several years has reduced genetic variability in muga[12].

However, during a recent survey conducted in the Sibsagar district of Assam, yellow, blue and orange colour morphs were observed among the normal green muga silkworm population. Out of a total of 176 rearings observed, yellow larvae were noticed among 65 rearings. The ratio of yellow to green larvae varied from 1 : 50 to 1 : 1000. The orange and blue-coloured larvae were however found in only one rearing each. The ratio of orange and blue to green larvae was 1 : 6000 and 1 : 3000 respectively. The blue colour larvae are bigger in size (wt 18.5 g) than the normal green form (wt 12.5 g) which is in conformity with the earlier observations[11]. The orange colour larvae have a coating of white powdery substance on the body surface. Unlike the tubercles in green larvae, the tubercles of yellow larvae are white in colour. The colour of tubercles in green larvae changes during different instars, bluish in the second, purple in the third, brick red in the fourth and crimson red in the last instar.

The present observation on the occurrence of colour morphs clearly indicates that the muga silkworm has not yet reached the zenith of homozygosity and the *different colour forms still survive and are not extinct.* The colour forms other than green have lower survival rate. It is known that the allelic expression of colour in insects is largely due to alteration in extrinsic and/or intrinsic factors influencing pigment metabolism[1]. The density of population and the nutritional status are also known to influence and determine the expression of colour types in *Zeiraphera diniana*[13]. Similar processes might operate in the expression of colour polymorphism in muga silkworm. Further studies on the inheritance, genetic variability and selection process are in progress.

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ASSOCIATION OF NEMATODES IN BUNCHY TOP OF BANANA

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MUSA PARADISIACA has been reported to be attacked by root infecting nematodes; a number of them have been identified: *Radopholus, Helicotylenchus, Rotylenchus, Dolichodorus, Xiphinema, Longidorus, Meloidogne.*

Bunchy top was first observed from banana growing tracts of Australia; however it also occurs in Fiji, Egypt and Sri Lanka. The infection is presumed to be introduced into India through infected suckers of Musa brought to Kerala State from Sri Lanka in 1940. From Kerala the disease has now spread to Orissa, West Bengal, Bihar, Assam and Karnataka States. The early investigations favoured a virus association and the causal organism was named *bunchy top virus, banana virus*, or *musa virus*, and the vector was reported to be *Pentalonia nigronervosa* Coquerel. But particles of virus could not be detected and bunchy top disease remained one of the national diseases of India, of unknown etiology like root wilt of coconut, sandal spike, arecanut yellows and citrus die back.

Symptoms of the disease:

The suckers removed for transplanting from infected banana clumps and planted in new areas produce infected plants. The transmission of the organism is therefore presumed to be through suckers used for propagating the crop vegetatively. The plants developed from the infected suckers gave rise to short,

narrow leaves in the form of a rosette at the top of the pseudostem. The mature leaves are brittle breaking into pieces during a strong wind. Unlike the normal healthy banana the diseased plant grows to a height of 2–3 ft only. Fruits are not formed. Secondary symptoms of the disease occur at any stage of the growth when infection starts in the healthy plantation in the field. Damage to the crop is total as the plants die without producing any fruit.

The edges of the corm from where the sucker develops, decay. The roots rot and disintegrate emitting a foul smell. Reddish brown lesions occur on the roots in the early stages of the infection. The spindles covered by young leaf sheaths also show extensive necrosis.

Materials were collected from the spindles of bananas showing distinct morphological symptoms of bunchy top disease from Trichur District of Kerala State. Pieces (1×1 cm^2) were cut from the spindle and fixed in 3% glutaraldehyde containing 0.1 Cocadylate buffer, pH 7.3, at 4°C for 60 min. The fixed material was again excised into still smaller pieces 2×2 mm^2 and fixed by the same process again for 60 min. The pieces were then washed with cocadylate buffer and kept in the buffer for 2 hr. The pieces were stained with a solution of osmium tetroxide containing 0.2 M phosphate buffer pH 7.3 and 5% sucrose. The material was then dehydrated and when this process was complete, the pieces were embedded in Spurr's low viscosity resin. Thin sections were cut with a LKB ultratome, using a glass knife, at 2 Å. These were examined under HITACHI an electron microscope (Hitachi Model 2).

