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Evaluating Some Insecticides for Controlling the Sunn Pest *Eurygaster* spp. Puton (Hemiptera: Scutelleridae) under Field Conditions

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Abstract: The sunn pest *Eurygaster integriceps* is the most important insect of cereals in Iraq and other countries. In this study, the field efficacy of 10 different kinds of insecticides with various mode of action was evaluated against sunn pest *E. integriceps* infested wheat on field at middle of Iraq. Experiments were conducted in 11 wheat fields with each field 0.5 ha, located in the middle of Iraq (Wasit and Salahudain governorates) during season 2015-2016. The wheat fields contained common varieties of wheat planted in Iraq. The population density of the pest was at its highest level (start of April 2015) of mostly nymphs, adults and eggs. The results indicated that the recommended dose for each insecticide used showed high efficacy (80.1%-93.8%) in reducing number of *E. integriceps* adults after one week of treatment, reaching 0.2-0.8 insects/m^2 compared to 3.6 insects/m^2 in the control treatment. These results will assist the control program of this pest and in implementing pest management practices to reduce resistance development chances.

Key words: Efficacy, insecticides, sunn pest, *Eurygaster* spp., wheat.

1. Introduction

The sunn pest *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae) is one of the most important pests of wheat and barley in West and Central Asia, including Iran, Turkey, Iraq, and in the Eastern Europe [1, 2]. *E. integriceps* attacks and feeds on both the vegetative stages of the plant and maturing grain. Bouhssini et al. [3] have pointed that the transmission of toxic enzymes into maturing grain can reduce the milling quality, rendering the flour useless for human consumption [2, 4]. Feeding on vegetative stages can cause withering and dead hearts, leading to a reduction in yield. In Iraq, *E. integriceps* represents continuous annual thread, especially in the north region, and was recorded in wheat fields north of the capital (Baghdad) during the nineteenth of last century. During season of 2000-2001, infestations were spread to cover new ecological areas, such as most of the middle of Iraq. The only strategy applied for the control depends solely upon spraying chemical insecticides. Turkish governments have conducted sunn pest management programs, mainly based on chemical control since 1927 [5, 6] and evaluated six insecticides for control overwintered adults of sunn pest under field conditions in Turkey. Mermithid nematode, *Hexamermis eurygasteri* n. sp. was used as a biological control agent in an integrated control program of the sunn pest in Turkey [7]. Turkish government has been changing the sunn pest overwintering adult control policy by wheat growers after shifting from aerial spray to ground application. Therefore, control application made according to the

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plant protection technical guidelines would improve the effect of the struggles to reduce the economic losses in wheat production and develop control application [8, 9] used the entomopathogenic fungus *Beauveria bassiana*, an oil-based formulation to control the sunn pest *E. integriceps* in wheat field.

The present investigation was conducted to evaluate field efficacies of some insecticides of different mode of action to be used in the control campaign of the sunn pest *Eurygaster* spp..

2. Materials and Methods

Experiments were conducted in 11 wheat fields with each field 0.5 ha located in the middle of Iraq (Wasit and Salahudain governorates) during 2015-2016. The population density of the pest was at its highest level (start of April 2015) of mostly nymphs, adults and eggs. Ten insecticides with different mode of action were used in the recommended doses to spray the wheat fields as was shown in Table 1 [10]. Selecting more than one brand of alphacypermethrin was due to the registration of all these brands by the national committee for pesticides registration and approval and to compare between products of the same active ingredient. Each treatment contained three replicates (1,000 m^2 per replicate). Numbers of nymphs and adults *Eurygaster* spp. present per 1 m^2 were counted carefully directly on the wheat plants of 10 m^2 chosen randomly per each replicate before and after treatments with one, three and seven days (one week) taken from different parts of plant. Two sprayers of 100 L EC and 2 L ULV Guarany were used for all replicates from up to down to ensure exposing the pest individuals to the insecticides tested.

