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ORIGINAL ARTICLE

Effect of some Microbial and Chemical Pesticides on Larvae of the Winter Moth in Dryland Chickpea

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ABSTRACT
In order to investigate the effect and compare of microbial and chemical pesticides on the winter moth in dryland chickpea, a field experiment was carried out as a split plot based on completely randomized block design with five replications. Treatments were included pesticides and biopesticides of Carbaryl (Sevin®) 85%WP, Diflubenzuron (DIMILIN®) 25%WP, Virus agrotis virid, Bacillus thuringiensis subsp. kurstaki (Btk) and control. Sampling was done before bait application and 5, 10, 15 and 20 after it in a depth of 20cm, then obtained results were converted to the percentage of experimented materials effect by the formula of Henderson and Tilton. Results of two years experiment as mean indicated that mortality percent of the larvae was 87/74% for Carbaryl, Btk 48/97%, viral biopesticide 51/63% and Diflubenzuron 65/1% respectively. In total, in evaluation of two years experiment, efficiency of Carbaryl was the better than other pesticides and biopesticides including Btk, Virus agrotis virid and Diflubenzuron.
Keywords: *Agrotis* spp., biopesticides, *pesticides*, chickpea, field.

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INTRODUCTION

Winter moth larvae of *Agrotis* spp. (Noctuidae) attack the young seedling of pea crops, sunflower, corn, potatoes and other fresh vegetables grown and with feeding of the crown part of freshly grown seedling cut them. In dryland regions due to the lack of moisture in the soil after rainfall season (spring), there is no possibility of regermination of plants in these areas, thus the increase of damages and irreversible losses are imposed to farmers annually in these area. Annually in Kurdistan province (west of Iran) nearly 100000 ha of total lands is under chickpea cultivation which in outbreak periods of *Agrotis* spp. almost third to half of crop are damaged seriously. Chemical control is the main strategy for the protection of vegetables against this pest but the use of synthetic pesticides causes some unfortunate consequences like environmental pollution, pest resistance and toxicity to other non target organisms [1]. These unfavorable effects are major challenge of our goal in pests management and common cause of the redundancy of researchers' agitation in assessment of biopesticides as replacement of chemical pesticides. Among combined methods in IPM strategies, biological control is the most prominent [2]. One of the biological aspects are biopesticides, biopesticides are biochemical pesticides that are naturally occurring substances that control pests by nontoxic mechanisms, in really, biopesticides are living organisms (natural enemies) or their products (phytochemicals, microbial products) or byproducts (semiochemicals) which can be used for the management of pests that are injurious to plants [3]. In present study our goal was to investigate and compare of some microbial (bacterial and viral biopesticide) and current chemical pesticides in control of *Agrotis* pest in Kurdistan province condition in Iran.

MATERIAL AND METHOD

In order to carry out this project, Kharkeh station was chosen (Agricultural and natural resources research center) for experiments during two years. Experimental land was divided into 20 plots and each plot had 15 cm^2 spaces. Each plot consisted of 10 rows to length of 5m and 30cm width between planting rows was considered. Distance between planted seeds was 10 cm and to avoid the traffic of larvae between plots 4m distance was considered. Before planting, seeds (Jam cultivar of chickpea) disinfected by Benomyl to proportion of two per thousand and fertilizer requirements was used based on common proportion. The experiment included five treatments in four replications including chemical *pesticides* of 1-Carbaryl (Sevin®) 85%WP 2- Diflubenzuron (DIMILIN®) 25%WP and commercial biopesticides of 3- Virus agrotis virid 4- *Bacillus thuringiensis* subsp. *kurstaki* (Btk) *and* 5- control. seeds were planted in early May and time to fight against pests in the area was tested according to notes of pheromone traps placed at the last decade of April. In each treatment, the determined doses of pesticide mixed with 20ml water and one kg wheat bran (early recommended amount for mixing of each experimental pesticide) and at the end of the day (sunset), baits were distributed in plots manually. To determine the number of alive and dead larvae, numbering was done one day before bait application and 5,10,15 and 20 days after it by throwing quadrate 0.5 × 0.5 m^2 as random and four times in each plot (in total 2 m^2) and in finally larvae were numbered. Numbering of alive and dead larvae in each sample was accomplished in depth of 20cm. In continue obtained data computed as the percentage of mortality by Henderson and Tilton formula [4] and by using MSTATC software, collected data were analyzed based on split plot as completely randomized block design. The means were compared by Duncan multiple-ranges test (DMRT) at $P \leq 0.05$.

