

**X-RAY STUDIES ON THE EFFECT OF *BACILLUS THURINGIENSIS* BERLINER ON THE FEEDING ACTIVITY IN THREE SPECIES OF LEPIDOPTERA**

THE effect of *Bacillus thuringiensis* Berliner has been studied on the citrus leaf caterpillar, *Papilio demoleus* L.<sup>1</sup>, the castor semi-looper, *Achoea janata* L.<sup>2</sup> and the castor leaf caterpillar, *Spodoptera litura* (F.)<sup>3</sup>. While the former two species showed symptoms of general paralysis and gut paralysis respectively, the latter was found to be not susceptible to the pathogen. It has been shown that the susceptible species do not feed again after an initial meal on contaminated foliage with the crystal-forming bacterium, *B. thuringiensis*, thus extensive defoliation during the incubation period of the disease is prevented. In the present study, observations on the bowel movement in the above three insects after treatment with *B. thuringiensis* have been made by taking X-ray photographs.

Finely powdered barium sulphate was mixed with sterile water to form a thick paste. This was added to an equal volume of Biotrol wettable powder containing 30 billion viable spores of *B. thuringiensis* per gram, and the mixture was painted on fresh foliage of the respective host plant, air dried and fed to test insects. The larvae were starved for 12 hr. before the commencement of the experiment. The treated larvae were taken 8 hr. after the feeding, and washed in water thoroughly to remove the adherent particles of BaSO<sub>4</sub>. The larvae were placed on Agfa Normal film and the X-ray photographs were taken by using Siemens-Reinigerwerke X-ray machine with an exposure of 2 seconds at 3 ma and 50 kV. The excreta collected from the treated larvae were also X-ray photographed.

It was observed that the food travelled the entire region of the alimentary canal without any obstruction in healthy *P. demoleus*, *A. janata* and *S. litura*. The presence of BaSO<sub>4</sub> was also confirmed in their excreta. In the case of *P. demoleus*, treated with BaSO<sub>4</sub> and *B. thuringiensis*, feeding has been stopped within 8 hr since food has remained in the foregut itself due to stoppage of bowel movement. The histopathological studies made earlier also showed complete breakdown of gut epithelium<sup>1</sup>. In the case of *A. janata* also there was a blocking of bowel movement in the alimentary canal but food passed through up to the midgut. The histopathological studies made on this insect revealed the severity of gut damage<sup>2</sup>. On the other hand, in the case of *S. litura*, the X-ray study showed no stoppage of food material in the alimentary canal. The faecal

pellets collected from this insect 12 hr after feeding also revealed the presence of BaSO<sub>4</sub>, thus confirming the food movement through the alimentary canal without any obstruction. This is an additional evidence for the non-susceptibility of this insect to *B. thuringiensis* reported by Govindarajan *et al.*<sup>3</sup>.

It is now realised, however, that the symptoms of general paralysis caused by crystalliferous bacteria is the exception rather than the rule, with reference to most of the susceptible lepidoptera<sup>4</sup>. Based on the X-ray photographic study and other histological and blood and gut pH studies, the above three species of insects may be grouped under type I, type II and type IV category showing general paralysis, gut paralysis and non-susceptible categories respectively as suggested by Angus and Heimpel<sup>5</sup> and Martouret<sup>6</sup>.

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1. Narayanan, K. and Jayaraj, S., *Indian J. exp. Biol.*, 1974, 12, 89.
2. Govindarajan, R., Jayaraj, S. and Narayanan, K., *Z. ang. Ent.*, 1976 (in Press).
3. —, — and —, *Indian J. exp. Biol.*, 1975, 13, 548.
4. Heimpel, A. M. and Angus, T. A., *J. Insect Pathol.*, 1959, 1, 152.
5. Angus, T. A. and Heimpel, A. M., *Canad. Ent.*, 1959, 91, 352.
6. Martouret, D., *Symp. Phytopharm. Phytiat.*, 12th, Ghent, Belgium, 1961, 8, 1.

