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Effects of Biological Insecticides on Predatory Spider's Population in Rice Field

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ABSTRACT: The study was conducted to compare the effects of different biological insecticides: extracts of *Azadirachta indica* and *Eucalyptus globulus*, and Spinosad on spider's population in a rice field at an agricultural farm in tehsil Daska of district Sialkot-51310, Pakistan. Spiders, as natural enemies play an important role in keeping pest population under control by not only feeding on pests but also limiting the availability of habitats open to pests by occupying various microhabitats in an agricultural ecosystem. The experiment was laid in randomized complete block design (RCBD) with three replicates. Biological insecticides including two botanical (extracts of *Azadirachta indica* and *Eucalyptus globulus)* and one microbial (Spinosad) were applied to the rice crop. The spider's population was counted after one, three and seven days from insecticide application. After one day from insecticide application, the reduction in spider's population was 42.18%, 36.68% and 33.38% with Spinosad, *A. indica* (20% conc.) and *E. globolus* (20% conc.) respectively. The trend of reduction of spider's population decreased with time from one to seven days. Spider's population showed significantly higher resistance to *botanical* than microbial insecticide.

KEYWORDS: Botanical insecticide, Microbial insecticide, Resistance, Natural enemies, Agricultural ecosystem.

1 INTRODUCTION

Rice (*Oryza sativa L.*) is the staple food of more than half of the world's population, especially in highly populated areas [1]. In Pakistan, It is the second staple food grain crop after wheat and major source of foreign exchange earnings after cotton. It accounts for 3.1 percent of value added in agriculture and 0.7 percent of GDP of Pakistan. Rice was cultivated on 2,571,200 hectares with a yield of 6,160,400 tons during 2011-12 [2]. Rice production is always challenged by insect pests' infestation, especially rice plant hoppers. The crop yield is reduced by pests ranging from 25-30% annually [3]. Plant hoppers can cause leaves to initially turn orange-yellow then brown and dying, a condition called as hopperburn. Plant hopper can also transmit ragged stunt and grassy stunt diseases. Crop loss may be upto 100% in hopperburn situation. There have been famous outbreaks of BPH in Pakistan, Malaysia [4] and India [5] in 1970s. Natural enemies play an important role to prevent the insect pest outbreak in rice field. Spiders, the most abundant rice predators [6] represent more than 90 percent of natural enemies of brown plant hoppers living in paddy fields [7]. Natural enemies can also be used to kill pests not only by direct attack but also by dislodging them from the plants and trapping then in the web [8].

Chemical insecticides are the major control method for rice insect pests. However, the continuous use of a wide range of chemical insecticides has caused many side effects, including loss of biodiversity, the problem of secondary pests, the resurgence of insect pests, insecticide resistance, residual toxicity, and environmental pollution. The impact of synthetic pesticides on beneficial arthropods and the human health risks posed by exposure to these chemicals are issues of growing concern [9]. This has prompted new compounds with reduced environmental persistence and low mammalian and avian toxicity but a fairly broad spectrum of insecticidal activity [10]. An example is Spinosad, mixture tetracyclic-macrolide compounds produced by actinomycete, saccharopolyspors spinosad, isolated from Jamaican soil samples [11]. The objective of the study was to compare the effects of different biological insecticides and to find a biological insecticide causing minimum reduction in spider's population.

2 MATERIALS AND METHODS

2.1 STUDY AREA AND EXPERIMENTAL DESIGN

The experiment was conducted in rice field at an arable farm in district Sialkot-51310, Pakistan situated at the intersection of 32.31° N and 74.36° E with an altitude of 242 m. The mean annual temperature is 30°C with mean annual rainfall of 350 mm. The soil is loamy with organic matter less than 1%. The experiment was laid in a randomized complete block design with three replicates. The nurseries were sown on well prepared raised beds. One month old seedlings were transplanted in the fields with normal spacing of 9 inch. The plot size for each treatment was 100*100 ft.

