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Impact of two formulation types to emamectin benzoate on physicochemical properties and bioefficacy against *Sesamia critica* (Lepidoptera: Noctuidae) infesting *Zea mays* plants

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Abstract:

The corn *Zea mays* is economically one of the most important and widely grown as a stable food in many parts of the world, corn consumed directly by humans, production ethanol, starch ,syrup and animal feed. Corn infested with many insects from it, greater sugar cane borer *Sesamia critica* Lederer (Lepidoptera: Noctuidae) is considered the most serious insect pest infesting corn in Egypt. The objective of this study was to study the impact of formulation types of emamectin benzoate 5% on mean number of larvae, reduction percentages of *S. critica* after first and second spray during two successive seasons and physicochemical properties to insecticide. The field experiment was conducted at Agricultural Research station "Qaha" in Qalubiya Governorate. Corn were seedling at 20th May during two successive seasons 2018 and 2019, respectively. The results showed that larvae population decreased gradually by time from first day till 10th day from spray in case of Hypnose and Absolute but living larva population in case of control were increased by time. Hypnose was more efficacies on living larvae population compared with Absolute. Especially, reduction percentage, the data illustrated that, Hypnose recorded the highest reduction % followed by Absolute. The Hypnose categorized in the first rank followed by Absolute in the second rank with reduction % were 91.5 and 28.0 reduction %, respectively after 10 days. On the other hand , impact of two formulation types on physicochemical properties, the results showed that, pH in case of Hypnose and Absolute recorded 7.9 and 7.7 near to equalized or to slightly alkaline , but surface tension lowered to 33.7 and 34.4 dynes/cm, causing increasing wetting to treatment surface of plants, but density were equalized . The foam recorded 3 ml with Absolute and non foam in case of Hypnose, especially suspensibility % recorded 100 % suspensibility in case Hypnose formulation type (5% SG**)**.

Introduction

The corn Zea *mays* is economically one of the most important and widely grown as a stable food in many parts of the world, corn consumed directly by humans, production ethanol, starch ,syrup and animal feed. Corn infested with many insects from it, greater sugar cane borer *Sesamia critica* Lederer (Lepidoptera: Noctuidae) is considered the

most serious insect pest infesting corn in Egypt. Used many insecticides, from it biopesticides offer more sustainable solutions to pest control than synthetic alternatives (Shaalan *et al.*, 2005 and Akdeniz and Özmen, 2011). Selective insecticides with modes of action different from those of broad spectrum neurotoxin insecticides are highly desirable in integrated pest management (IPM) programs. Among these insecticides are insect growth regulators (IGR,s) that affect the ability of insects to grow and mature normally. IGR,s have been developed due to their high activity and selectivity against insects with inherently low toxicity to non target wildlife. As a result of their mode of action, a subtle effect of these compounds is likely to pose a greater effect to immature stages than to adults of a number of insect species. An IGR, therefore, does not necessarily have to be toxic to its target, but may lead instead to various abnormalities that impair insect survival (Siddall, 1976). Most of the compounds that belong to the IGR class are not stomach or neurotoxins, but have a unique mode of action that disrupts the molting process or cuticle formation in insects or interferes with the hormonal balance of insects. They are characteristically slow with acting against a narrow range of sensitive stages of the insects life cycle harmful effect against target pests. Insect growth regulators may come from a blend of synthetic chemicals or from other natural sources, such as plants (Tunaz, 2004). Insecticides plant extracts could inhibition some enzymes (Chun and Zhang, 2003). All high doses of insecticides based on changes that lead to deformities and abnormal growth of wings and not molting to the next stages and finally die after 24-48 hours from treatment (Kodandaram *et al.*, 2008). Feeding behavior of plant feeding insect may change when they feed on the pesticide by which plant was treated, especially when exposure to a lethal dose; so change their metabolism in both digested or undigested food in their bodies leading to changes in the continuing growth, deformation and maturation (Srinivasa and Rao, 2003). The concept of using feeding attractants and stimulants in combination with a toxicant for adult control of noctuid pest has been documented (López *et al*., 2000). Emamectin benzoate belongs to the avermectin group of chemicals produced by the soil-dwelling actinomycete (NRRL 8165) alias, *Streptomyces avermitilis* (Burg *et al*., 1979). It possesses excellent insecticidal potency against neonates of *Helicoverpa zea* (Boddie) (Lepidoptera: Noctuidae) in foliar application with an LC90 value of 0.002 g/ml (White *et al.*,1997). Argentine *et al.* (2002) found that the LC90 values for emamectin benzozte ranged from 0.0050 to 0.0218 g/ml for six species of Lepidoptera. Dunbar *et al*. (1998) reported that emamectin benzoate was very effective in controlling *Heliothis virescens* (F.) (Lepidoptera: Noctuidae) and *H. zea* larvae at low active ingredient rates (0.0084-0.084 kg /ha). Jansson and Dybas (1996) reported that emamectin benzoate is stored as a reservoir in plant parenchyma tissues and this accounts for its long residual activity against several phytophagous insects. Jansson *et al.* (1996) reported that solid formulations of emamectin benzoate were as efficacious as the emulsifiable concentrate formulations in controlling *H. virescens* and beet armyworm *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae) larvae.

