1x10^9 CFU's/ml) formulation. Nimbecidine EC (0.03% a.i.) is a neem-oil-based botanical insecticide containing Azadirachtin and other limonoids including Meliantriol, Salanin, Nimbin and a host of other terpinoids in the ratio as it occurs naturally in Neem . Impact 17.8% (SL) is Imidacloprid**,** a neonicotinoid insecticide. It contains 1-(6-chloro-3-pyridylmethyl)-N-nitroimidazolidin-2-ylideneamine. Neonicotinoid insecticides are synthetic derivatives of nicotine, an alkaloid compound found in the leaves of many plants in addition to tobacco. The rates of applications were 5.0 ml /distillate water liter for Bio-Magic & Nimbecidine and 0.5 ml / distillate water liter for Impact. The compounds were applied at the recommended rate in subsurface drip irrigation system. The compounds were purchased from local market.

Treatment samples & applications

Two applications were conducted with irrigation system, once each two weeks. Examine the roots of 10 plants at random / replicate. The live larvae were recorded before and after treatment by one week and 2 weeks. The reduction percentage in live larvae was calculated with Henderson &Tilton formula, 1955.

Statistical analyses of data

All the obtained results were statistically analyzed according to completely randomized design by using SPSS, 18 programs Computer.

Results

The results in Table (1) indicated that the first application achieved 53.4 & 48.2 % reduction with *M. anisopliae* and nimbecidine, respectively .While; Imidacloprid was caused 53.4 % reduction in live larvae. No significant differences were found in the efficiency between the three formulations. However, the three formulations were begun at the second week from application to achieved 78.0, 75.0 and 67.2 % reduction in live white grub larvae for Imidacloprid, *M. anisopliae* and nimbecidine, respectively. However, the numbers of larvae were reached to 7.8 larvae /10 plants in the untreated area with the second week from the first application and this explains the importance of conducting control as soon as possible.

The second application was conducted after two week from the first application. This application indicated that there were significant differences between the three compounds and the control. Bioformulations showed high efficiency against white grub larvae where the percentage reduction reached 88.1 and 75.3% for *M. anisopliae* and nimbecidine, respectively. While, Imidacloprid achieved a ratio of 95.5% reduction compared to the untreated area which had 9.4 larvae / 10 plants.

The results indicated that the control should be start early. However, the treatment of the organic manure by one of these compounds before additive to the soil and the planting by enough time were effective to kill any different insect stages.

Discussion

In Egypt, *Pentodon algerinum* recorded in sugarcane and the infestation reached to the most of 60.0% (Abd-Rabou & Saadia, 2006). Kalleshwaraswamy *et al*., (2015) reported that root grubs were caused 27.86 to 36.97 % damage leading to decline in a yield reduction of the arecanut tree (39.79 to 41.60 % reduction) in different districts of Karnataka. Under hard infestation, the palms lose their roots and fell with a little jerk (Kumar, 1997). Also, the authors stated that *Metarhizium anisopliae* dust formulation had become very popular with the arecanut farmers of Karnataka and the main components of IPM. The authors found that the best application with *M. anisopliae* with drip irrigation system, an application would yield higher grub mortality when combined with EC formulations of biopesticides. Time of application, the failure of entomopathogenic fungi (EPF) when applied at the soil surface was killed by combination of desiccation and ultra violet light damage (Smith, 1996; Wilson and Gaugler, 2004). The literature available on utilization of EC formulations of biopesticides especially *M. anisopliae* and *B. bassiana* is very much lacking. There is need to standardize the optimum and effective dose of EC formulation of *M. anisopliae* to get maximum white grub mortality before it can be used in subsurface drip irrigation system. Glare and Milner, (1991) reported that high dosages of 10^8 to 10^9 conidia per ml causes normally the higher mortality of white grub larvae. Rakesha *et al.* (2012) reported that *M. anisopliae* at higher dosage of 4 x 10^8 conidia/g recorded higher per cent mortality of *L. lepidophora* grubs (33.33%) as compared to lower dosage of 2 x 10^8 conidia/g resulting in 14.81 per cent mortality.

The plant products, aqueous mixture of soapnut and neem oil were used in white grubs control. Prabhu *et al*., (2011) stated that aqueous mixture of soapnut and neem oil (5%) at the rate of 10 % achieved 53.71 % mortality compared with chlorpyriphos at the rate of 6.0 ml per palm (63.95 %mortality) against arecanut white grub, *L. lepidophora*. Thus, this botanical could be used in field to control the pest and it will be effective up to 60 days. Also, *Metarhizium anisopliae* with 2 x 10^8 conidia per gm at the rate of 20.0 gm per palm recorded 31.38% mortality and the strychnine seed extract at the rate of 5 % caused 31.64 % mortality. The authors found that as there is a overlapping of generations in field, it is advisable to incorporate the fungus culture with the onset of monsoon, when beetles emerge in large numbers and lay eggs. Apply this aqueous extract once during 1st week of July and second time during September last week based on the grub load in the field. Vinayaka *et al*., (2018) found that chlorpyriphos (10.0 ml / palm) was the best treatment at all observation periods followed by Chlorantraniliprole (25.0g/ tree) against arecanut white grub, *Leucopholis lepidophora* .

The results of this research are agreement with the previous research. However, use of entomopathogenic fungi or neem compounds depends on the timing and application methods. Whereas, the application with irrigation water after sunset is the best way to control of this insect pest and protection of entomopathogenic fungi or neem compounds from the sun radiation that decreasing the efficiency of these compounds . Also, the repeat of treatment was effective in reducing the rate of white grub infestation.

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Table 1: Efficacy of some commercial compounds against white grub larvae, *Pentodon algerinum* under field conditions.

formulations	Rate of application (ml/l)	1st application					2nd application				Avg. % Reduction
		Avg. No. live larvae / 10 Plant ±SE					Avg. No. live larvae/ 10 Plant ±SE				
		Before treatment	After treatment by				After treatment by				
			1st week	% Reduction	2nd week	% Reduction	1st week	% Reduction	2nd week	% Reduction	
Nimbecidine	5.0	4.8±0.5a	3.2±0.6b	48.2	2.2±0.4b	67.2	3.2±0.3a	56.6	2.0±0.8b	75.3	47.7
Bio-Magic	5.0	4.0±0.7a	2.4±0.5b	53.4	1.4±0.4b	75.0	1.0±0.3b	83.8	0.8±0.3bc	88.1	75.1
Impact	0.5	5.2±0.96a	3.2±0.6b	52.8	1.6±0.5b	78.0	1.2±0.3b	87.5	0.4±0.2c	95.5	78.5
Cont.	0.0	5.6±0.5a	7.2±0.4a	----	7.8±0.4a	---	8.6±0.4a	---	9.4±0.4a	---	---
F	-----	0.91	15.9*	----	46.58*	----	92.9*	-----	67.25*	----	-----
$LSD_{0.5}$	-----	2.14	1.62	----	1.34	----	1.1	-----	1.54	----	-----

Treatment means followed by the same letter are not significantly different from each other ($P < 0.05$).