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Research Article

Biological control of key pest of jute, *Spilosoma obliqua* Walker (Lepidoptera: Arctiidae) - A case study

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ABSTRACT: Surveys were conducted in intensive jute growing areas of West Bengal to collect information on natural enemies and other entomopathogens infecting jute hairy caterpillar *Spilosoma obliqua* (Lepidoptera: Arctiidae). The jute crop supports large number natural enemies of *S. obliqua* and entomopathogens. Among the braconid larval parasitoids, *Meteorus spilosomae* (Hymenoptera: Braconidae) and *Protapantales obliquae* (Hymenoptera: Braconidae) were the key mortality factors. The activity of these parasitoids was noticed from mid-May to mid-July during the cropping season. The parasitoid, *P. obliquae* is a gregarious, endoparasitoid specific to *S. obliqua* and parasitize to the extent of 38% up to third instar of larvae whereas *M. spilosomae* reported to cause up to 77% of parasitisation on *S. obliqua* under field condition. *Bacillus thuringiensis* and nuclear polyhedrosis virus were found be very effective with mortality of, 64 and 93% respectively. These parasitoids and pathogens can be used as potential bio-control agents against jute hairy caterpillar through conservation, augmentation and mass multiplication.

KEY WORDS: Biocontrol, jute, natural enemies, *Spilosoma obliqua*

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INTRODUCTION

Jute is grown in pre-kharif season, many insect pests infests the crop throughout the crop duration. Rahman *et al.* (2006), India has estimated about 31-34% fibre loss due to multiple insect pests attackin West Bengal. Among them jute hairy caterpillar, *Spilosoma obliqua* (Lepidoptera: Arctiidae) is one of the highly polyphagous key pests which infests many economically important crops often causing severe economic damage (Gupta and Bhattacharya, 2008). It is a regular pest of jute causing defoliation and crop damage extensively. It often causes severe economic damage to jute crop reducing the fibre yield loss up to 30% (Bandyopadhya *et al*., 2014). Timely management of this pest is very important as delay may lead to complete defoliation of crop. Farmers are resorting to frequent use of toxic insecticides and considerable level of resistance to conventional insecticides has developed (Dhingra *et al.,* 2007). Therefore, the role of natural enemies for management of this pest needs to be explored. Information on spectrum and type of native natural enemies is a pre-requisite for large scale inundative release of biocontrol agents. The jute agro-ecosystem supports large number of natural enemies (Rahman *et al*., 2009) and their importance in integrated approach for management of pests of jute has been developed (Rahman *et al.,* 2010). The role of natural enemies for management of *S. obliqua* needs to be explored. In this backed up information on different aspects of natural enemies active in jute agro ecosystem was generated for exploring the possibility of their use as biocontrol agents.

MATERIALS AND METHODS

Surveys were undertaken in intensive jute growing areas of South Bengal for natural enemies and other entomopathogens infecting hairy caterpillar since 2012. During the survey, different stages of field collected *S. obliqua* larvae were maintained and grouped into different stages and further reared in biocontrol laboratory of ICAR-CRIJAF. Separate cylindrical glass jars (27 cm ht X 24 cm dia) provided periodically with fresh jute leaves as feed, covered with muslin cloth till pupation for identification of the parasitoids involved and the extent of parasitisation. Nuclear Polyhedrosis Virus (NPV) was isolated from the NPV infected larvae of hairy caterpillar. The POBs count from infected larva was estimated using hemocytometer. The leaf dip bioassay was carried out with 3rd instar larvae and larval mortality was recorded after 48 hrs of treatment. Median lethal concentration was estimated using SPSS version 16.0. The serial dilutions of *Bacillus thuringiensis* var. *kurstaki* (Delfin WG) commercial formulations were used for estimating the median lethal concentration against 5 days old larvae of jute hairy caterpillar.

RESULTS AND DISCUSSION

The jute crop supports large number of *Spilosoma obliqua* natural enemies particularly, the parasitoids identified were *Protapanteles obliquae* (Wilkinson) (Braconidae: Hymenoptera) and *Meteorus spilosomae* Narendran and Rema (Hymenoptera: Braconidae).

Natural enemies

The early instars (up to third instars) of jute hairy caterpillar were vulnerable to the density dependent mortality factors. The braconid larval parasitoids, *M. spilosomae* and *P. obliquae* were the key mortality factors. Whereas late instars, mortality due to virus was more as compared to parasitoids.