Complete randomized block design was used in conducting all experiments. Genstat program and LSD (0.05 level) were implied in statistical analysis and determined the significance between insecticides efficacies. Henderson-Tilton's formula [11] was used to calculate corrected insecticides efficacies (measured as *a*%) on nymphs and adults *Eurygaster* spp. mortality.

3. Results and Discussion

The results showed that recommended doses of the tested insecticides (as in Table 1) gave high efficacies in reduction of adult and nymph numbers of *E. integriceps* on wheat plants. Results in Table 2 indicated the significant reduction in the average number of nymph and adults per 1 m^2 (0.3-1.6) individuals after three days of treatment in comparison with 3.4 individuals in the control of EC treatment. The reduction in number of live adults after one week

Table 1 Tested insecticides used in the experiments of measuring their efficacies on sunn pest *E. integriceps*.

Insecticide brand name	Company	Recommended concentration	Mode of action according to IRAC 2016 [10]	Active ingredients and concentration	Chemical sub-group
Desis	Bayer	75 mL/100 L	Sodium channel modulators	Deltamethrin 2.5 g/L EC	3A, pyrethroid
Megaalpha	Meghamani	30 mL/100 L	Sodium channel modulators	Alphacypermethrin 10% EC	3A
Alphasin	Sineria	30-40 mL/100 L	Sodium channel modulators	Alphacypermethrin 10% EC	3A
Levo	Seneria	4 L/ha ULV	Uncertain mode of action unknown	Oxymatrin	unknown, plant extract
Flash	Tagros	35-40 mL/100 L	Sodium channel modulators	Alphacypermethrin 10% EC	3A
Matrixin plus	Russell IPM	60 mL/100 L	Glutamate-gated chloride channel allosteric modulators	Abamactein + oxymatrin and unknown, plant extract	6
Golan	Seneria	75-100 mL/100 L	Nicotinic acetylcholine receptor (nAChR) allosteric modulators	Acitamiprid 20 SL	4A, neonicotinoids
Talstar	FMC, USA	100-150 mL/100 L	Sodium channel modulators	Bifenthrin 10% EC	3A
Bestoy	FMC, USA	150-200 mL/100 L	Sodium channel modulators	Alphacypermethrin 10% EC	3A
Bestseller	FMC, USA	100-150 mL/100 L	Sodium channel modulators	Alphacypermethrin 5% EC	3A

of treatment reached 0.2-0.8 nymph or adults/m^2 and 3.6 nymph or adults/m^2 in the control treatment. Significant differences were found between results of some tested insecticides and that of the controls and for all periods. Insecticides efficacies after one week of treatment is 83.1% for Matrxin plus (abamactein + oxymatrixin) as glutamate-gated chloride channel allosteric modulators and 98.4% for Levo ULV (a. i. Oxymatrin, is one of many quinolizidine alkaloid compounds extracted from the root of *Sophora flavescens*, a Chinese herb) [6]. This comparison indicated that using insecticides with acetamiprid (SL, soluble concentrate), chlorpyrifosethyl (EC, suspension concentrate), lambda-cyhalothrin (CS, sodium channel modulators suspension), monocrotophos (SC, suspension concentrate), thiacloprid (SC) and zeta-cypermethrin (EC) as active ingredient gave high efficacies in controlling *E. integriceps* adults and reduced subsequent egg laying and the appearance of nymphs in the trial area in Turkey.

The low mortality rate compared to the rate (93.8%) obtained during recent investigation could be attributed to the difference of the source and dose rate, in addition to the difficulty of counted adults. The results of treatment of nymphs and adults indicated that spraying with the recommended doses of the tested insecticides (Levo, Golan, Desis, Flash, Telstar, Bestoy and Bestseller) showed high efficacies in nymphs and adults mortality. The results in Table 2 showed high effect on nymphs and adults after one week of treatment ranged from 81.3% to 94.1% for Bestoy (alphacypermethrin as sodium channel modulators) and Golan (acitamiprid as nAChR allosteric modulators), respectively. Mortalities were ranged between 84.0%-87.2% for Matrxin (abamactein + oxymatrixin) glutamate-gated chloride channel allosteric, Alphasin (alphacypermethrin, 10% EC) sodium channel modulators and Talstar (bifenthrin 10% EC) sodium channel modulators.

