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INFLUENCE OF *HELICOTYLENCHUS MULTICINCTUS* ON THE CHLOROPHYLL CONTENT, PHOTOSYNTHETIC RATE AND ROOT ACTIVITY IN RICE¹

by
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Summary. Changes in total chlorophyll content, photosynthetic rate and root activity as influenced by the spiral nematode, *Helicotylenchus multicinctus* have been estimated. In infested plants the total chlorophyll content was reduced by 1.06, 49.26 and 28.73 %, the photosynthetic rate by 1.1, 5.6 and 10.2 % and the root activity by 26.14, 16.14 and 8.99% respectively in 15, 25 and 35 days old seedlings in comparison to control.

The spiral nematode, *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956 has been recorded in association with rice in Puri district of Orissa, India (Anon, 1986). Changes in total chlorophyll content, photosynthetic rate and root activity induced by infestation of the nematode in the crop have been investigated and are reported here.

Materials and methods

Seeds of rice (*Oryza sativa* L.) cv. Satia were soaked in water and were germinated in a seed germinator at 25° C. The seedlings were planted singly in 1200 earthenware pots (11 x 7 cm) filled with sterilised soil. Five days later half of the pots were inoculated with 250 *H. multicinctus*/pot.

Fresh leaves from uninoculated and infested plants were collected at 10, 20 and 30 days after inoculation and the amount of total chlorophyll present was estimated separately in four replications. The leaves were cut into small pieces and immersed in 80% acetone (1 g of fresh tissue/10ml) and comminuted in a mortar and pestle. The supernatant was passed through filter paper Whatman No. 41 and the residue was again extracted with acetone and filtered. Both the extracts were pooled and the final volume was adjusted to 500 ml for 1 g fresh tissue used (Yoshida *et al.*, 1976). The absorbance of the extract was measured at 652 nm with a spectrophotometer (Spectronic

20, B & L, U.S.A.) and the total chlorophyll content calculated (Arnon, 1959).

Leaves, second from the top of the main tiller of uninoculated and infested plants, were collected separately, excised under water and stabilised at 40 k — Lux light for 1 hr before transferring to a photosynthetic assimilation chamber which was connected to an infrared gas analyser (make ADC, series 225, U.K.). Ambient air containing 330 ppm of CO₂ was drawn through the photosynthetic chamber at the rate of 0.25 l/min and depletion in CO₂ inside the chamber (due to assimilation) was recorded with IRGA. The initial and final readings were recorded and the photosynthetic rate per unit leaf area (Po) was calculated as mg CO₂/dm²/hr' using the following formula of Nayak *et al.* (1983):

$$P_o = \frac{44,000 \times \text{flow rate (l/hr)} \times \text{CO}_2 \text{ depletion (ppm)}}{0.08205 \times \text{temp. } ^\circ\text{K} (273 + \text{ambient temp. } ^\circ\text{C}) \times \text{leaf area (dm}^2\text{)}}$$

* (ambient temp. = 30°C)

Both uninoculated and inoculated plants were uprooted carefully, washed and the roots then cut off. The roots were cut into 0.5-1 cm pieces and mixed thoroughly. Samples (1-2 g) were transferred to a conical flask containing 50 ml of 20 ppm alphanaphthylamine solution and then incubated for 2-3 hr with continuous shaking. Before and after incubation 2 ml of the solution was pipetted into a graduated test tube and diluted to 10 ml with water. One ml of 1 % sulphanilic acid (1 g of sulphanilic acid dissolved in 100 ml of 30 % acetic acid) and 1 ml of 100 ppm sodium nitrite solution (100 mg sodium nitrite dissolved in water and made up to a litre) were added and the mixture was made up to 20 ml with water. After 30 min incubation, spectrometric (Beckman UV — VIS, 35 Double beam, USA) determination of the alphanaphthylamine concen-

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tration in the solution was made using 500 nm wavelength (Ota, 1970). From this, as the alphanaphthylamine is related to the rate of respiration, the quantity of alphanaphthylamine oxidised which is directly related to the oxidising activity of the roots (root activity) is calculated and expressed as μ per g fresh weight of roots per hr.

Results and discussion

The total chlorophyll content of the leaves of uninoculated plants was 2.82 mg/g fresh tissue at 15 days age and increased to 4.35 mg/g fresh tissue at 35 days. Inoculation of 5 days old seedlings with *H. multicinctus* resulted in decrease of the chlorophyll content: 15 days after inoculation the reduction was 1.06 % compared with uninoculated plants at 25 days (49.26 %) and at 35 days (28.73 %). Similar reductions in chlorophyll content were reported in rice infested with *Meloidogyne graminicola* (Rao *et al.*, 1988; Swain and Prasad, 1988) and *Heterodera oryzae* (Rao *et al.*, 1988). Reduction in chlorophyll content has also been observed with viral (Ling, 1972) and bacterial (Ou, 1972) infections.

The photosynthetic rate in 15 day old uninoculated plants was 27.3 mg CO₂/dm²/hr' and this increased to 31.3 mg CO₂/dm²/hr' in 35 day old plants. In infested plants the photosynthetic rate was 26.8 and 28.2 mg CO₂/dm²/hr' respectively on 25 and 35 day old plants. The reduction in photosynthetic rate caused by the nematode infestation was 1.1 % in 15 day old plants and this increased to 10.2 % in 35 day old plants. Swain and Prasad (1988) recorded 25.7 % reduction in the photosynthetic rate in plants infested with *M. graminicola*. Reduction in total

chlorophyll content in infested plants reflects a reduction of the photosynthetic rate.

The root (oxidising) activity in uninoculated plants was 0.352 μ /g fresh weight/hr at 15 days age which reduced to 0.178 by 35 days age. The root activity was reduced by 26.14 %, 16.14 % and 8.99 % in the inoculated plants at 15, 25 and 35 days respectively. Ota (1970) reported that in case where the nutrient absorption by roots is inhibited the oxidising activity of root is very low. In the present studies, the damage by the nematode to the root might be responsible for the reduction in the root activity.

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