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Study on Parasitisation of Different Egg Parasitoids on Egg Mass of Fall Armyworm, *Spodoptera frugiperda* (J.E. Smith) under Laboratory Condition

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ABSTRACT: Fall armyworm is a major polyphagous insect pest, causing a significant damage on different agricultural crops. Developing an alternative non-chemical tool to suppress the pest infestation is essentially needed. Therefore, a study was conducted during the year 2021-2022 to evaluate the parasitisation of different egg parasitoids on egg mass of fall armyworm, at Centre for Biocontrol Laboratory, NIPHM, Hyderabad. During this study the effect of different egg parasitoids namely *Telenomus remus* (Nixon), *Trichogramma chilonis* (Ishii), *Trichogramma pretiosum* (Riley) and *Trichogramma embryophagum* (Hartig) were tested on FAW egg mass. The experiment revealed that the parasitisation rate was significantly higher in *T. remus* (88.05%) followed by *T. chilonis* (53.69%), *T. pretiosum* (49.76%) and *T. embryophagum* (28.94%). It was noticed that *T. remus* was potential to parasitize more than one-layer of eggs in FAW egg mass uniformly. Whereas, *Trichogramma* sp. are able to parasitize eggs in the outer most layer of egg mass.

Keywords: Fall armyworm, Parasitoids, *T. remus* and *Trichogramma* sp.

INTRODUCTION

Fall armyworm (FAW), *Spodoptera frugiperda* (J.E. Smith) is the most destructive pest of many economically important crops across the globe. This pest is a native to tropical and subtropical regions of America and first reported as an invasive pest in Africa in the rainforest zones of Nigeria in 2016 and thereafter it spread to different parts of Africa (Goergen *et al.,* 2016; Abrahams *et al.,* 2017). In India, this pest was reported on maize during May, 2018 in Karnataka (Sharanabasappa *et al.,* 2018). The ICAR-National Bureau of Agricultural Insect Resources, Bengaluru has reported the damage intensity of FAW as 9 to 62% with the yield loss of 34% in Karnataka (Samota *et al.,* 2021). Since then, it has spread to many states of India causing havoc to maize production. It is regarded as a polyphagous and voracious feeder damaging several crops belonging to families Poaceae, Fabaceae, Asteraceae etc and can destroy wide variety of crops like Maize, Sorghum, Cotton, Millets, Peanut, etc.

FAW can cause significant yield losses if not well managed. It can have several generations per year and the moth can fly up to 100 km per night (Johnson, 1987). FAW is a damaging transboundary pest that will continue to spread due to its biological characteristics and high volumes of trade between countries. The ideal climatic conditions for fall armyworm present in many parts of Africa and Asia such as more cloud cover, coupled with low temperature and high rainfall favour the rapid increase of population of FAW to an outbreak. The abundance of suitable host plants suggests the pest can produce several generations in a single season. Its main impact is on maize crop, affects the crop at different stages of growth, from early vegetative to physiological maturity.

Larval stage is the most destructive stage of FAW. So, controlling the pest on or before it reaches to larval stage is very much important (Abrahams *et al.,* 2017; Prasanna *et al.,* 2018). The easiest way to manage the insect pest outbreak is to formulate a self-propelling and self-perpetuating system for the restoration or stimulation of self-sustainable biological control tactics. Biological control agents, such as predators, parasitoids, and pathogens, were supplied to keep close synchronization of the community of other organisms. *Trichogramma* and *Telenomus* are the most active biological control agents, which parasitized the FAW eggs and other key pests. *Telenomus remus* Nixon (Hymenoptera: Scelionidae) is an important control agent of this pest due to its capacity to invade the whole egg mass (Gutierrez, 2012). Parasitoids are closely associated with one of the pest stages and have a higher level of specificity.

MATERIALS and METHODS

The Study on parasitisation of different egg parasitoids on egg mass of *Spodoptera frugiperda* (J.E. Smith) was conducted at Centre for Biocontrol Laboratory at National Institute of Plant Health Management during the year 2021-22. Parasitoids tested for parasitisation of *Spodoptera frugiperda egg mass* were namely, *Telenomus remus* Nixon, *Trichogramma chilonis* Ishii,

Trichogramma pretiosum Riley and *Trichogramma embryophagum* Hartig.

A. Rearing of Host Insect

Initially the FAW egg masses was collected from NIPHM maize field. The larvae were reared individually on maize leaves in petri dishes. The mature larvae were transferred in to a tub filled with soil for pupation. The newly emerged adults were identified based on wing characters. Fore wing of male was shaded with grey and brown colour, with triangular white patch at the apical region and circular spot at the centre of wing. The fore wing of females was uniform greyish brown to fine mottling of grey and brown. The hind wings are silver-white with narrow dark border in both male and female (Sharanabasappa *et al*., 2018).

The freshly emerged adults were released into glass jar for mating and oviposition. Later the jar was covered with muslin cloth and the inner side of the glass jar was lined with the blotting paper to create favourable conditions for egg laying. Cotton swab soaked with 50 per cent honey was kept attached to one end of glass jar as adult food. The cotton swab was changed periodically. A piece of paper folded and placed at centre of jar as oviposition substrate. The eggs laid on them were collected by cutting away the piece of paper with the egg mass. These egg masses were used to conduct the further investigations.

