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Field parasitization of larvae of different broods of top shoot borer, *Scirpophaga excerptalis* (Walker) (Lepidoptera: Crambidae)

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ABSTRACT: The top shoot borer, *Scirpophaga excerptalis* (Walker) (Crambidae: Lepidoptera) is a major borer of sugarcane in almost all the important cane growing areas of India and it attacks the top portion of a shoot or cane. The different broods (first to fourth broods) of top shoot borer were parasitised by three parasitoids i.e., *Isotima javensis*, *Rhaconotus scirpophagae, Stenobracon nicevillae*. The parasitization of top shoot borer larvae (first to fourth broods) by three larval parasitoids varied from 13.3 to 74.2 per cent. The contribution of mortality of larvae/pre-pupae of the top shoot borer by *I.javensis* (alone) was found to parasitise (6.7- 50.2%) in first to fifth broods and is the dominant parasitoid among three parasitoids. Maximum activity of these parasitoids in field was during August to October which synchronizes with the maximum activity of top shoot borer.

Key words: Top shoot borer, parasitoid, sugarcane, Isotimajavensis, *Rhaconotus scirpophagae, Stenobracon nicevillae*

Introduction

The top shoot borer, *Scirpophaga excerptalis* (Walker) (Crambidae: Lepidoptera) is a major borer of sugarcane in almost all the important cane growing areas of India and it attacks the top portion of a shoot or cane. Its incidence is usually more serious in North Indian sugarcane belt when it causes considerable reduction in yield and quality (Gupta, 1959; Kalra, 1972; David*et al*., 1986 and Mazumder, 2018).

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Understanding behavior of parasitoids is critical to their successful use for biological control. A number of biotic and abiotic factors can affect the efficacy of parasitoids. The efficiency of larval parasitoids as measured by percent natural parasitization has greater possibilities to acclimatize the parasites for the management oftop shoot borer. Insufficient information is available on population dynamics of larval parasitoids of different broods of top borer under field conditions. To gather knowledge on field parasitisation affecting larval stages of top borer, a study was undertaken.

Materials & Methods

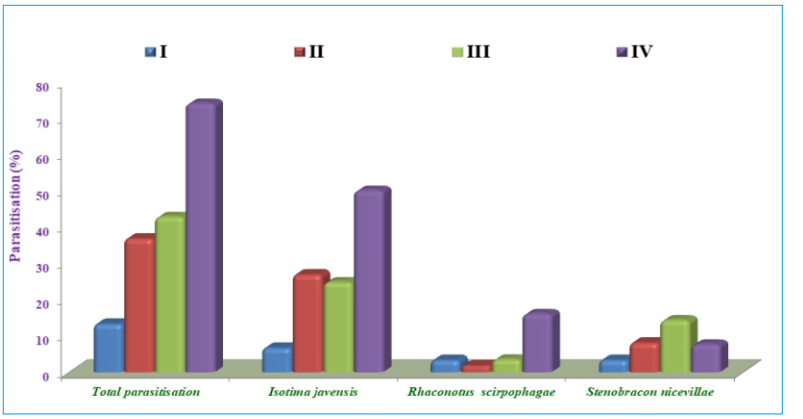
Weekly collections of top shoot borer damaged shoots (three times in each brood) was taken from the I, II, III and IV broods at exit hole stage (the stage before the emergence of moths) from March to October 2021-22 in plant crop of cv. Co 0238 in farmers field at Meerut, UttarPradesh. The collected shoots were dissected to find out whether larvae were parasitized and if so, shoots were kept individually in glass jars and observed for emergence of parasitoids.The totalfield parasitisation and individual parasitisation by each parasitoid were observed and percent parasitisation was calculated.

Results and Discussion

The parasitization of *S.excerptalis* (first brood) by larval parasitoids, (*S.nicevillae*, *I.javensis* and *R.scirpophagae*) was 13.3% . The contribution of mortality of larvae/pre-pupae of the top borer by *Isotimajavensis*was 6.7 percentand it was dominant parasitoid in first brood of top shoot borer (Fig.1). The extent of parasitization during the first brood of the pest has been observed to be about 4 per cent in Uttar Pradesh (Gupta, 1954).

The parasitization by prepupal parasitoid, *I. javensis*inin second brood was 36.8% which was more than *R. scirpophagae* and *S. nicevillae* (Fig.1). The contribution of parasitization by *I. javensis*, *S. nicevillae*and *R. scirpophagae* was 26.9 percent, 8.1 percent and 1.8 percent, respectively. In the third brood larvae were parasitised as high as 42.9. The maximum activity of these parasitoids was observedin field during August to October this activity synchronizes with the maximum activity of S.exceptalis and 35-40 per cent host larvae are parasitised (Mathur, 1942).