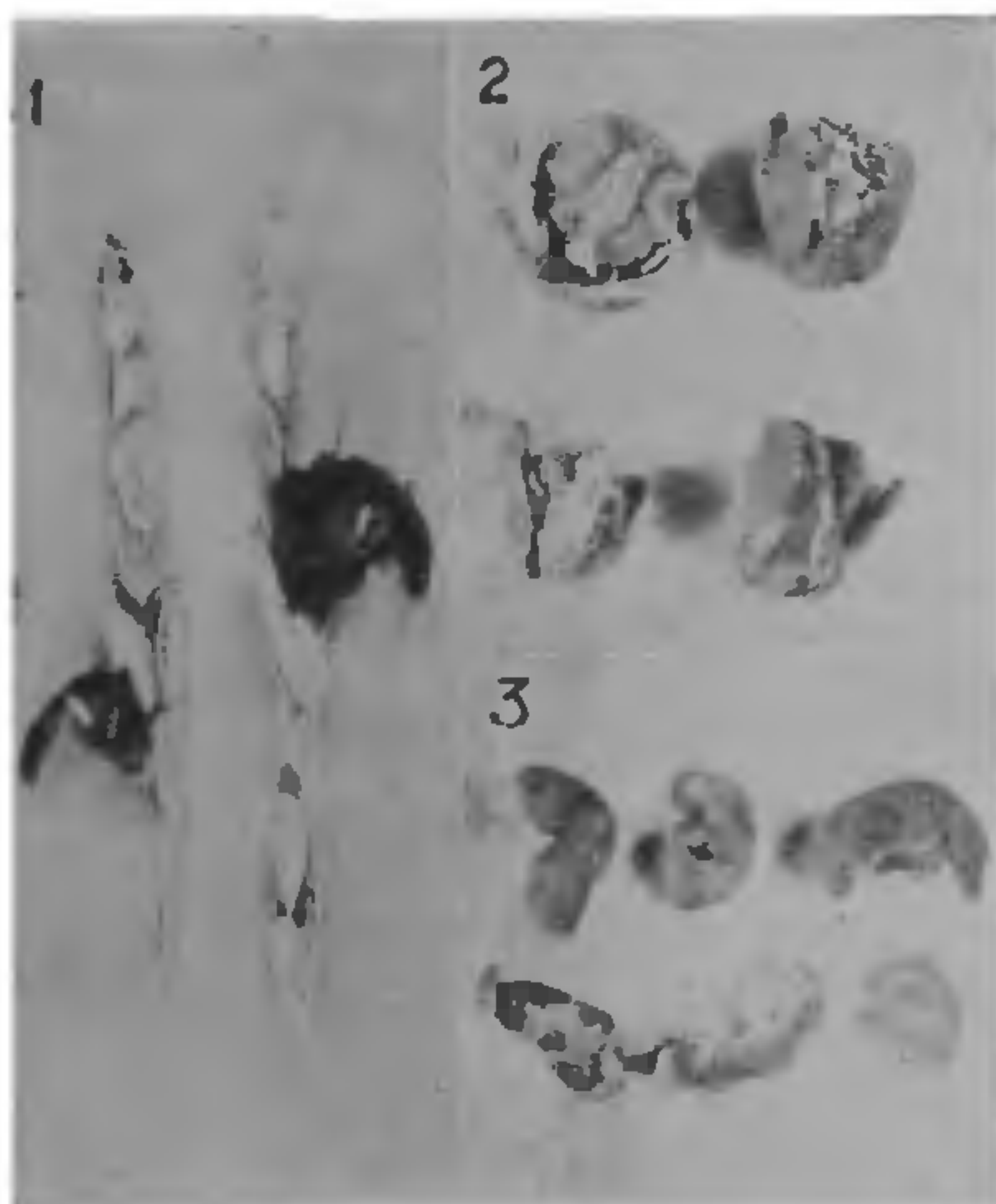
**OCCURRENCE OF TRUE SCLEROTIA IN *CLAVICEPS ORYZAE-SATIVAE*—THE CAUSAL ORGANISM OF FALSE SMUT OF RICE**

'FALSE SMUT' of rice caused by *Claviceps oryzae-sativae* Hashioka [imperfect stage *Ustilagoidea virens* (Cke.) Tak.] is considered to be a minor disease, but its occurrence has been reported from almost all the rice-growing countries in Far-East, South-East Asia, Africa, North and South America. However, under favourable conditions, the disease causes considerable loss in grain yield. In India, the disease is common in coastal parts of Orissa, Andhra Pradesh, Haryana and Tarai and Hills of Uttar Pradesh. Of late, the incidence of the disease is reported to be on an increase especially on the high yielding varieties.