Therefore the objective of this research work was to study the impact of formulation types of emamectin benzoate 5% on mean number of larvae , reduction percentages of *S. critica* after first and second spray and physicochemical properties to insecticide.

Material and methods

1. Experimental field and formulations of insecticide :

The field experiment was conducted at Agricultural Research Station "Qaha" in Qalubiya Governorate. Corn *Z. mays* were seedling at 20th May to study the impact of two formulation types to emamectin benzoate on larvae populations of *S. critica*

during two successive season 2018 and 2019 , respectively. Each treatment was repeated three times, on area about kirate (175 m^2) per each treatment. Treatment numbers was three treatments included control. When *Z. mays* plants infested with *S. critica* were sprayed two times by kanabsac sprayer motors during 20th June by spray solution contain emamectin benzoate , the period between two spraying 10th days .

1.1. The first formulation is Hypnose formulation type (5% SG**)** with a rate of 60gm, /feddan .

1.2. The second formulation is Absolute formulation type (5% ME.) with rate of 75 ml/ feddan.

1.3. Control was sprayed with ground water at 700 milimose.

The efficiency of treatments was determined by inspecting 30 randomly plants from each treatment then each sample was kept in a tightly closed paper bag and transferred to the laboratory in the same day for inspection under stereomicroscope at Qaha, Plant Protection Research Station Laboratory to count *S. critica* larvae. Inspection of plants was carried out before spraying and after 1,3,5,7 and 10 days from application, larvae livingly were accounted and recorded , the reduction percentage of larvae populations was calculated according to the equation of Henderson and Tilton (1955).

2. Physicochemical properties of insecticide at two formulations :

Emulsification stability and foaming were evaluated. Surface tension (dyne / cm), pH value , density and suspensibility % were measured using Tensiometer, respectively **(W.H.O. , 1973)**.

Results and discussions

1.Impact of formulation types on living larvae populations of *Sesamia critica* after spraying :

Data in Table (1) showed that the mean number of *S.critica* larvae during two successive seasons 2018 and 2019 , respectively after first and second spray and impact of two formulation types to emamectin benzoate on the mean number of *S. critica* larvae. From data in tabulated in Table (1), showed that larvae population decreased gradually by time from first day till 10th day from spray in case of Hypnose and Absolute but living larva population in case control were increased by time. Hypnose was more efficacy on living larvae population compared with Absolute, recorded 19th , 14th , 11th , 8th and 7th living larvae after 1,3,5,7and 10 days from spray. On the other hand, Absolute recorded 20th , 16th , 13th , 10th and 9th larvae in the same days aforementioned, respectively. Statistical analysis showed that there are significant differences between each treatments , except after first and ten days from spray indicated not significant .

Table (1): Impact of two formulation types to emamectin benzoate on populations of *Sesamia critica* larvae.