Mortality percent formula (Henderson and Tilton, 1955) = $\left[1- \frac{Ca \times Tb}{Cb \times Ta} \times 100\right]$

Ta: Insect population before treatment
Tb: Insect population after treatment
Ca: Insect population in control before treatment
Cb: Insect population in control after treatment

RESULT AND DISCUSSION

In present study, the means of two years experiment indicated that in four times sampling, Carbaryl 85%WP pesticides with mean of 87.74% had the highest effect in control of *Agrotis* spp.. Also the other pesticides including Btk, agrotis virid and Diflubenzuron 25%WP were effective in control process but in comparison to Carbaryl were arranged in next rankings (Table 1). In a laboratorial study for evaluation biopesticides against cotton leaf worm has been demonstrated that the effect of chemical insecticide of Teflubenzurone was higher than *Bacillus thuringiensis* subsp. *Kurstaki* (used at LC50) and *Serratia macrescens* [5]. With refer to table 1 we show that in two years experiment in the field among treatments, bacterial and viral biopesticides after Carbaryl had acceptable control while the efficiency of chemical *pesticide* of Diflubenzuron in field condition was lower than them. in Figure 1, sampling times have been shown in four times in two years as mean, in during first ten days Carbaryl had 100% control but in continue gradually its ability mortality reduced and achieved to about 40% while the control ability of Btk biopesticide initially was 30% but in next times increased so that in tenth day achieved to 60% and in twentieth day became 83%. This condition also was observed in agrotis virid biopesticide. Virus usually takes between 4 and 14 days to kill their hosts [6]. In other studies the importance of viral and bacterial pesticides in control of pests have been reported for instance, Gelierss and Schlie Peke 1992 [7] estimated the efficiency of Granular virus on *Agrotis* larvae in ornamental plants and reported that the maximum control rate was 94% and the same researchers with comparing of the effect of viral biopesticide and the chemical pesticides during field experiments announced that the application of biopesticides is appropriate and even more. The use of *Anticarsia gemmatalis* NPV (AgMNPV) to control *A. gemmatalis* in soybean in Brazil was a very successful program and was considered and reported as a comprehensive control in the world [8]. A mortality record of 76% has been reported for *Malacosoma neustria* using *B. thuringiensis* (MnD) isolated from *M.neustria*. [9]. Karamanlidou *et al* 1991[10] achieved to a mortality > 80% when they applied different Bt strains versus old larvae of the dipteran olive fruit fly, *B. oleae* (Gmelin). Queen et al 1991[11] applied Btk (3%) as 0.5, 1 and 1.5 gl/ha on larvae and stated that when consumed dose increased subsequently mortality rates increased. Also Macintash 1990 [12] in his study reported that sensitivity of *Agrotis* larvae to Btk is in result of secreted protein by bacteria. *Bacillus thuringiensis* has many molecular mechanisms to produce pesticidal toxins; most of toxins are encoded by several *cry* genes [13].Therefore, with regard to control ability of Btk (65.1%) in this study we can say that in field condition to replace of usual chemical *pesticides* with Btk and the application of it as five to seven days sooner can achieve to a favorable control level against *Agrotis* spp.. Although potential of the used viral biopesticide in this study was lower than Btk, but the transmission ability of viruses can exploit as a potential management tool to reduce pests [14] and also must be said that the main prominence of the viral than Bacterial biopesticides is their specificity [15]. Moreover, with the improvement of control efficacy of viral biopesticides by selecting enhancers can be reached to optimal efficiency, for example, mixture of a chitin synthase inhibitor, chlorfluazuron, with formulation at a concentration of 4.2 ppm reduced HearNPV median lethal time in 3rd instar *Helicoverpa. armigera* larvae from 4.90 days to 2.24

