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RESEARCH ARTICLE

EFFICIENCY OF PARASITOID FLIES, ENTOMOPATHOGEN AND BIOPESTICIDES IN THE CONTROL OF FALL ARMYWORM, *SPODOPTERA FRUGIPERDA* ON MAIZE CROP ECOSYSTEM IN CHITRAKOOT, DISTRICT SATNA, MP, BHARAT

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ABSTRACT

Background: Maize, *Zea mays* belongs to the family Poaceae, and its production is affected by many pests. ICAR recognized one of the major pests called fall army worm, *Spodoptera frugiperda* (FAW) in 2018. The fall armyworm is a severe pest of many cereal, medicinal plants and others crops. The nature of this pest is polymorphic, so the management of FAW for agriculture requires necessary attention. Biological control methods reduce the burden of chemical insecticides in the agriculture field because chemicals reduce taste and nutritional value of food along with soil, water, air pollution and health hazards. **Method:** In the present study, endoparasitoid (*Trichogramma pretiosum*)**,** entomopathogen **(***Beauveria bassiana*), and plant based insecticides like neem seed kernel extract have been used as biocontrol agents for the management of fall armyworm. The experiment was conducted in randomized block design with three replications. **Interpretation and Conclusion:** The biological control agents are very effective in the management of FAW. The egg parasitoid *Trichogramma pretiosum* achieved 44.26% mortality, whereas the entomopathogenic fungus *Beauveria bassiana* recorded the highest mortality rate at 46.16% against *Spodoptera frugiperda* larvae. These findings suggest that *B. bassiana* demonstrated superior pathogenic potential for larval suppression relative to botanical formulations and parasitoid-based interventions.

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INTRODUCTION

Maize is the third major crop of the world after rice and wheat (Sandhu, Singh and Malhi, 2017). According to the Third Advance Estimates issued by the *Ministry of Agriculture and Farmers' Welfare, Government of India*, the projected maize output for the 2024–25 agricultural years has reached an unprecedented 422.81 lakh metric tonnes (LMT). In alignment with national statistics, the United States Department of Agriculture (USDA), Production, Supply and Distribution (PSD) database also reports India's maize production for 2024/25 at 42,281 thousand tonnes, confirming parity with domestic estimates. This represents a notable rise compared to the 37,665 thousand tonnes recorded in 2023/24, highlighting a significant year-on-year production increment. The fall armyworm belongs to the order Lepidoptera and family Noctuidae Capinera (Capinera 2017). The term "armyworm" can refer to diverse species, it often describes the large- scale protruding behavior of larval stage of the species. This pest has adverse effect on crops as it damages a wide variety of crops, which cause huge financial loss. In India fall armyworm was first reported from Karnataka and Andhra Pradesh in May 2018. Fall armyworm has ability to attacks all the stages of maize crops from seedling emergence to ear development. The total loss was 33% caused by FAW attributed infestation. The fall armyworm, *Spodoptera frugiperda* is a very serious and ruinous pest of maize and other cereal crops such as sorghum, cotton, soybean, rice etc. in many countries like India, America, Africa, Mexico, Brazil and Argentina (Prowell *et al.,* 2004; Clark *et al.,* 2007, Pogue, 2002, Nagoshi *et al.,* 2007: Bueno *et al.,* 2010). The fall armyworm is effectively controllable while the larvae are small (RicBessin, 2019). FAW have many generations per year and moths have ability to fly up to 100 km per night.

MATERIAL AND METHODS

Experimental Details: The fall armyworms were collected in June to Nov 2021-2023 from the Agriculture Farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot, Satna (M.P). The experiment was conducted in randomized block design with three replications. The geographical co-ordinates of Chitrakoot has 25°10'32.7972" N to 80°52'5.9664"E. District is bounded in the North by Chitrakoot, in the south by Rewa (M.P). The rain in Chitrakoot falls mostly in the month of July to September, with relatively little rain in the winter. The soil texture of Chitrakoot is loamy-

sandy. The temperature of Chitrakoot varied from June to November, the maximum temperature 47°C and the minimum temperature was 29°C, relative humidity was 61.5%. The biochemical formulations were used for field efficacy test viz. neem seed kernel extract, *Beauvaria bassiana*, and egg parasitoid, *Trichogramma pretiosum* (TP). A leaf-dip bioassay method (Tukaramet *et al*., 2014) was used for stabilizing the median lethal dose for different bioinsecticides. A New fresh, Uniform Sized leaf bit (3.4 cm length × 2.1 cm with (Hybrid 'JM216') seedling was from 20days day after sowing (DAS). The length and width of the field layout was 40.5 m and 12.8 m, respectively. Each block has a length of 3 m and a width of 3.6m. The plantation was repeated three times with four different bio treatments. Block one (T_1) treated with the distilled water (control), block 2 (T2) treated with neem seed kernel extract, block 3 (T9) treated with TPR and block four (T10) treated with *Beauveria bassiana*. All these treatments were repeated thrice in the gap of 20 days.