Some sections were cut at 10 Å with the ultratome for light microscopy. Under the light microscope, coiled nematodes were observed in the intercellular spaces and inside the cells. The nematodes were seen in the lower portions of the spindle near the rhizomes as well as on the aerial parts away from the centre of infection in the soil.

The nematodes were concentrated in some cells of the central stele but mostly near the parenchyma cells in the phloem tissues and the sieve tubes. The cell walls showed extensive rupture and disintegration. Under the electron microscope, the nematodes were visible in the thin sections of the spindle well above the rhizomes (figures 1, 2).

The empty cells in the pith and the phloem region indicate the ingestion of the cell contents by the nematodes. The break down of the cell walls results in a cavity in the central spindle of the young banana plant developing from the infected sucker. This cavity

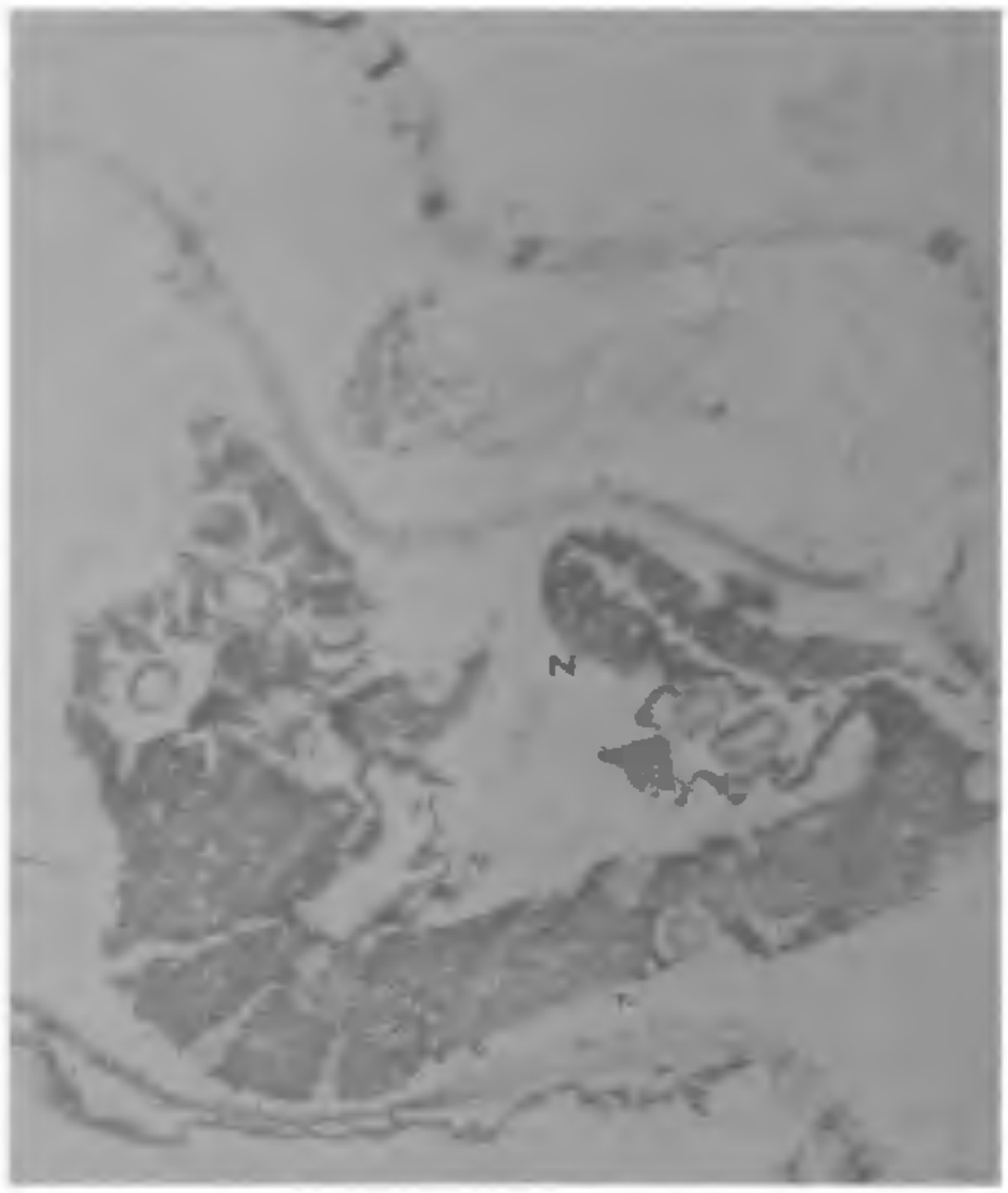

Figure 1. Nematodes N in the phloem parenchyma of Musa × 96000.

provides a clear channel for the transport of the nematodes inside the pseudostem from the base to the top. Adjacent cavities coalesce forming long tunnels facilitating quick and easy movements of the pathogen. Four to 5 nematodes are often coiled together within the cells.

The nematodes were indentified as *Helicotylenchus multicinctus* and *Radopholus similis*. The latter were more frequent in the diseased samples. No nematode was observed in healthy banana sections collected from the disease free locality and cut under identical conditions as the diseased samples.

The following measures were adopted for the control in the field for 12 months:

1. Suckers were dipped in water at 70°C for 120 min before planting. 2. Agronomic practices like burning the soil in the pit for transplanting the suckers and allowing it to lie fallow for 15 days, drenching the burnt soil with 5% Dithane-Zn or 2% Bavistin to erradicate possible soil fungi, drenching the soil used for filling up the pit with carbon di sulphide (1 cc to 1 g of soil) and covering it for 7 days before use to eliminate insects were carried out. 3. The pseudo stem was injected with 1000 ppm tetracycline hydrochloride to eliminate MLO. 4. The pits and the suckers were