The symptom of the disease becomes discernible after the flowering when the ovary of the infected kernel is transformed into a large velvety, yellow to orange pulverulent mass (pseudomorph) changing to olive green in colour. The pseudomorph covered with spore-mass had been erroneously termed as "sclerotia" by earlier workers which never produced ascigerous state of the fungus. The formation of true sclerotium, its germination and formation of perithecia and ascospores have been demonstrated in Japan<sup>1-3,5</sup> but has not been reported from any other country.

Extensive surveys for the incidence of this disease in Uttar Pradesh and Haryana and the careful examination of the several specimens received from Andhra Pradesh, Orissa and Bihar revealed that the true sclerotia of the fungus are not produced in the plains. The formation of true sclerotia was observed in almost all the collections done at an altitude of 1200 m and above in Kumaon region of Uttar Pradesh.

After the dispersal of conidia, true sclerotia remained loosely attached on the pseudomorphs and may fall in the field with slight jerk (Fig. 1).



FIGS. 1-3. False smut of rice. Fig. 1. Spikelets showing true sclerotia hanging on the pseudomorph,  $\times 1-2$ . Fig. 2. True sclerotia covering the spore ball,  $\times 1-75$ . Fig. 3. True sclerotia,  $\times 2$ .

The number of true sclerotia per ball varies from 1 to 5 but 2 are most frequently observed. These sclerotia remained attached separately or sometimes joined to cover the pseudomorph like an umbrella

(Fig. 2). The sclerotia are hard, dark-brown, clavate, botuliform, reniform, horse-shoe shaped to indefinite in shape, concave on the inner-side and convex on the outer side measuring 3-10 mm  $\times$  1-5 mm and 0.5-1-5 mm. in thickness (Fig. 3). The transverse section of the sclerotia shows the outer tissue to be made of compact pseudoparenchymatous cells while the inner tissue is hyaline with prosenchymatous cells. Ou<sup>4</sup> mentions that some of the green spore balls develop 1 to 4 sclerotia in the centre. Hundreds of green balls, especially bigger ones were examined for true sclerotia but could not be observed in the centre.

This constitutes the first report for the occurrence of the true sclerotia in the country. Further work on its germination and role in the disease cycle are in progress.

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1. Hashioka, Y., *Il. Riso*, 1971, 30, 235.
2. —, Yoshino, M. and Yamamoto, T., *Saitama Agr. Expt. Sta. Res. Bull.*, 1951, 2, 1.
3. Hemmi, T. and Konishi, Z., *J. Pl. Prot.*, 1939, 26, 857.
4. Ou, S. H., *Rice Diseases*, Commonwealth Mycological Institute, Kew, 1972, p. 368.
5. Sakurari, M., *Ann. Phytopath. Soc. Jap.*, 1934, p. 70.

#### EMS-INDUCED MULTICARPELLATE CONDITION IN *CAJANUS CAJAN*

DURING the course of the observations on M<sub>1</sub> progenies of pigeon pea treated with EMS, a number of morphological variants were observed under different treatments. The most interesting among them which we wish to report here is the multicarpellate condition observed in an early maturing variety, treated with 0.03 M. EMS.

Although the plant produced abundant flowers, it was found to be devoid of fruits at the time of harvest. A closer examination of several flowers of the plant revealed a tendency for the presence of supernumerary petals (8 to 10 instead of 5). Some of the flowers showed 12 stamens (11 + 1 instead of 10). Some of the stamens also appeared to be transformed into sepal-like or petal-like structures.