2.2 BIOLOGICAL INSECTICIDES

Extracts from the leaves and seeds of *Azadirachta indica* and *Eucalyptus golobolus were* obtained by soaking them in boiled water for two hours. The soak was left for two days and then extracts were sieved through muslin cloth. These extracts were used as botanical insecticides and formulation of *Sacchalaropolyspora spinosa* (Spinosad) was used as microbial insecticide.

2.3 SPIDERS COUNTING AND STATISTICAL ANALYSIS OF THE DATA

The data was taken 24 hours before, and 24 hours, 72 hours and 7 days after the pesticide application. The data was collected by direct counting of 10 rice hills at random in the paddy field at five different points. The data was compiled as percent reduction in spider's population with different treatments after 1, 3 and 7 days of insecticide application. The data was analyzed by using JMP Pro 11 software. The student's t test and contrast test were used for ANOVA and mean comparison respectively.

3 RESULTS

The reduction in spider's population due to *A. indica* extract, *E. globolus* extract and microbial pesticide application after 1, 3 and 7 days of insecticide application is given in table 1. There were significant differences among different treatments in term of reduction in spider's population.

Treatments	**Mean reduction (%) in spiders population**		
	After 1 day	**After 3 days**	**After 7 days**
Spinosad	42.18 ± 3.43 a	37.92 ± 3.67 a	19.60 ± 2.76 a
Azadirachta indica	36.68 ± 4.49 ab	32.90 ± 3.85 a	14.44 ± 1.90 b
Eucalyptus globolus	33.38 ± 3.74 b	30.64 ± 3.72 a	11.18 ± 1.65 b
Control	1.74 ± 0.29 c	1.49 ± 0.45 b	1.22 ± 0.37 c
Significance (α=0.05)	<0.0001*	<0.0001*	<.0001*

There is a significant difference between direct and indirect reduction (%) in spider's population with pesticide treatments. The reduction in spider's population was significantly higher with pesticide treatment than control (contrast test). After one day from the pesticide application, Spinosad caused higher reduction in spider's population than Eucalyptus and control treatment. There was no significant difference within botanical insecticides (*A. indica* and *E. globulus*) in reducing the spider's population. The reduction in spider's population with different insecticides was same, but higher than control treatment after three days. Significant decrease in % reduction in spider's population was observed with the passage of time from pesticide application in all treatments except control treatment.

4 DISCUSSION

Chemical control is still used as a main method for insect-pest control because it is easy to use, cheap and efficient. However, continuous use of chemicals has caused different health and environmental problems, and increased pest resistance and mortality of natural enemies. Chemical pesticides like triazophos (0.05% conc.) and quinalphos (0.05% conc.) showed 64.78 and 46.79 % mortality in spider's population, respectively [12]. On the other hand, biological insecticides are least damaging to natural enemies. The study showed the order of mortality had been Spinosad with highest effect on spider's population followed by Neem and Eucalyptus. Biological insecticides also showed less mortality in an experiment conducted by Samiayyan and Chandrasekharan [13]. Maximum reduction of population was found after 1st day of insecticide application suggests that there were less insecticide persistence. The %age reduction of population reduced showing reducing trend of toxicity with passage of time. The results of spinosad were in accordance with the findings of Ghosh [14] where microbial pesticides showed 38.16% reduction in spider's population. When spinosad treated aphids were fed to coccinelid reported no predator mortality [15]). Larvae of Chrysoperla carnia is exposed to spinosad showed 19 percent mortality after 12 days [16]. Joseph et al., [16] observed 24.50% reduction of population with Azadirachtin significantly lower than synthetic pesticides.

5 CONCLUSION

The use of chemical pesticides causes significant reduction in the population of natural enemies of pests. This may reduce the efficiency of biological control of insect-pest in rice field and can cause severe outbreak. The biological insecticides especially of botanical nature are less harmful and can be used in rice field for pest management without causing adverse effects on natural enemies and environment. The use of inexpensive botanical insecticide will also encourage agroforestry at farm level.

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