days [16], But in general, *Bacillus thuringiensis* because of its rather good specify, low mammalian toxicity and limited non target impacts has been chosen as a agent for eradication of both white spotted tussock moth and painted apple moth as aerial application [3]. As a result of these traits, for various crop types, bacterial biopesticides have allocated about 74% of the market to itself and other biopesticides like fungal biopesticides respectively 10%, viral biopesticides 5%, predator biopesticides 8% and other biopesticides 3% [17]. In finally, given to results of this study can be stated that the application of biopesticides including *Bacillus thuringiensis* subsp. *Kurstaki* and agrotis virid is effective in control and management of *Agrotis* spp. and use of them instead of synthetic pesticides can be a appropriate style in increasing of control level and reducing adverse effects of chemical pesticides on the environment and society.

Table 1. Effect of different pesticides on the control of *Agrotis* spp.

Treatments	First year	Second year	Total two years
Carbaryl 85%WP	91.83[a]	83.65[a]	87.74[a]
Bacillus thuringiensis subsp *kurstaki*	64.37[ab]	65.83[ab]	65.1[b]
Viral insecticide	55.35[ab]	47.9[bc]	51.63[c]
Diflubenzuron 25%WP	50.02[b]	47.92[c]	48.97[d]
Control	0[c]	0[d]	0[e]

Common letters have not significant difference in level of ($p<0.01$).

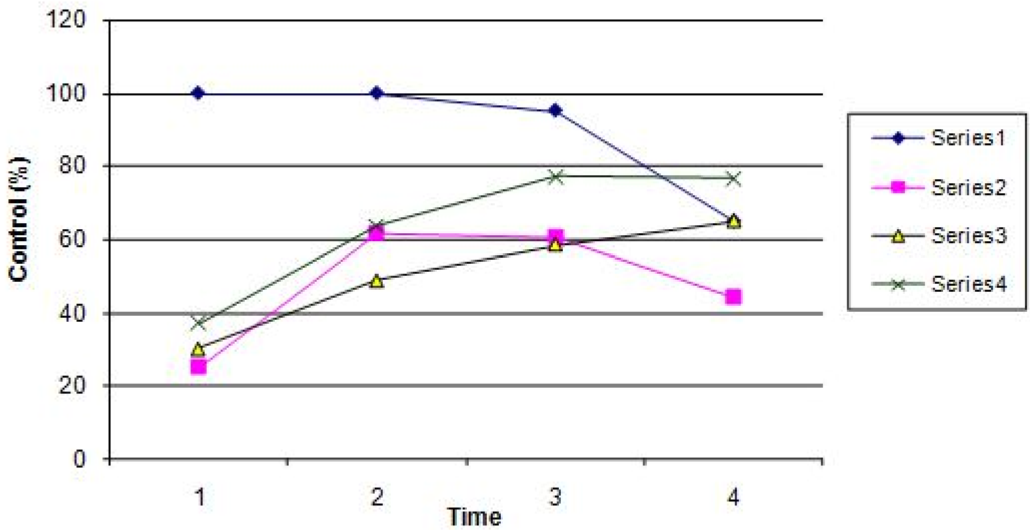

Figure 1**.** The mean percentage of the effect of different pesticides in four times sampling after the application of pesticides Treatments: Series 1: Carbaryl (Sevin®) 85%WP, series 2: Diflubenzuron (DIMILIN®) 25%WP, series 3: Virus agrotis virid, series 4: *Bacillus thuringiensis* subsp. *kurstaki* (Btk*)*. Times: 1: fifth day, 2: tenth day, 3: fifteenth day, 4: twentieth day.

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