DOSSIER ON* ACIGONA STENIELLUS *AS A PEST OF SUGARCANE

Acigona steniellus (Hampson, 1899) (Lepidoptera: Crambidae)

Bissetia steniella (Hampson, 1899)

Chilo steniellus Hampson, 1899
Chilo griseoradians De Joannis, 1930
Chilo trypetes Bisset, 1939
Bissetia steniella: Kapur, 1950

Common names
Gurdaspur borer, Dehradun borer, Doon borer.

Distribution
India, Pakistan and possibly northern Vietnam (Bleszynski 1969; Irshad *et al.* 1982). This species was first recorded by Hampson (1899) as *Chilo steniellus* from Assam, India. It was later reported by Hussain in 1923 from the Sialkot district (now in Pakistan) and by Dutta in 1925 in Gurdaspur, Punjab, where it was considered a major pest of sugarcane in that district (Mehla *et al.* 2003). It has since spread to several parts of the Indian sub-continent (Mathur 1967).

Host plants
Sugarcane.

Symptoms
Larvae feed gregariously in sugarcane tops, resulting in wilting of the tops (Irshad *et al.* 1982). During summer months, the larva tunnels up the cane stalk in a spiral manner making minute punctures from inside which appear as a dark spiral streak on the outside. The bottom half of the plant produces side shoots just below the spiral-like cut caused by feeding, while the upper half of the plant above that cut dries off and is ultimately blown off by the wind during winter (Garg & Chaudhary 1979).

Economic impact
Reports from India and Pakistan give very variable damage levels to sugarcane crops that range from 10% to 80% (Irshad *et al.* 1982; Masih *et al.* 1988). Detailed studies by Mehla *et al.* (2001, 2003) in Karnal, India, recorded losses caused by *A. steniellus* of 11.12-70.92% in total weight, 23.78-55.45% in millable cane length, 16.80-34.03% in cane diameter, and 18.53-50.59% in internode number at maturity. In addition, infestations by various generations resulted in losses of 10.40-29.74% in polarity, 10.34-5.51% in total solids, 10.00-41.42% in commercial cane sugar, 0.11-21.70% in purity and 10.00-30.32% in sucrose content. Cane attacked later in the season (during winter months) usually sustains less damage in tonnage but the juice quality is severely reduced (Singh *et al.* 1957).

Morphology
Bleszynski (1969) gives the following description of this species:
Alar expanse 25-32 mm. Forewing with R1 and R2 free; ground colour pale grey-brown irrorated with fuscous; veins paler. Transverse lines much reduced. Hindwing silky white. Other characters as given for the genus.
Male genitalia: Uncus pointed with apical portion curved. Valva with cucullus curved; basal-costal projection bilobed, costa toothed near projection. Aedoeagus slightly bent, cornuti absent (Fig. 1).
Female genitalia: Subgenital plate with several hairs dorsally. Ostium pouch moderately sclerotized, opening dorsally. Ductus short, with slight ribbing in middle. Bursa copulatrix large with one distinct, rounded signum. (Fig. 2).

Fig. 1. *Acigona steniellus* male genitalia (Bleszynski, 1969).

Fig. 2. *Acigona steniellus* female genitalia (Bleszynski, 1969).

Egg

Singh *et al.* (1957) give the following description of the egg stage:

"The eggs, which are flattened, scale like in appearance and creamy white (changing to dark grey before hatching) in colour, are laid in clusters in and around the groove of mid-rib on the upper side of the leaf near the leaf sheath."

While Garg & Chaudhary (1979) give the following description:

"The eggs are flattened and scale like. They are creamy white when freshly laid and turn to grey before hatching. They are laid in clusters on the upper side of green leaves or about an inch [25 mm] away from the mid-rib. The number of eggs in each egg mass varies between 3-92 and one female can lay upto 400 eggs.

Mehla *et al.* (2003) give the following dimensions for the egg stage: 0.89-1.11 x 0.61-0.78 mm."

Larva

Singh *et al.* (1957) give the following description of the larval stage:

"A full grown larva measures about one inch [25 mm] in length and is of a creamy white colour with light orange head and four longitudinal reddish brown stripes along its back and sides. The lateral stripe on either side is thicker and more prominent."

While Garg & Chaudhary (1979) give the following description of the larva:

"The full grown larva measures 30-35 mm long and 4.5 mm broad. It is creamy white. The head is light orange in colour. It has four prominent violet stripes arranged sub-dorsally and laterally in pairs. The lateral stripes are thicker than sub-dorsal. The body bears numerous dark grey to black tubercles with prominent setae. The colour of the tubercles and stripes becomes faint during winter. The crochets of the abdominal prolegs are arranged in complete circle."