The full-grown *P. obliquae* emerged out through the ventro-lateral body region of the host larva (Mostly 2-3rd instar). The activity of this parasitoid was noticed from mid-May to mid-July during the cropping season. The parasitoid, *P. obliquae* is a gregarious, endoparasitoid specific to *S. obliquae* and parasitize to the extent of 38% up to third instar of larvae. Rahman and Khan (2010) also found that the larval parasitoid, *Apanteles oblique* (Braconidae: Hymenoptera) was found attacking the larvae of *S. obliqua*.

Another parasitoid, *Meteorus spilosomae* is a solitary, koinobiont endoparsitoid, specific to *Spilosoma obliqua* and reported to cause up to 77% of parasitisation under field condition, indicated the possibility of these parasitoids to be used as potential natural enemy of *S. obliqua* of jute through conservation, augmentation and mass multiplication (Fig.1). Earlier Rahman *et. al*., (2007) reported two species of hymenopteran parasitoids of the genus *Glyptapanteles* sps.and *Meteorus* sp. on *S. obliqua* in jute from Bangladesh. In India, Geetha Bai and Marimadaiah (2006) recorded *M. spilosomae* on *S. obliqua* in mulberry from Karnataka.

The study confirms the parasitisation by *M. spilosomae,* a larval parasitoid of *S. obliqua* in jute ecosystem of West Bengal for the first time.

Entomopathogens

Nuclear Polyhedrosis Virus (NPV) occurred naturally and produces about 93% of disease in the hairy caterpillar larvae (Fig. 2). The virus was isolated from the NPV infected larvae of hairy caterpillar. The leaf dip bioassay with the *Spilosoma obliqua* NPV against 3rd instar larvae of *S. obliqua* at differential POB ranges proved to be lethal with the median lethal dosage deduced as 2.4 X 10^{10} POBs (F.L.1.10 X 10^{10}- 5.70 X 10^{10} POBs).

Studies conducted elsewhere revealed that of 7 HaNPV isolates evaluated, strains CBE I and NEG I applied at 3.0 X 10^{12} POB/ha and 1.50 X 10^{12} POB/ha significantly reduced the *Helicoverpa armigera* larval population when sprayed on cotton and chickpea respectively (Jeyarani *et al.,* 2010). The LC_{50} values of various NPVs against 2nd and 3rd instar larvae of *H. armigera*, *Spodoptera litura* and *Amsacta albistriga*

Fig. 1. *Meterous spilosomae* (Hymenoptera: Braconidae).

Fig. 2. NPV infected *Spilosoma obliqua* larva.

indicated 2.30 X and 1.5 X 10^5 OBs/ml for Ha NPV, 3.5 X 10^4 and 2.4 X 10^5 OBs/ml for Sl NPV and 5.6 X 10^4 and 3.96 X 10^5 OBs/ml for Amal-NPV (Sridhar *et al*., 2011).

Similarly, bioassay with commercial formulation of Delfin WG against *S. obliqua*, indicated the concentration to be 0.74 (F. L. 0.588-0.969) and 0.36gm/ml (F. L. 0.285-0.445) at 24 and 48 hrs after treatment. The persistent toxicity of a commercially available formulation of Delfin WG against the 3rd-instar larvae of *S. obliqua* infesting four host plants *viz*, mung bean, pigeon pea, rice, bean and jute crops, respectively were estimated and the results revealed that *Bacillus thuringiensis* var. *kurstaki* (*Btk*) degraded very fast, which was evident from the reduction in larval mortality within 4 days after spraying from 100.00 to 10.00%, 100.00 to 16.67%, 100.00 to 13.33%, and 93.33 to 6.66% on the four host plants (Pramanik *et al.,* 2000). Bhattacharya and Pramanik (2005) evaluated the potency of commercially available *Bt* formulation *viz,* BtK@55000SU/mg and reported that BtK@ 0.2% gave 80% and 93.33% mortality at 48 and 96 HAT against 2nd instar larvae of *S. obliqua.*

Considering the regularity and extent of parasitisation both the natural enemies *i.e*., *Protapanteles obliquae* and *Meteorus spilosomae* and entomopathogens, *viz*., NPV and *Bacillus thuringiensis* observed in this study are quite potential as bio control agents of hairy caterpillar. Among the entomopathogens, NPV of hairy caterpillar holds true potential as an effective entomopathogen for management of hairy caterpillar. However, systematic study is required on mass multiplication, dose and delivery mechanisms.

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