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Short Communication

Quantification of photosynthetic pigments in moderately resistant and susceptible rice varieties infected by rice root knot nematode, *Meloidogyne graminicola* golden and brichfield

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Abstract

Response of Photosynthetic pigments such as chlorophyll and carotenoid content of moderately resistant (ADT 41, ADT 45, TRY 1, TPS 3, Swarna and GEB 24) and susceptible rice varieties (Co 47, Pusa Basmathi, ASD 19, Co 43, Co 2, Co 19 including TN 1 as susceptible check) induced by the root knot nematode, Meloidogyne graminicola were analysed. Photosynthetic pigments in moderately resistant and susceptible varieties were recorded 45 days after nematode inoculation. The study revealed that in moderately resistant varieties, chlorophyll and carotenoid contents were found to increase after nematode infestation.

Keywords: Root-knot nematode, *Meloidogyne graminicola,* Photosynthetic pigments, Chlorophyll, Carotenoid, Rice.

Introduction

Plant Parasitic nematodes break down cell structure and consume cell contents of the root system. The disruption by the adaptive feeding behaviours of the rice root knot nematode, *Meloidogyne graminicola* interferes with the physiological processes involved in water and nutrient relations and thereby creating a cascade effect on photosynthetic pigments in the shoot. This leads to reduction in plant productivity and poor growth compared with healthy plants. Root knot nematodes are more dependent on the host and likely to have greater energy demands than migratory nematodes Melakeberhan and Ferris[1]. The effect of plant parasitic nematodes on growth and yield of different crops has been widely studied Dropkin[2]; Jones[3]. However the precise mechanisms by which nematodes influence these parameters have received very little attention. Growth and yield of crops are the outcome of various physiological processes which could be studied by considering the impact of various factors on these processes Loomis and Adams[4]. The aim of the present investigation were to analysis the responses of photosynthetic pigments in moderately resistant and susceptible rice varieties infested with rice root knot nematode, *Meloidogyne graminicola.*

Materials and methods

Seeds of moderately resistant (ADT 41, ADT 45, TRY 1, TPS 3, Swarna and GEB 24) and susceptible varieties (Co 47, Pusa Basmathi, ASD 19, Co 43, Co 2 and Co 19) were sown in the pots containing 250 g sterilized sandy loam soil. Seven days after germination, two healthy seedlings were maintained in the pots while others were uprooted. After two weeks, about 500 freshly hatched infective juveniles were inoculated around the rhizosphere region of the seedlings by making holes. The variety PY 1 and TN 1 served as resistant and susceptible check respectively. The pots were arranged in a completely randomized design in the glass house. Watering of the pots was done regularly. Physiological analysis was carried out 45 days after nematode inoculation.

Quantification of chlorophyll and carotenoids: The third leaf from resistant and susceptible varieties was weighed 250 mg and macerated in a homogenizer with 80% acetone. The extract was centrifuged at 4000 rpm for 15 minutes. The supernatant was collected and adjusted to a known volume. The absorbance of extract was read at 480, 510, 645, 652 and 663 nm by a spectrophotometer against 80% acetone as a blank to estimate total chlorophyll, chlorophyll 'a', chlorophyll 'b' and carotenoids. The following formulae were used for the calculation Arnon[5].

Chlorophyll 'a'= (12.7 x A. 663) – (2.69 x A. 645) x V/ 1000 x W
Chlorophyll 'b'= (22.9 x A. 645) – (4.68 x A. 663) x V/ 1000 x W
Chlorophyll 'ab' Ratio = Chlorophyll a / Chlorophyll b
Total chlorophyll = A. 652 x 1000/ 34.5 x V/ 1000 x W
The chlorophyll content of the samples expressed as mg/g of fresh leaf.
Carotenoids = (7.6 X OD at 480) – (1.49 X OD at 510) x V/ 1000 x W
Where: A = absorbance of extract at the specific wave length,
V = final volume, W = Weight of the leaf tissue used for extraction.