In addition, Mehla *et al.* (2003) give the following description of the larva:

"The newly hatched caterpillar measured 2.04 ± 0.02 mm in length and 0.55 ± 0.02 mm in width, with a dark brown head and faint violet strips on body. Whereas full grown larva measured 23.80 ± 0.08 by 3.20 ± 0.01 mm with four violet strips present subdorsally and laterally in pairs, lateral strips being thicker."

Pupa

Singh *et al.* (1957) give the following description of the pupal stage:

"The pupae are yellowish brown in colour with two reddish brown stripes. Pupation takes place in a specially constructed pupal cell in the attacked shoot."

While Garg & Chaudhary (1979) give the following description of the pupa:

"The pupae are yellowish brown in colour with reddish brown stripes. The abdominal segments bear numerous but very small spines. The anal segment is short and possesses, in each half, a prominent projection, which is carved upwards. The ventral surface of this segment has three short spines in each half."

In addition, Mehla *et al.* (2003) give the following description of the pupa:

"The pupa was yellowish brown in colour with reddish brown strips. The abdominal segments bore numerous microscopic spines and the anal segments were shorter. The genital openings were guarded by prominent abdominal lobes. The size of the pupa ranged from 15.13 ± 0.04 by 2.70 ± 0.00 mm."

Adult

Garg & Chaudhary (1979) give the following description of the adult:

"The moth is brownish and measures 35-40 mm at wing expanse. The forewings are pale grey brown and have several blackish spots along the outer margins."

While Mehla *et al.* (2003) give the following description of the adult:

"The moths were creamish or dull in colour along with several blackish spots along the outer margins of fore wings."

Detection methods

Close examination of damage during summer months will reveal a series of punctures positioned side by side resembling beads in a rosary (Singh *et al.* 1957). Infested plants wilt as a result of infestation (Masih *et al.* 1988).

Biology and Ecology

Attacks by this pest usually start at the end of June or the beginning of July (Singh *et al.* 1957; Garg & Chaudhary 1979). Studies in Karnal, Haryana, India, showed that *Acigona steniellus* incubation, larval and pupal periods ranged from 7-9, 17-46 and 6-13 days, respectively. The percentages of pupation and adult emergence were 13.2-17.57% and 64.28-70.83% during different generations, respectively. The longevity of adult males and females was 2-5 days and the sex ratio was 55.5-60.7% (female) and 39.3-45.5% (male). Female fecundity varied from 14 to 121 eggs during July-October, with the pre-oviposition period ranging from 0 to 2 days. The pest is active from June to October, and three overlapping generations are usually exhibited under field conditions, where the first generation (brood) extends from June – August, the second lasts until October and the third and longest generation extends to June in the following year (Mehla *et al.* 2003). However, Kapoor (1957), working in Gurdaspur, Punjab, determined the life cycle on average to occupy 35, 37 and 284 days during the first, second and third broods respectively, with the third brood lasting much longer due to hibernation of the larvae during winter month (from about November to May in the following year) after which larvae pupate and emerge as moths in June, with the onset of rain being the key factor in their emergence (Kapoor 1957). Larvae of the third brood usually hibernate in the stubble under ground level, but may also be above ground level in the lower part of the plant (Kapoor 1957).

Other studies in the Punjab record the egg stage of 9 – 11 days, and that a cluster containing 30 – 60 eggs and sometimes up to 100 eggs is laid near the upper nodal rings of the stem (Singh *et al.* 1957). While Mehla *et al.* (2003) records egg clusters on the upper side of the leaves near or on the midrib in 3-4 overlapping rows.

Young larvae enter the shoot through the bud point upon hatching and, during summer months, feed inside the stalk for 4-6 weeks before they pupate. While in winter (October onwards), the larva migrates downwards towards the stubble where they hibernate from December – June (Singh *et al.* 1957).

In the initial stages after hatching, larvae from one egg cluster enter the same shoot and feed gregariously. After 7 – 10 days, all but one larva exit the shoot and migrate individually to adjacent shoots using silken

threads. During summer months, the larva tunnels up the cane stalk in a spiral manner but later it bores deeper into the stalk and feeds in a single straight line moving upwards (Singh *et al.* 1957).
Other detailed studies by Mehla *et al.* (2001) in Haryana, India recorded the number of larvae in the gregarious and solitary phases to range from 10 to 35 and 1 to 2, respectively, with the highest larval density recorded on the second internode during the first generation and on the meristematic zone during the second and third generations in the gregarious phase. While in the solitary phase, the highest larval density was observed on the second internode (first generation), first internode (second generation) and on the meristematic zone (third generation). The number of internodes showing spirally-arranged holes ranged from 1 to 9, while the length of the tunnel traversed by the larvae varied from 6 to 29 cm. The same authors also found that moderate temperature (20.20-33.50°C), high relative humidity (74.46-86.86%), average to heavy rainfall (1.34-14.50 mm/day) and less sunshine hours (5.50-8.36) favoured the proliferation of *A. steniellus* in the field.
It was noticed that plant cane is more susceptible to infestation compared to ratoon crops. In addition, heavily fertilized and frequently irrigated crops seem to suffer more damage. Also, water logged and high rainfall areas usually sustain heavier damage by this pest (Garg & Chaudhary 1979). However, Chaudhary *et al.* (1987) found that varying levels of rainfall after July did not have much impact on infestation, but it was the early rainfall in July that was the key factor in triggering the activity of the borer.

