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Safety of Two Granulosis Viruses Infecting Sugarcane Borers to Certain Parasites and Predators

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ABSTRACT

The granulosis virus (GV) infecting sugarcane shoot borer, *Chilo infuscatellus* Snell., is not affecting directly the principal tachinid larval parasite, *Sturmiopsis inferens* Tns., and is found safe when tested both by adult feeding and maggot dipping methods. This GV and another GV infecting internode borer, *Chilo sacchariphagus indicus* (Kapur) are found safe to parasites, *Trichogramma chilonis* Ishii, *T. japonicum* Ashm., *S. inferens*, *Apanteles flavipes* Cam., *Elasmus zhentneri* Ferr., *Tetrastichus israeli* Rohw., *Adelencyrtus mayurai* Subba Rao and coccinellid predators, *Chilocorus nigritus* (F.) and *Pharoscymnus horni* Wsl., commonly occurring in the sugarcane ecosystem.

Key Words : Granulosis viruses, Sugarcane borers, safety, parasites and predators.

The granulosis viruses (GVs) of sugarcane shoot borer, *Chilo infuscatellus* Snell., (Easwaramoorthy and David, 1979) and internode borer, *C. sacchariphagus indicus* (Kapur) (Mehta and David, 1980) are occurring naturally in the different agroclimatic zones (Easwaramoorthy and Jayaraj, 1987). From the results of both laboratory and field studies, it is evident that at least the GV infecting shoot borer is a potential agent which can be utilised as an important component in the integrated management of the pest (Easwaramoorthy, 1984). It becomes necessary to find out whether or not these GVs are pathogenic or toxicogenic to parasites and predators present in the sugarcane ecosystem. Detailed studies were therefore carried out on the safety of the GV infecting shoot borer to its principal larval parasite *Sturmiopsis inferens* Tns., and also on the safety of the two GVs to parasites and predators commonly occurring in the sugarcane ecosystem.

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MATERIALS AND METHODS

1. Studies with *S. inferens*

Adult feeding method

The parasite was reared as per the methods outlined by David *et al.* (1980). The females on the day of emergence were allowed to mate with 1-2 day old males and one set of mated females were fed with 50 per cent honey mixed with 1.1×10^{10} inclusion bodies (IBs)/ml of shoot

borer virus. For control flies, 50 per cent honey alone was given. The flies were reared at the rate of three per gestation cage (11.5 x 8.5 x 11.5 cm). The treatments were replicated five times with three females per replication. The females upon completion of gestation period were dissected out and fertility and fecundity were determined. The resulting maggots were inoculated on the fourth and fifth instar larvae of shoot borer following Scaramuzza's technique. The inoculated larvae were reared at 28 ± 1°C and relative humidity of 80 ± 10 per cent. The per cent effective parasitization was calculated by excluding the diseased larvae.

Maggot dipping method

The maggots obtained by dissecting the gravid females were dipped for 10 min in purified intact shoot borer virus at 1.1 x 10^{10} IBs/ml or in virions freed using 0.01 per cent sodium hydroxide as per the procedure outlined by Tanada and Hukuhara (1971). The maggots dipped in distilled water served as control. The maggots were inoculated at the rate of two per host larva on fourth and fifth instar shoot borer larvae disinfected with one per cent sodium hypochlorite. The inoculated larvae were reared on sugarcane shoot bits and data were collected on per cent virus infection in host larvae, host pupation, pupal weight and moth emergence. The per cent effective parasitization was calculated by excluding the diseased larvae. The parasite puparia on the day of formation were weighed individually, disinfected with one per cent sodium hypochlorite and kept in fly emergence box (30 x 22.5 x 26.5 cm) and checked twice a day for adult emergence. The females on the day of emergence were got mated and reared upto the completion of gestation period on 50 per cent honey. The average fecundity of the females was determined by dissecting out the gravid females.

Safety tests with parasites commonly occurring in the sugarcane ecosystem

With a view to determine the safety of the two granulosis viruses to the parasites commonly occurring in the sugarcane ecosystem, adult feeding tests were carried out. The parasites studied included two egg parasites of sugarcane borers, *Trichogramma chilonis* Ishii and *T. japonicum* Ashm., larval parasite of shoot borer, *S. inferens*, larval parasite of shoot and internode borers, *Apanteles flavipes* Cam., larval parasite of top borer, *Elasmus zhentneri* Ferr., pupal parasite of sugarcane borers, *Tetrastichus israeli* Rohw., and scale insect parasite, *Adelencyrtus mayurai* Subba Rao. The parasites on the day of their emergence and on the subsequent day were fed with 1.1 x 10^{10} IBs/ml of shoot borer or internode borer GV thoroughly mixed with honey. In all the cases except in *S. inferens*, virus-mixed honey was given as droplets on wax cards. For *S. inferens*, the virus-mixed honey dipped in cotton swabs was given as feeding material. The treatments were replicated five times. Observations were made on the general behaviour, mortality and mean longevity of the parasites.

Safety tests with predators

Two coccinellid predators that feed primarily on the sugarcane scale

insect, *Mleanaspis glomerata* (Green), *viz., Chilocorus nigritus* (F.) and *Pharoscymnus horni* Wsl. were used in this study. These were fed with scale insects colonized on sugarcane bits. Cane bits (variety CoC 671) of 25 cm length prepared from top half of 10 months old cane were waxed at both the ends. These cane bits were artificially infested with scale insect by covering them with live scale insect scrapings in a plastic tray which is then covered with black cloth for the first few days for uniform settlement of crawlers (Rao, 1983). The crawlers upon emergence, established on the cane bits and such cane bits 20 to 30 days after the establishment of the crawlers were given to the predators. Five day-old grubs and newly emerged beetles were used for testing the virus safety. The cane bits with well developed scale insects dipped in shoot or internode borer GV at the dose of 1.1×10^{10} IBs/ml mixed with Teepol 0.05 per cent and then dried under shade were given for the first two days. In the case of control, cane bits dipped in distilled water along with Teepol 0.05 per cent was given. After two days, cane bits with healthy scale insects were given in all the treatments. The treatments were replicated five times with 50 adults or grubs in each replication. Data were collected on mean longevity of grubs and adults and mean fecundity of females.