Fig. 1.Field parasitization of larvae of different broods of top borer by parasitoids



Ahmad and Mathur (1945)reported the natural parasitism up to 40 per cent in Uttar Pradesh, while Gupta (1953) reported to be as low as 5 to 9.5 per cent during 1947-49.The weather condition during third brood is favorable for parasitoid reproduction in the field. The exit hole (covered with several circular discs) renders the grown up larvae or the newly formed pupa vulnerable to parasitization by *Isotima javensis* (Kalra and David, 1967; Avasthy and Tiwari, 1978 and Kalra, 1980). The top borer larvae while constructing the silken nest or the exit hole comes closer to surface of the rind. Sometimes in this process the cortical tissues are eaten away to such an extent that the caterpillar is exposed but for the silken lining above it. It is at this stage that the top borer larvae are generally parasitised. The adult wasp pierces the silken lining by its long ovipositor to deposit the eggs (Cherian and Israel, 1938 and Baitha and Tripathi, 2018).

The maximum parasitatization was observed in the of fourth brood (74.2%) with the order of dominance by *I. javensis*50.2%, *R.scirpophage*16.2% and *S.nicevillae*7.8%, (Fig.1). similar parasitisation rate was observed when the borer infestation remains generally very high (Gupta, 1958 and Baitha and Tripathi, 2016). The synchronization of parasitization with the availability of the borer larvae in the fields at this time helps a good deal in keeping the pest under check (Singh, 1964).The parasitization of different broods of top borer by *Isotima* ranged from 2-6 percent and 7-20 percent during Jan-May and July-Oct, respectively in Punjab, U.P and Bihar (Gupta 1954;Anonymous, 1989 and Baitha *et al*., 2017).

S.nicevillei preferentially does not lay eggs on exposed or dead hosts or already parasitized hosts. This may be one of the reasons for the low population of parasitisation than *Isotimajavensis* (Chishti and Quicke, 1996). The dominance of *Isotima javensis* is dominant parasitoid, it may be due to climatic factors, varities or host parasitoid relationship or population mating structure and females of *I.javensis* ability to manipulate their offspring's sex ratio based on prevailing climatic conditions.

The reports from India show that both *I. javensis*and *S. nicevillei* (Cherian and Israel, 1938 and Rao, 1964) give good control of *S. nivella* in the Southern part of India. Both of them are quite active in killing the larvae of the top shoot borer in Bangladesh. Presumably these two parasites are well suited under warmer climate. The percentage of parasitism observed in the field in 1935 and 1936 varied from three to five (Narayanan, 1938).

Smith and DeBach (1942) were of the view that the parasitoids depend on the supply of host for the reproduction and the probability that the effective reproductive rates rose when host were abundant and fell when hosts were scarce. This is quite true in the case of the top borer and that were reflected in the rose and fall in parasitisation. The mortality of larvae of the top shoot borer by parasitism is high particularly in the fourth brood and it parasites between there are able to keep down the population of top borer, *S.excerptalis* under control during the rainy season which is the main growing period of sugarcane (Kalra and Sidhu, 1965). Sellers (1941) stressed that all the successful cases involved only a single species of parasites and predators and if two or more were involved, usually one was dominant as

in present study. Wilson (1960) held the view that single species of parasites or predators were in adequate to control its host over the whole area that the pest occupied in a continent. According to DeBach and Sundby (1963), the co-existence of two or more parasites of the same host, attacking the same stage may not be possible in the absence of alternate hosts in nature, and they are of the opinion that this could be one of the reasons of the displacement of one *Aphytis*sp. by another in California. In the case of the top-borer of sugarcane, all the three parasites, recorded, attack the same stage of the host. All of them lay eggs on the early larval stage and the parasite larvae become mature and pupate when the host is in the advanced larval stage, and this probably causes displacement as has been suggested by DeBach and Sundby (1963) in the case of *Aphytis*sp.

The larval parasitization ranging between 28-60 percent in 1957-1961, it failed to suppress the top borer incidence which remained at 58 and 85 percent during the same period in Punjab (Singh, 1964). Similarly, Samoedi (1988) reported that the natural enemy complex did not suppress the top borer population. A study of the behaviour of the top borer larva in host spindle indicated that the vulnerable stage of the top borer accessible to the parasitoids lasts for a very short period which limits the effectiveness of parasitoids in endemic pockets. Moreover, in nature the larval parasitization by *I. javensis* occurs only after the exit whole formation, by then the plant had already damaged (Singh *et al.,* 1984).

In nature, top borer has to face so many parasitoids for their survival. This opens up a battery of active biological warfare that can be gainfully utilized in the containment of top borer. Despite a large number of parasitoids, to date only a few could be exploited commercially for the containment of top borer of sugarcane. It is hoped that with more intensive research in this direction, new parasitoids might be found or new technique of mass multiplication for utilizing the existing ones would be developed for the containment of top borer.

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