Management

Chemical control

Studies in Pakistan showed that treatment of the cane crop with Furadan 3G at a rate of 12 kg/ha at 60 and 90 days after combined with weed hoeing gave best results in controlling the moth borer complex in sugarcane plantations in Faisalabad (Halimie *et al.* 1994).

Biological control

Parasitoids

***Allorhogas pyralophagus* Marsh (Hymenoptera: Braconidae):** Larval parasitoid native to Mexico. It was introduced into India for the control of the stemborer complex and was recovered from release sites (Shenhmar *et al.* 1990).
***Apanteles flavipes* (Hymenoptera: Braconidae):** Larval parasitoid, responsible for low parasitism rates in India (Mathur 1967).
***Cotesia flavipes* (Hymenoptera: Braconidae):** Recorded to attack *A. steniellus* larvae in Pakistan (Mohyuddin & Mohmmad 1986, Shami & Mohyuddin 1988; Shenhmar & Brar 1996).
***Elasmus zehntneri* Ferriere (Hymenoptera: Elasmidae):** Larval parasitoid, India (Mathur 1967).
***Isotima* sp. (Hymenoptera: Ichneumonidae):** Pupal parasitoid, recorded to be responsible for upto 25% parasitism rates in India (Mathur 1967).
***Paratheresia claripalpis* Van der Wulp (Diptera: Tachinidae):** Larval parasitoid, recorded to attack *A. steniellus* in India, achieving parasitism rates of up to 12.5% (Mehla *et al.* 2001).
***Rhaconotus roslinensis* Lal (= *R. caulicola* Muesebeck) (Hymenoptera: Braconidae):** Larval parasitoid, India (Mathur 1967).
***Stenobracon deesae* (Hymenoptera: Braconidae):** Larval parasitoid, recorded to attack *A. steniellus* in India, achieving parasitism rates of up to 12.9% (Mehla *et al.* 2001).
***Stenobracon nicevillei* (Hymenoptera: Braconidae):** Larval parasitoid, recorded to attack *A. steniellus* in India, achieving parasitism rates of up to 31.57% (Mathur 1967).
***Sturmiopsis inferens* (Diptera: Tachinidae):** Larval parasitoid (David *et al.* 1989; Mehla *et al.* 2001).
***Trichgramma evanescens minutum* (Hymenoptera: Trichogrammatidae):** Egg parasitoid. Parasitism rates of 2- 15% were recorded in the Punjab (Kapoor 1957).

Pathogens

Varietal Resistance

Varietal resistance has been noticed, for example, Masih *et al.* (1988) recorded significant differences in infestation levels between varieties L-54, Triton and BL-4 in Pakistan. The lowest *A. steniellus* infestation on ratoon crops was observed in S.79. B.779 (early-maturing) and S.85.US.83 (mid-maturing) while the highest was noted in S.86.US.1032 (early-maturing) and SP.SG.26 (mid-maturing). Among plant crops, *A. steniellus* infestation was highest in S.86.US.1025 (early-maturing) and SP.SG.26 (mid-maturing) and lowest in S.79.B.779 (early-maturing) and S.85.US.83 (mid-maturing) (Gul *et al.* 2002).

A field survey was conducted during 1995-96 in eastern Uttar Pradesh, India, to identify insect pests of sugarcane. During the survey, *Acigona steniellus* was identified damaging important sugarcane genotypes (CoS 8436, COS 687 and Cos 88230) (Pandey *et al.* 1997).

Mechanical Control

Chemical control of this species appears difficult due to the concealed nature of the larva and the fact that ground application of pesticides can be hindered by the size of the mature crop (Mathur 1967; Irshad *et al.* 1982; Masih *et al.* 1988; Afzal *et al.* 1996). Therefore mechanical control is a widely used technique in India and Pakistan for the management of this pest species, where infested cane tops are cut and disposed of at weekly intervals between July - October (Chaudhary *et al.* 1987; Jolly & Singh 1990; Pandey *et al.* 1997). In field experiments carried out during 1985-86 in Faisalabad, Pakistan, cane yield was greater when infected cane shoots were removed biweekly and dead shoots removed monthly (Halimie *et al.* 1989). Other studies by Masih *et al.* (1988) showed that three mechanical top cuttings between the 3rd week of July and the last week of September when young gregarious larvae are most abundant in young crops gave good control of the pest.

