Spodoptera frugiperda and its Management

K. Sindhura Bhairavi[1]*

[1]*Ph.D Scholar, Department of Entomology, Assam Agricultural University, Jorhat-13*

Corresponding Author
K. Sindhura Bhairavi
Email: sindhurak111@gmail.com

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ABSTRACT

Spodoptera frugiperda is a major invasive pest, responsible for causing widespread destruction and economic loss in countries across the world. A native of North America, it has eventually spread through Asia and Africa in the last few decades. It possesses certain biological characteristics like long migration abilities and high fecundity which are advantageous to the pest and makes it difficult to manage its population and spread. This article discusses some of the management strategies that could be potentially used to manage the pest populations.

INTRODUCTION

Fall armyworm (FAW) has become immensely popular in recent times owing to its status as an invasive pest. First reported from Georgia, USA in the year 1797 as *Phalaena frugiperda* and then renamed as *Spodoptera frugiperda*, its area of occurrence was mostly limited to the tropical or subtropical areas of North America. The first report of its spread outside the North American continent was from Israel where adults were identified as FAW. The insect has since been successful in spreading and establishing populations all over Asia, Africa and to as far as Australia. As an invasive and alien pest of 353 species with a high infestation and spreading potential, *S. frugiperda* possesses a huge threat to the local flora and cultivated species of plants It was first reported in India as an invasive pest of maize from Shivamogga district of Karnataka. Thereafter, it has been reported from other parts of India on a variety of crops such as sugarcane, sweet corn, sorghum. Divergence along with their voracious feeding have made *S. frugiperda* a major threat and the changing climate in recent scenarios have pointed out

the chances of further spread and increase in population of the pest. Hence, a detailed study of the ecology and behavior of the insect is essential for the implementation of a proper management programme.

Management of FAW

S. frugiperda has a host plant range of around 353 species and 76 different families. Due to its broad host range and migratory potential, management of *S. frugiperda* is extremely crucial to incur further economic losses. A thorough knowledge of the biology and population dynamics of FAW is hence quite important. Through previous and currently ongoing studies it can be concluded that FAW could only be controlled or managed through proper and constant monitoring and surveillance. FAO and CAB International have launched data portals for the monitoring of FAW such as CAB International fall armyworm portal and United Nations' Fall Armyworm Monitoring and Early Warning System platform. Prediction models for pests which included data of monitoring and surveillance has assisted in the determination of the *S. frugiperda* distribution and migration patterns.

Use of Pheromones

While the control of the pest is a major priority, it is equally important to find eco-friendly approaches before resorting to chemical ones. (Z)-9-tetradecenyl acetate (Z9-14:OAc) was the first FAW pheromonal compound to be identified in the year 1967. Pheromone based lures have proved successful in mating disruption and trapping. In Togo, about 216 traps containing different combinations of lure components were able to collect 304 numbers of *S. frugiperda* adults during a survey period of 45 nights at a rate of 1.41 moths/ trap. In China, a male-attractant pheromone blend was created consisting of *Z*9-14:OAc, *Z*7-12:OAc and *Z*11-16:OAc (Wang *et al*., 2022). A combination of *Metarhizium anisopliae* and *Beauveria basiana* with *S. frugiperda* FALLTRACT lure could suppress *S. frugiperda* population through auto-dissemination.

Use of Bio-control agents

Microbial infections of FAW can be seen occurring naturally under field conditions, arguably with a low population or at least not enough to have a major influence on the pest population dynamics but these can be exploited and may prove successful on a larger scale. Application of 1×10^9 conidia ml^{-1} *B. bassiana* strain isolated from FAW larvae induced 96.6% mortality in the 2nd larvae instar. Soil isolated *B. bassiana* strain induced 75% larval mortality when introduced as an endophyte in maize (Ramirez-Rodriguez and Sánchez-Peña, 2016). In India, large scale field application of *Metarhizium rileyi* formulation at the rate of 2 g/l on maize whorls reduced FAW incidence from 58.9 to 62.9%. In bioassay studies, Ma22, Ma41 and Mr8 strains of *M. anisopliae* showed a mortality rate of 100% in egg and neonate larval stage.

Under laboratory bioassays against *S. frugiperda* pupae, *Steinernema carpocapsae* and *Heterorhabditis indica* were able to induce 72 and 85% mortality respectively, and complete mortality in the 3rd and 4th larvae instars. A strain of *S. carpocapsae* from Rwanda caused a mortality of 75% in 6th instar larvae and recorded complete mortality of 2nd and 3rd instar larvae. Biological control agents such as predators are also highly effective in keeping an insect pest population under check (Fallet *et al.*, 2022). The males and females of *Orius similis*, a predator found in Southern China reportedly attacked and fed on the eggs and 1st instar larvae of FAW. The maximum estimated prey consumption for female and male adult was 23.7 and 22.5 eggs and 26.2 and 19.6 larvae, respectively (Zeng *et al.*, 2021).

Use of insecticides

Insecticides like spinetoram, chlorantraniliprole, emamectin benzoate, and lufenuron were highly toxic to *S. frugiperda* while azadirachtin and lambda-cyhalothrin were less toxic. In case of leaf-dip bioassay method, the highest toxicity was caused by emamectin benzoate, followed by chlorantraniliprole and spinetoram. The most effective insecticide under field conditions have been found to be chlorantraniliprole and emamectin benzoate. Application of Ampligo (a formulation consisting of chlorantraniliprole and lambda-cyhalothrin in a 2:1 ratio) at an interval of 21 and 28 days, has shown significant *S. frugiperda* reduction.

CONCLUSION

FAW is an economically important pest. Therefore, extensive studies have to be carried out on the ecology, distribution pattern, biology, and reproductive behavior of the pest. With respect to the management of FAW, the main drawback when it comes to lures is the nature and behavior of *S. frugiperda* such as wide area of distribution and constant migration. In case of bio-control agents, there is still a lot of research required to establish the effectiveness of an agent under the varied field conditions. The best approach for the management of FAW is an integrated approach through which we could find a way to combine all possible components. The degree and intensity of the damage caused by *S. frugiperda* across the globe is an alarming situation. With the repercussions of climate change in the horizon, the coming decades might see a rise in the population of more than one invasive insect pest like FAW. The scientists and farming communities might face their biggest challenge and must be fully equipped to face the problems head on.

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