The result also showed that insecticide Flash (35-40 mL/100 L) has the highest efficacy between brands

Table 2 Field efficacies of some insecticides in controlling sunn pest *E. integriceps* in wheat fields.

Treatment	Average insect number of sunn pest per 1 m^2, mortality (%) and efficacy (%) before and after									
	Before treatment	One day after			Three days			One week		
	Insect	Insect	Mortality (%)	Efficacy (%)	Insect	Mortality (%)	Efficacy (%)	Insect	Mortality (%)	Efficacy (%)
Control	3.6	3.4	---	---	3.4	---	---	3.6	---	---
Desis	3.2	0.6	81.3	80.2	0.4	87.5	86.8	0.2	93.8	93.8
Megaalpha	2.6	0.8	85.7	84.7	0.3	87.3	85.9	0.41	84.1	83.2
Alphasin, L	3.8	0.8	78.9	77.7	0.6	84.2	83.3	0.7	81.5	81.6
Alphasin, H	3.6	0.6	83.3	82.3	0.4	88.9	88.2	0.5	86.1	86.1
Control/ULV	18.3	---	---	---	19	---	---	20	---	---
Levo/ULV	17.3	---	---	---	1	94.2	94.4	0.3	98.3	98.4
Flash, L	3.1	0.6	80.6	79.5	0.4	87.1	86.3	0.3	90.3	90.3
Flash, H	3.6	0.6	83.3	82.4	0.45	87.5	86.7	0.3	90.7	91.7
Matrxin plus	5.0	1.1	77.3	76.0	0.98	81.3	80.0	0.8	84.0	83.1
Golan	5.1	0.9	82.4	81.3	0.5	90.2	89.6	0.3	94.1	94.1
Talstar, L	4.1	1.7	59.5	57.1	1.6	65.1	64.2	0.5	87.2	86.0
Talstar, H	2.6	0.8	68.3	76.0	0.6	77.7	76.5	0.2	92.0	89.8
Bestoy, L	3.5	0.5	84.2	82.6	0.4	87.4	86.5	0.5	83.0	81.3
Bestoyl, H	3.2	1.05	67.2	66.0	0.4	78.1	77.5	0.3	89.7	89.0
Bestseller, L	3.7	0.9	74.3	72.7	0.4	89.2	88.5	0.35	90.5	89.2
Bestseller, H	4.8	0.9	80.3	78.7	0.5	89.4	88.5	0.3	90.9	90.0

LSD at 0.05 = 5.1420, L = low dose, H = high dose.

with Alphacypermethrin as active ingredient. In addition using ULV formula (Levo, i. a. oxymatrin) gave the highest efficacy (98.4%) after one week of treatment in controlling sunn pest individuals.

Therefore, it is recommended that application of insecticide must be timed correctly, targeting the most vulnerable life stage of the insect pest and mixing and applying insecticides carefully. In addition, a key element of effective resistance management is the use of alternation, rotations or sequences of different insecticide mode of action classes. It is important to avoid selecting for resistance or cross resistance by repeated use within the crop cycle, or year after year, of the same insecticide or related products in the same mode of action class, but continues use of pesticides in sunn pest its effect on the environment, reduction of the beneficial fauna, costly human health and environment safety [2].

4. Conclusions

It could be concluded from the above illustrated results the availability of some insecticides of different mode of action with high efficacies on sunn pest. Thus, these insecticides were recommended to use in sequence of different mode of action each time during the season, to minimize the chance of resistance selection.

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