Cultural practices

Soaking billets in water for 12 hours were found to kill hibernating larvae (Kapoor 1957).

Means of Movement

The most likely means of entry of this species into Australia would be by the introduction of infested planting material from Asia. The chance of the introduction of moths or eggs on aircraft, in luggage, or on people is much smaller, though still significant.

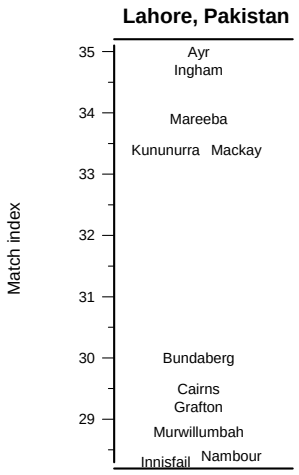
Phytosanitary Risk

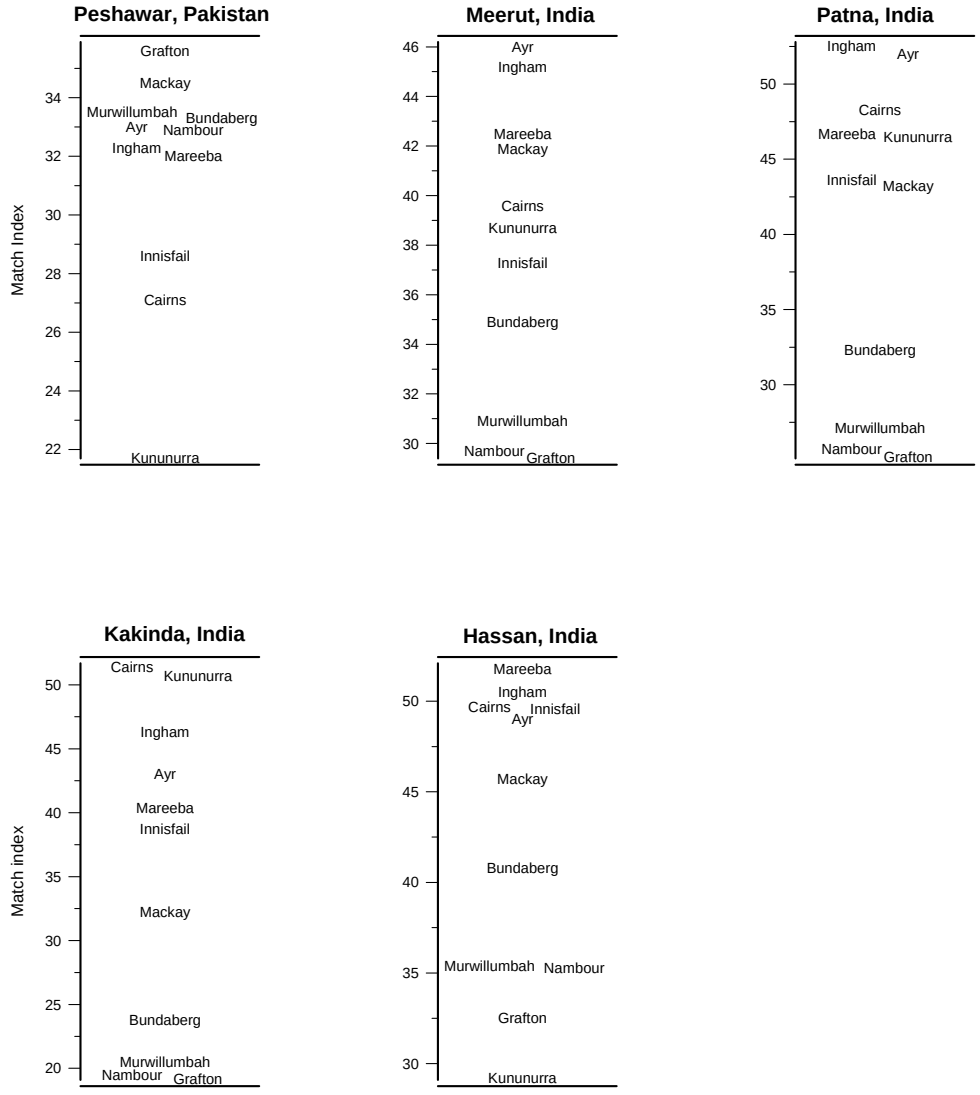
Entry potential: Low – Medium**.** Seems to have a restricted geographical distribution although capable of colonizing new habitats.

Colonisation potential: High in all sugarcane areas in Queensland and New South Wales.

Spread potential: High.

Establishment potential: High in all sugarcane growing areas of Queensland and NSW (see Match Indexes for climate in principal Australian areas below).





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