RESULTS AND DISCUSSION

Neem seed kernel extract (NSKE) exhibited comparatively lower bioefficacy, resulting in 35.96% larval mortality. This finding is alike to Hernández-Trejo *et al*. (2021), who reported that neem seed kernel extract (NSKE) resulted in comparatively lower larval suppression relative to other biocontrol agents. The efficacy of neem-derived botanicals is largely attributed to their antifeedant, growth-inhibitory, and oviposition-deterrent properties, whereas their capacity to induce direct larval mortality in lepidopteran pests is generally limited.

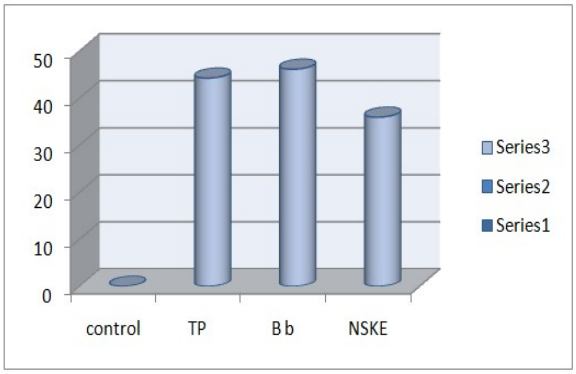

Fig.1. Efficiency of Different Treatments on FAW

The egg parasitoid *Trichogramma pretiosum* achieved 44.26% mortality, whereas the entomopathogenic fungus *Beauveria bassiana* recorded the highest mortality rate at 46.16% against *Spodoptera frugiperda* larvae. These findings suggest that *B. bassiana* demonstrated superior pathogenic potential for larval suppression relative to botanical formulations and parasitoid-based interventions, where as Idrees *et al*., (2022) reported that *B. bassiana* exhibits high levels of pathogenicity against *S. frugiperda*. For instance, specific isolates QB-3.45, QB-3.46, and QB-3.428 caused cumulative mortality rates of 71.3–93.3% at 14 days post-treatment, alongside significant reductions in larval feeding efficacy (69.4–77.8%). Shahzad *et al*. (2021) emphasized the pathogenic efficacy of *Beauveria bassiana* against *Spodoptera frugiperda*, reporting that second-instars larvae experienced mortality levels approaching 79% under laboratory bioassays. The isolate evaluated in their study exhibited a median lethal concentration (LC_{50}) of 1.8×10^7 conidia mL^{-1} and a median lethal time (LT_{50}) of approximately 81 hours, indicating its strong virulence and potential suitability for targeting early larval instars in pest management programs. Jaraleño-Teniente *et al*. (2021) reported that *Trichogramma pretiosum* exhibited relatively low parasitism efficiency on *Spodoptera frugiperda* eggs, with rates averaging approximately 29% under controlled laboratory conditions. In contrast, *Telenomus remus* demonstrated markedly higher performance, exceeding 70% parasitism, thereby highlighting the superior host-searching and oviposition capacity of the later species. Navik *et al*., (2023) reported a parasitism rate of ~29.7% by *T. pretiosum*, whereas *T. atopovirilia* parasitized about 48.3%, indicating variability even among closely related species.

CONCLUSION

The various types of treatment were applied and observed for sixty days in the sets of twenty-twenty days three times. Among all the treatments, Neem seed kernel extract (T_2) was found relatively more effective than the control T_1, while *Trichogramma pretiosum* (T_9) is more efficient than T_1, T_2 and T_{10}. TPR is a parasitoid fly, so it does not contain any chemicals. It supports the growth of the crop, keeping the nutritional values and its taste as usual. TPR has some limitations as it is not applicable in every atmosphere. Also, it is sensitive to temperature (TPR survive in the Temperature range of 18-33^{0}C). The eggs emerged at temperature of 10-11^{0}C. The rainfall also affects its surviving capability as its eggs get messed up. All these treatments are useful only for the first three stages of fall armyworms in maize. These treatments as well as broad spectrum insecticides are not very effective when FAW reached at 4th 5th and 6th stages of larvae. No such chemical insecticides or biochemical insecticides are reported that can control the 4th, 5th and 6th stages of larvae. Biological control of fall armyworm is more efficient than chemical control. It also has the advantage of being eco-friendly because T_2 also contains detergent along with neem seed kernel extract. TPR (T_9) works as an egg parasitoid, while T_{10} is a fungus that causes diseases in fall armyworm larvae.

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