Treatments (trade, common and formulation types)			Pretreatment	Mean No. of larvae after first and second spray during 2018 and 2019 seasons					
Trade name	**Common name**	**Formulations Types**		**1 day**	**3 day**	**5 day**	**7 day**	**10 day**	**residual**
Hypnose	**Emamectin Benzoate**	**5% SG**	19 ab	19 a	14 b	11 b	8 c	7 b	11.8 b
Absolute	**Emamectin Benzoate**	**5% ME**	20 a	20 a	16 b	13 b	10 b	9 ab	13.6 b
Control	**Water**	----------	16 b	19 a	20 a	18 a	15 a	10 a	16.4 a
F	----------	----------	4.333	0.214	16.8	13.01	39.00	3.5	16.12
P	----------	----------	Ns	Ns	**	**	***	Ns	**
LSD	----------	----------	3.46	4.31	2.579	3.46	1.99	2.83	1.99

2.Impact of different formulations to emamectin benzoate for reducing the population of *Sesamia critica* larvae :

Data in Table (2) illustrated that, impact of two formulation types to emamectin benzoate. In respect to, initial effect of the tested formulations to emamectin benzoate on reduction percentage of *S. critica* larvae under field conditions showed that , Hypnose recorded the highest reduction % followed by Absolute , respectively. Hypnose and Absolute recorded reduction % similarity 15.7 and 15.78 % after 1st spray , but the results differed beginning 3 days till 10 days , recorded (41.05 and 36.00) , (48.5 and 42.2) , (53.08 and 46.00) and (91.05 and 28.0) after 3,5,7 and 10 days, respectively. The Hypnose categorized in first rank followed by Absolute in the second rank, with reduction % were 91.05 and 28.0 reduction %, respectively after 10 days **.**

Table (2): Impact of two formulation types to emamectin benzoate on reduction percentage of *Sesamia critica* populations.

Treatments (Trade, Common and Formulation Types)			Reduction percentage in larvae of *Sesamia critica* after first and second spray during 2018 and 2019 season				
Trade Name	**Common name**	**Formulation Types**	**1 day**	**3 day**	**5 day**	**7 day**	**10 day**
Hypnose	**Emamectin Benzoate**	**5% SG**	15.7 a	41.05a	48.5 a	53.08 a	91.05 a
Absolute	**Emamectin Benzoate**	**5% ME**	15.78 a	36.00 b	42.2 b	46.0 b	28.0 b
F	----------	----------	14.78	38.25	59.5	37.59	2.38
P	----------	----------	Ns	**	**	**	***
LSD	----------	----------	3.205	2.26	2.26	3.205	3.58

Statistical analysis illustrated that there are significant after 3, 5 and 7 days and highly significant differences after 10 days between Hypnose and Absolute. In fact Hypnose has constant influence till 10 days after 1st and 2nd spray during two successive seasons.

3. Impact of two formulation types on physicochemical properties to emamectin benzoate insecticide:

Data in Table (3) showed that, impact of two formulation types on physicochemical properties to emamectin benzoate insecticide such pH, surface tension (S.T.), density (Den.), foam and suspensibility % (Sus.%). The results from Table (3) it is obvious that , pH in case of Hypnose and Absolute 7.9 and 7.7 near to equalized or to slightly alkaline , due to retentions emamectin benzoate constant . In the same Table S.T. recorded 33.7 and 34.4 dyne/ cm , cause increasing wetting to treatment surface of plants, but Den. were equalized . On the other hand , foam record 3 ml with Absolute and non foam in case of Hypnose , especially Sus. % record 100 % suspensibility in case of Hypnose formulation type (5% SG). These results agree with Soliman, 1998 and 2004 and Soliman and Mohamed (2007).

Table (3): Impact of two formulation types on physicochemical properties to emamectin benzoate insecticide.

Treatments (Trade, common name and formulation types)			Physicochemical properties				
Trade Name	**Common Name**	**Formulations Types**	**PH**	**S.T** Dyn/ cm	**Den.** Gm/ cm	**Foam**	**Sus.%**
Hypnose	**Emamectin Benzoate**	**5% SG**	7.9	33.7	2	-	100
Absolute	**Emamectin Benzoate**	**5% ME**	7.7	34.4	2	3 ml	-

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