B. Studies on Rate of Parasitization of Egg Parasitoids

The freshly laid FAW egg masses were collected and counted number of eggs in each egg mass under stereo zoom microscope and the counted egg masses were kept separately in glass vials of dimensions (7 cm × 4 cm). Eggs in layers in masses were counted from the surface layer, multiplying them by the number of layers in the mass, counting the visible fringe eggs in the next lower layers, again multiplying the count by the number of layers appropriate to the count, etc., until the whole mass was counted (Leuck and Perkins 1972). Later, 24 hr old adult egg parasitoids were released in to glass vials. The parasitoid-host ratio was adjusted accordingly to 1: 10 (parasitoid adults: host eggs) to get effective parasitism. The vials were covered with cotton plugs by keeping cotton swab containing 50% honey solution at one end of vial as food for adult parasitoids. The FAW larvae emerged from un parasitized eggs were separated and counted. The parasitized FAW eggs in egg masses which turned into black colour were counted to calculate per cent parasitisation by using the following formula.

$$\text{Parasitization Percentage} = \frac{\text{No. of parasitization eggs}}{\text{Eggs exposed}} \times 100$$

RESULTS and DISCUSSION

During this study, four different egg parasitoids viz., *Telenomus remus, Trichogramma chilonis, Trichogramma pretiosum and Trichogramma embryophagum* were studied on egg mass of *Spodoptera frugiperda* at constant temperature of 25 ± 1 ºC with 75% RH and the results were presented in the table (1). The parasitised eggs of FAW by different egg parasitoid species individually on FAW egg mass under no-choice test were recorded based on blackening of *S. frugiperda* eggs.

The results under this study showed that there was a significant difference in parasitisation by *T. remus, T. chilonis, T. pretiosum and T. embryophagum* with the highest parasitism rate obtained for *T. remus*. The parasitisation rate was significantly higher in *T. remus* (88.05%) followed by *T. chilonis* (53.69%), *T. pretiosum* (49.76%) and *T. embryophagum* (28.94%). The aboveresults are in accordance with Laminou *et al*. (2020) found that *T. remus* parasitised on average 78 per cent of FAW eggs and also was able to parasitise egg masses that were fully covered with scales. Pinto and Fernandes (2020) reported that rate of parasitism by *T. remus* on the eggs of *S. frugiperda* was 90.0 + 9.3 eggs per female during the first 24 hours. Which was closely related to per cent parasitisation (per cent) by *T. remus* results obtained in present investigation. Kumari *et al*., (2016) reported the parasitisation capacity of *T. chilonis* on *C. cephalonica* eggs was ranged from 58.94 to 68.9 per cent with an average of 64.28 per cent.

Howeverin India, laboratory studies at ICAR-NBAIR indicated 100% parasitism by *T. remus* on FAW eggs. Meanwhile at NBAIR a laboratory screening of field collected *Trichogramma chilonis* and lab reared *T. pretiosum, T. chilonis* and *Trichogrammatoidea armigera* indicated that field-collected and lab-reared *T. chilonis* and lab-reared *T. pretiosum* could provide high rates of parasitism 74%, 69%, and 67%, respectively, Anonymous (2020). According to numerous research *T. remus* is *S. frugiperda's* most prevalent egg parasitoid with a high level of parasitism Shylesha *et al.* (2018). The reason for effective parasitisation of *T. remus*. on *S. frugiperda* egg mass was due to, the females of *T. remus* respond to the (Z)- 9-dodecene-1-ol acetate and (Z)-9-tetradecene-1-ol acetate Lewis and Nordlund (1987) which were the components of sex pheromone of *S. frugiperda* Nordlund *et al*. (1983). Material from *S. frugiperda* accessory glands stimulated ovipositor probing and drilling by female *T. remus.* Due to the presence of these chemicals increase the parasitism rates of *T. remus*on *S. frugiperda*. Naturally, *Trichogramma* species have difficulties in parasitizing *S. frugiperda* eggs because of scales covering the egg masses and the eggs are deposited in layers Beserra *et al.* (2002); Dequech *et al.* (2013). Whereas, *T. remus* was more aggressive parasitoid on egg mass of *Spodoptera* spp. due to its larger and robust size, which allows it to penetrate all the layers of egg mass and parasitize each egg Cave (1999).

Table 1: Per cent of parasitisation by different egg parasitoids on *Spodoptera frugiperda* egg mass during the year 2021-2022.

Sr. No.	Treatments	Per cent parasitisation of FAW eggs
1.	*Telenomus remus*	88.05
2.	*Trichogramma chilonis*	53.69
3.	*Trichogramma pretiosum*	49.76
4.	*Trichogramma embryophagum*	28.94

CONCLUSIONS

Biological control of invasive fall armyworm is important in Integrated Pest Management. It was noticed that *T. remus* was the potent biocontrol agent to be used as biocontrol agent for *S. frugiperda* followed by *T. chilonis*, *T. pretiosum* and *T. embryophagum*. *T. remus* was potential to parasitize more than one-layer of eggs in FAW egg mass uniformly. Whereas, *Trichogramma* sp. are able to parasitize eggs in the outer most layer of egg mass. Our results are encouraging, the *T. remus* and *Trichogramma* spp. are viable biocontrol agents for *S. frugiperda*. Still, other aspects need to be further studied, such as other factors that influence the success of parasitoids.

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Conflict of Interest. None.

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