RESULTS AND DISCUSSION

Studies with *S. inferens*

Adult feeding method

The gestation period, fertility and fecundity of *S. inferens* females were not significantly affected when they were administered with shoot borer virus (Table 1). The activity of the offsprings was also not significantly retarded as evidenced from the per cent effective parasitization. There was no virus infection in the larvae inoculated with maggots obtained from virus-fed females indicating that the virus has not been transmitted through the adults of *S. inferens*.

Maggot dipping method

The maggots, dipped in intact virus or freed virions, when inoculated on shoot borer larvae showed no appreciable variation in any of the characters studied (Table 2).

Table 1. Safety of shoot borer virus to *S. inferens* by adult feeding method

Characteristics	Shoot borer virus-fed	Control
Females successfully completed gestation period (%)	72.1[a]	72.0[a]
Females fertilized (%)	75.0[b]	76.8[b]
Average fecundity	225.8[c]	227.0[a]
Effective parasitization (%)	51.2[d]	49.3[d]
Virus infection (%)	0.0[e]	0.0[e]

Figures followed by the same letters are not significantly different (P=0.05) by L. S. D.

Table 2. Safety of shoot borer virus to *S. inferens* by maggot dipping method

Characteristics	Maggots dipped in virus	Maggots dipped in virion	Control
Virus infection (%)	2.9[a]	12.3[a]	0.0[a]
Host pupation (%)	20.7[b]	18.7[b]	24.7[b]
Host pupa weight (mg)	73.6[c]	70.7[c]	77.7[c]
Moth emergence (%)	22.8[d]	16.3[e]	50.2[d]
Effective parasitization (%)	49.8[f]	48.2[f]	51.6[f]
Puparial weight (mg)	39.0[g]	40.8[g]	44.8[g]
Fly emergence (%)	100.0[h]	100.0[h]	100.0[h]
Mating (%)	83.3[i]	83.3[i]	66.8[i]
Average fecundity	330.5[j]	370.3[j]	370.0[j]

Figures followed by the same letters are not significantly different (P=0.05) by L. S. D.

Table 3. Longevity of adult parasites fed with shoot and internode borer GVs

Parasite Species	Sex	Number tested	Shoot borer virus-fed	Internode borer virus-fed	Control
Trichogramma chilonis	Male	350	10.3[a]	10.9[a]	10.6[a]
	Female	350	10.5[b]	10.9[b]	10.4[b]
Trichogramma japonicum	Male	250	10.3[e]	10.5[e]	10.8[e]
	Female	250	10.9[d]	10.8[d]	11.2[d]
Sturmiopsis inferens	Male	25	16.1[e]	18.3[e]	15.5[e]
	Female	25	14.3[f]	14.2[f]	14.2[f]
Elasmus zhentneri	Male	40	5.6[g]	5.0[g]	5.9[g]
	Female	40	10.1[h]	10.2[h]	10.1[h]
Apanteles flavipes	Male	60	3.5[i]	3.6[i]	3.3[i]
	Female	60	3.5[j]	3.7[j]	3.6[j]
Tetrastichus israeli	Male	100	15.1[k]	13.7[k]	15.4[k]
	Female	100	13.9[l]	13.9[l]	13.0[l]
Adelencrytus mayurai	Female	100	11.1[m]	10.3[m]	11.1[m]

Figures followed by the same letters are not significantly different (P=0.05) by L. S. D.

Safety to parasites

The general behaviour and daily mortality rate of both males and females of different parasites were similar in the case of treatment with virus and control. The mean longevity of the parasites (Table 3) were not significantly altered, when they were fed either with shoot borer or internode borer GV.

Safety to predators

The mean longevity of grubs and adults of the two species of coccinellid predators was not affected when they were fed with scale insects dipped in GVs (Table 4). The fecundity of *C. nigritus* was 12.8 ± 1.6, 13.2 ± 1.7, 11.8±2.3, and that of *P. horni* was 26.2 ± 3.8, 27.5 ± 3.6 and 27.0 ± 4.3 on shoot borer virus-fed, internode borer virus-fed and control adults,

Table 4. Mean longevity of coccinellid predators fed with shoot and internode borer GVs

Species and Stage	Number tested	Shoot borer virus fed	Internode borer virus fed	Control
Pharoscymnus horni				
a. Grub	250	11.6[a]	11.5[a]	10.6[a]
b. Adult	250	15.5[b]	15.8[b]	16.6[b]
Chilocorus nigritus				
a. Grub	250	12.3[a]	12.6[a]	12.8[c]
b. Adult	250	25.0[d]	24.1[d]	24.9[d]

Figures followed by the same letters are not significantly different (P=0.05) by L. S. D.

respectively, and there was no appreciable variation.

The two viruses failed to show any pathogenic or toxicogenic effect on the species of parasites and predators studied. This confirms the well established fact that infections of GVs have been observed only in Lepidoptera (Summers *et al.*, 1975). Kaya (1982) reported that, generally, viruses do not infect the parasite or predator. However, detailed studies carried out on the competition between *S. inferens* and GV of shoot borer showed that if the host died from GV infection before the immature parasite can complete its development, the parasite also died (Easwaramoorthy and Jayaraj, 1988). This indicates that the larval parasites may be indirectly affected, but not directly by the viruses.

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