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

B. S. GOTYAL\(^1\), V. RAMESH BABU\(^1\), S. SATPATHY\(^2\) and K. SELVARAJ\(^2\)

\(^1\)ICAR- Central Research Institute for Jute and Allied Fibres, Barrackpore, Kolkata – 700120, West Bengal, India
\(^2\)ICAR- National Bureau of Agricultural Insect Resources, H. A. Farm Post, Bellary Road, Hebbal, Bangalore – 560024, Karnataka, India
*Corresponding author E-mail: gotyalento@gmail.com

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*

(Article chronicle: Received: 07-09-2018; Revised: 21-07-2019; Accepted: 02-08-2019)

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 endoparasitoid, 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 Marimadaiyah (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 LC50 values of various NPVs against 2nd and 3rd instar larvae of *H. armigera*, *Spodoptera litura* and *Amsacta albistriga*
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 SI 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 0.36g/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., Protopanteles 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 bio control agents of hairy caterpillar. Among both the natural enemies and entomopathogens, viz., i.e. Meteorus spilosomae and NPV and Bacillus thuringiensis against Bihar hairy caterpillar, Spilarctia obliqua Walker. Biopest Int. 10: 71-76.

Bhattacharya S, Pramanik A. 2005. Studies on different aspects of efficacy of some commercial microbial pesticides against Diacrisia oblique on jute. Ind J Agric Res. 39: 47-51.

Ch. Sridhar Kumar, Ranga Rao GV, Sireesha K, Lava Kumar P. 2011. Isolation and characterization of baculoviruses from three major lepidopteran pests in the semi-arid tropics of India. Ind J Virol. 22: 29-36. https://doi.org/10.1007/s13337-011-0029-0 PMid:23637499 PMCid:PMC3550719

Dhingra S, Bhandari JKS, Shankarganesh K. 2007. Relative resistance of Bihar hairy caterpillar to insecticide mixtures. J Entomol Res. 31: 209-212.

Geetha Bai M, Marimadaiah B. 2006. Parasitoids for management of Bihar hairy caterpillar bio-organics in sericulture and related technologies. Tech Bull. pp. 79-80.

Gupta G, Bhattacharya AK. 2008. Assessing toxicity of post emergence herbicides to the Spilosoma obliqua Walker (Lepidoptera: Arctiidae). J Pest Sci. 81: 9-15. https://doi.org/10.1007/s10340-007-0175-8

Jeyarani S, Sathiah N, Karuppuchamy P. 2010. Field efficacy of Helicoverpa armigera nucleopolyhedrovirus isolates against H. armigera (Hubner) (Lepidoptera: Noctuidae) on cotton and chickpea in Tamil Nadu. PI Prot Sci. 46: 116-122. https://doi.org/10.17221/30/2009-PPS

Pramanik A, Somchoudhury AK, Khatua DC. 2000. Persistent toxicity of Bacillus thuringiensis var. kurstaki to Spilosoma obliqua Walker on different host plants under field conditions. J Entomol Res. 24: 91-95.

Rahman R, Rahman MM, Islam Huque R. 2007. Observations on the growth parameters of Spilosoma obliqua (Lepidoptera: Arctiidae) reared on artificial diets and reproductive competence of this irradiated pest and progeny. In: FAO/IAEA final research co-ordination meeting. Evaluation of population suppression by irradiated lepidoptera and their progeny, 28-30 May, 1998. Penang, Malaysia, 561 pp.

Rahman S, Khan MR. 2006. Incidence of pests and avoidable yield loss in jute, Corchorus olitorius L. Ann Pl Prot Sci. 14: 304-305.

Rahman S, Khan MR. 2009. Natural enemies of insect and mite pests of jute ecosystem. Ann Pl Prot Sci. 17: 466-467.

Rahman S, Khan MR. 2010. Integrated management approach for control of the pest complex of olitorius jute, Corchorus olitorius, J PI Prot Res. 50: 340-346. https://doi.org/10.2478/v10045-010-0058-5