Results and discussion

Chlorophyll and carotenoid content in moderately resistant varieties (ADT 41, ADT 45, TRY 1, TPS 3, Swarna and GEB 24), resistant variety (PY 1) and susceptible varieties (Co 47, Pusa Basmathi, ASD 19, Co 43, Co 2, Co 19 including TN 1 as susceptible check) were analysed. Among the moderately resistant varieties, highest chlorophyll content of 'a' (1.64 mg g^{-1}) and 'b' (0.37 mg g^{-1}) were recorded in the leaf samples of PY1 whereas it was equal in susceptible varieties of Co 43 and Co 19 with 0.95 mgg^{-1}. A decrease of 43.03% in chlorophyll 'a' was recorded in susceptible varieties compared to resistant varieties, while a decrease of 54.54% in chlorophyll 'b' was recorded in susceptible varieties compared to resistant varieties. Total chlorophyll content was ranged from 1.85 to 1.96 mg g^{-1} for moderately resistant varieties and it was 1.09 to 1.28 mg g^{-1} in susceptible varieties. There was a reduction of 39.79 % in the total chlorophyll content in the leaf samples from the susceptible varieties compared to moderately resistant varieties. In moderately resistant varieties 'ab' ratio ranged from 4.36 to 5.26 mg g^{-1} whereas in susceptible varieties it was 4.94 to 6.92 mg g^{-1}. There was an increase in 'ab' ratio (25.74%) of susceptible varieties compared to moderately resistant varieties (Table-1). Among the moderately resistant varieties, highest carotenoid content (0.49 mg g^{-1}) was recorded in the leaf sample of PY 1 followed by in TRY 1 (0.46 mg g^{-1}) whereas in susceptible variety ASD 19 it was 0.33 mg g^{-1}. A decrease of 36.36 per cent was recorded in the content of carotenoid in the susceptible varieties as compared to moderately resistant varieties (Table-1).

The present study revealed that in moderately resistant varieties, chlorophyll and carotenoid contents were found to increase after nematode infestation and the susceptible varieties infested by the rice root knot nematode showed a reduction in photosynthetic pigments. Chlorophyll and carotenoid both takes part in photosynthetic reaction. The present finding supports the observation that in moderately resistant varieties, chlorophyll content was found to increase after nematode infection Swain and Prasad[6].

Table-1: Influence of *M. graminicola* on photosynthetic pigments of moderately resistant and susceptible rice varieties.

Moderately resistant varieties	Chlorophyll (mg/g)				Carotenoid (mg/g)	Susceptible varieties	Chlorophyll (mg/g)				Carotenoid (mg/g)
	a	b	Total	a/b ratio			a	b	Total	a/b ratio	
ADT 41	1.44	0.33	1.89	4.36	0.42	Co 47	0.83	0.12	1.10	6.91	0.24
ADT 45	1.62	0.36	1.95	4.50	0.44	Pusa Basmathi	0.91	0.14	1.09	6.50	0.28
TRY 1	1.59	0.31	1.85	5.12	0.46	ASD 19	0.83	0.15	1.15	5.53	0.33
TPS 3	1.56	0.34	1.90	4.58	0.42	Co 43	0.95	0.17	1.18	5.58	0.26
Swarna	1.58	0.30	1.91	5.26	0.45	Co 2	0.94	0.19	1.28	4.94	0.30
GEB 24	1.63	0.35	1.94	4.65	0.41	Co 19	0.95	0.19	1.19	5.00	0.31
PY 1 (Resistant check)	1.64	0.37	1.96	4.43	0.49	TN 1 (Susceptible check)	0.90	0.13	1.11	6.92	0.24
Grand Mean	1.58	0.33	1.91	4.70	0.44		0.90 (-43.03)	0.15 (-54.54)	1.15 (-39.79)	5.91 (25.74)	0.28 (-36.36)
SEd	0.63	0.26	0.11	0.13	0.21	SEd	0.33	0.16	0.10	0.11	0.13
CD (P = 0.05)	1.30	0.54	0.23	0.28	0.42	CD (P = 0.05)	1.20	0.44	0.12	0.10	0.12

Conclusion

Plant parasitic nematodes like many other obligate parasites are capable of altering the metabolic processes of the host plant, which is expressed in the form of physiological changes occurring in the infected host. The result revealed that the rice root knot nematode infestation may seriously damage the photosynthetic pigment in susceptible rice varieties. However, it is considered that the present results confirm the consequence of induction of the antioxidant system to protect the moderately resistant varieties against the oxidative damage under nematode infestation.

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