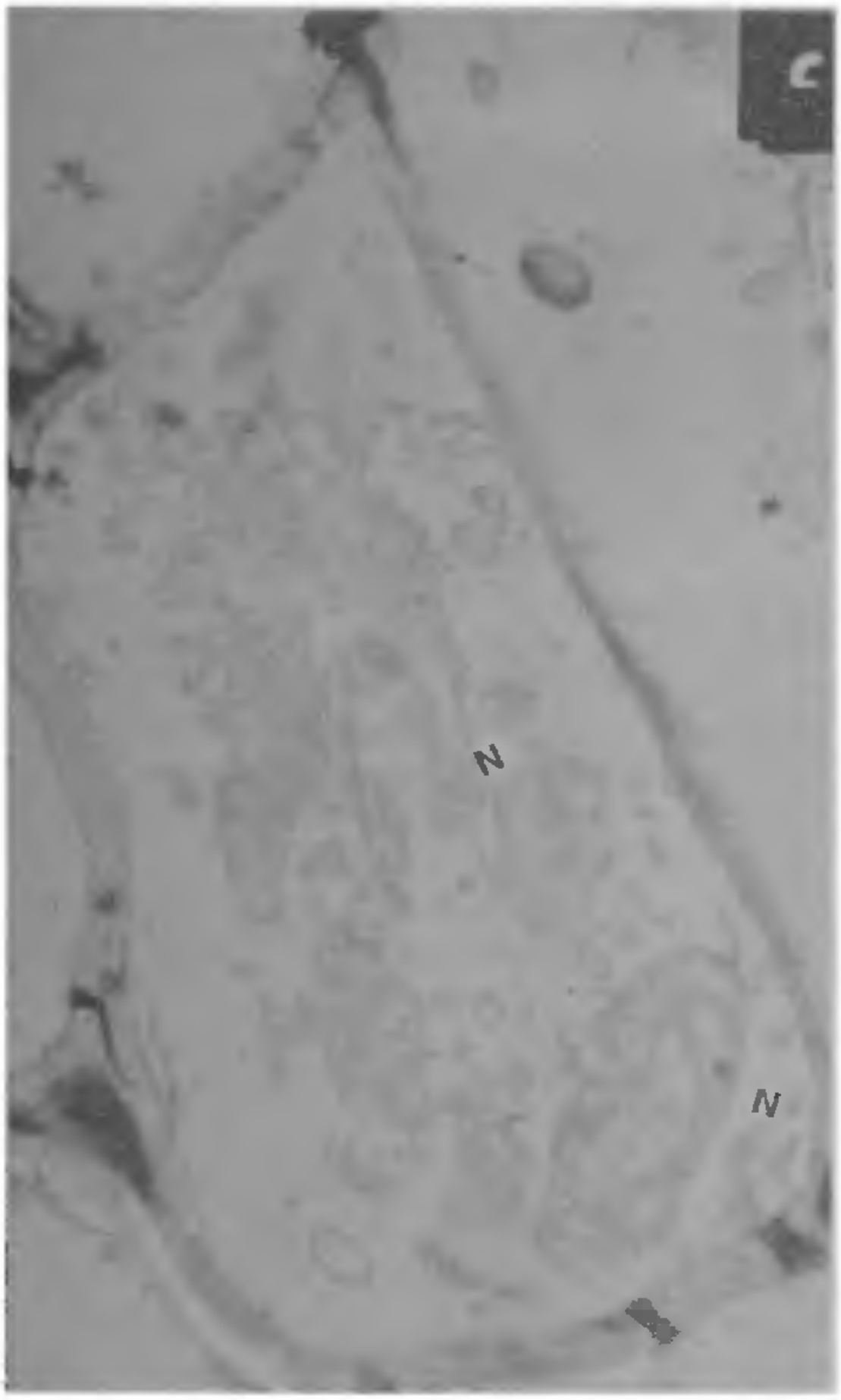

Figure 2. Coiled nematodes in phloem parenchyma × 96000.

treated with Ekalux-25 (Sandoz) active ingredient 0,0-diethyl-0(quinoxalinyl-(2)-thionophosphate) at 0.150% for 60 min before planting.

The treatments were carried out for 12 months in two plots under the same edaphic factors. Hot water treatment gave 10% success; burnt soil treated with fungicides and fumigant gave 2% success. The maximum control was observed with Ekalux-25 soil treatment once in every 3 months, when 80% success was obtained. In the control where no treatments were given all the plants died during the course of 12 months.

Bunchy top of banana is caused by a nematode. Both *Radopholus similis* and *Helicotylenchus multicinctus* were isolated from the diseased soils but the intensity of attack by Radopholus is more. Treatment of the pits with Ekalux before planting and drenching the suckers with the insecticide before planting can control the disease effectively.

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APICAL DISINTEGRATION OF FUNGAL HYPHAE WITH REFERENCE TO THEIR BRANCHING POTENTIAL

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BARTNICKI-GARCIA and Lippman[1] showed that hyphal tips of fungi burst when flooded with a variety of dilute solutions of acids, neutral salts or detergents. They suggested that, in the hyphal tip of a fungus, there is a delicate balance between wall-synthetic and wall-lytic enzymes and flooding the hyphae with solutions disturbs this delicate balance leading to violent disintegration of the apices. This finding strengthened the belief that autolytic enzymes play a role in hyphal development.

One of the morphogenetic processes of filamentous fungi that involves localised participation of wall-lytic enzymes is branch initiation[2–4]. It has earlier been reported that some filamentous fungi branch more profusely while growing on a disc of cellophane overlying agar medium[5]. Accordingly, while growing on cellophane, these fungi should posses increased wall lytic activity. To study this, the work of Bartnicki-Garcia and Lippman[1] was repeated for fungi growing on agar medium and on cellophane overlying agar medium.

Single spore isolate of *Aspergillus nidulans* (Eidam) Winter, *Botryodiplodia theobromae* Pat., *Fusarium solani* (Mart) Sacc. and *Syncephalastrum racemosum* Cohn were used. The fungi were grown for 3 days on Czapek's agar medium at 30 ± 1°C. The margin of the colony was cut by a sterilized cork borer and this plug of mycelium was used as inoculum. It was placed mycelium surface down on a semicircular piece of cellophane overlying Czapek's agar medium in a