



Research Paper

**EFFECTS OF PHENOL CONTENTS OF GREENGRAM VARIETIES / LINES
AS INFLUENCED BY ROOT-KNOT NEMATODE, *Meloidogyne incognita***

Ritu Kumari Pandey¹, D.K. Nayak² and Rajesh Kumar Kar³

**DEPARTMENT OF NEMATOLOGY, COLLEGE OF AGRICULTURE,
ORISSA UNIVERSITY OF AGRICULTURE & TECHNOLOGY, BHUBANESWAR-3
ORISSA, INDIA.**

Abstract

The variation in total phenolic substances in six greengram cultivars i.e 24 ML-233 (R), 7 GGG 10-14 (R), 17 IPM 9901-6 (R), 8 GM 04-02 (R), 28 PM 10-12(S) and 29 PUSA 0672 (S) were studied 45 days after inoculation of *Meloidogyne incognita*. The total phenolic substances in the shoots of both healthy resistant cultivars was higher compared to the susceptible infected cultivars. However, in the inoculated plants the total phenolic substances in four resistant variety varied from 0.78 mg/g to 0.97 mg/g as compared to two susceptible variety (0.32 mg/g to 0.41 mg/g). An increasing trend was also observed in the phenolic contents in the shoots of inoculated susceptible and resistant cultivars.

Key words: Biochemical modifications, Greengram cultivars, *Meloidogyne incognita*, Phenolic substances.

INTRODUCTION

Green gram being one of the major pulse crop of the Fabaceae family is rich source of dietary protein (22.9%), carbohydrate (62.8%), fat (1.2%), minerals (3%) and fibre (1%) and also it has considerable amount of calcium 105 mg, phosphorous 330 mg, Fe, ashes, etc. The major causes of low productivity are the incidence of insects and diseases including plant parasitic nematodes. Plant parasitic nematode, *Meloidogyne incognita* alters the metabolic processes of the host which are manifested in the form of cellular, physiological and biochemical changes occurring in the infected host.

Thakur, N.A. and Yadav, B.S. (1985) [9] reported that higher levels of phenol per gram fresh root were associated with greater resistance. There was no increase in phenol content in inoculated susceptible varieties. Thakur, N.A. and Yadav, B.S. (1986) [10] concluded that increased phenolic levels in cv. 556-1 may confer resistance against *R. reniformis*. Upadhyay, K.D. and Banerjee, H. (1986) [11] revealed that after 60 days of biochemical analysis there was a 10-18 and 26-54% increase of total protein and amino acids contents, respectively which was greater in the stem and at the higher levels of infection. They also revealed that the total sugar content decreased by 13-20 and 10-22% in the roots and stem, respectively with the loss of non-reducing sugar being six times greater than that of reducing sugars in the roots. They reported that infected plants showed decreased chlorophyll a and b content but increased pheophytin levels.

Ganguly and Dasgupta in 1982[3], studied the composition of the polyphenol oxidase enzyme, in the tomato roots infected by *M. incognita*. They inferred that the polyphenol oxidase enzymes in resistant variety was different from that of the susceptible variety. Enzymes in the resistant variety was more stable in wide range of temperature and pH conditions than that of any susceptible variety. Singh *et al.* In 1985 observed tomato plants had higher the phenolic content in *M. incognita* infected plants than the healthy ones. Chlorogenic acid and caffeic acid were identified as two major phenolic compounds in both healthy and inoculated root extracts of susceptible (Pusa Ruby) and resistant (BT-1) cultivars of tomato by Mohanty and Pattanaik (1993)[7]. The quantity of phenolics of uninoculated resistant variety BT-1 was higher in comparison with that of uninoculated Pusa Ruby. Hassan *et al.* (1994)[6] studied the free amino acid and oxidative enzyme content of susceptible and resistant tomato genotypes. Activity of oxidative enzymes like peroxidase, polyphenol oxidase, ascorbic acid oxidase and catalase were higher in the resistant genotypes. Gopinath *et al.* (2002) [5] observed that tomato cultivars Vivek and Radha that are moderately resistant to *M. incognita*, recorded maximum concentration of phenols, proteins, peroxidase and polyphenol oxidase enzymes. Conversely in the susceptible cultivar Pusa Ruby the concentration of phenols, proteins, peroxidase and polyphenol oxidase enzymes were lesser as compared to other cultivars tested.

Agrawal *et al.*, in 1985[1] revealed that the infected okra plants by *M. incognita* had increased levels of phenolic compounds over the healthy plants.

Pankaj *et al.* (1992)[9] while observing the phenolic compounds in the resistant and susceptible varieties of barley found increased level of the compounds in the resistant varieties than in the susceptible ones. Further, it was noted that the phenol content of the resistant varieties was higher than that of the susceptible varieties even before nematode infection.

Nayak (2015)[8] studied the effects of nematode infestation on contents of phenolic substances as influenced by root-knot nematodes in both susceptible and resistance brinjal found that the total phenolic substances in the roots of both healthy and resistance brinjal cultivars were higher compared to the susceptible cultivars.

MATERIALS AND METHODS

Exactly 0.5 g root sample was ground with a pestle and mortar in 10 ml of 80 per cent ethanol until it became a pulp. The homogenate was centrifuged at 5000 rpm for 20 minutes. The process was repeated with another 5 ml of 80 per cent ethanol. Both the supernatants were pooled and evaporated to dryness. The residue was dissolved in 10 ml distilled water. The aliquot was pipetted into test tubes with 0.5 ml each. The volume was made up to 3 ml with distilled water. Exactly 0.5 ml of folin-ciocalteu reagent was added into it. After 3 minutes 2ml of 20 per cent Na₂ CO₃ solution was added into each tube. The contents were mixed thoroughly, placed in boiling water for 1 minute and then cooled. Absorbance was measured at 650 nm in a colorimeter and compared with a blank. A standard curve was prepared using different concentrations of catechol.

RESULTS

In order to know the chemical and genetic basis of resistance, six varieties were grown with utmost care, both in inoculated and control condition.

Effect of nematode infection on contents of phenolic substances

The phenolic content of healthy plants of green gram cultivars were 0.22, 0.13, 0.72, 0.63, 0.56 and 0.67 $\mu\text{g/g}$ in 28 PM 10-12, 29 PUSA 0672, 24 ML-233, 7 GGG 10-14, 17 IPM 9901-6 and 8 GM 04-02 respectively. But due to infection of root knot nematode the phenolic contents of these varieties increased by 86.36, 146.15, 34.72, 36.51, 39.29 and 23.88 per cent respectively (Table 1). Giebel and Stobieka (1974)[4] considered phenolic compounds as the best known factors involved in susceptible-resistant response of plants towards the nematode infection as phenolic content was observed to be more (Fig.1).

Table 1. Percentage increase /decrease in Phenol content in Healthy(H) and root-knot infected (I) plant

Sl. No.	Variety	Phenol content $\mu\text{g/g}$ on fresh weight basis			
		Healthy	Infected	Mean	% increase(+)/ decrease(-) over control
		Leaf	Leaf	Leaf	
1	28 PM 10-12	0.22	0.41	0.32	86.36
2	29 PUSA 0672	0.13	0.32	0.23	146.15
3	24 ML -233	0.72	0.97	0.85	34.72
4	7 GGG 10-14	0.63	0.86	0.75	36.51
5	17 IPM 9901-6	0.56	0.780.7	0.67	39.29
6	8GM 04-02	0.67	0.83	0.75	23.88
	SEM(\pm)	0.273	0.311		
	CD(0.05)	0.859	0.976		

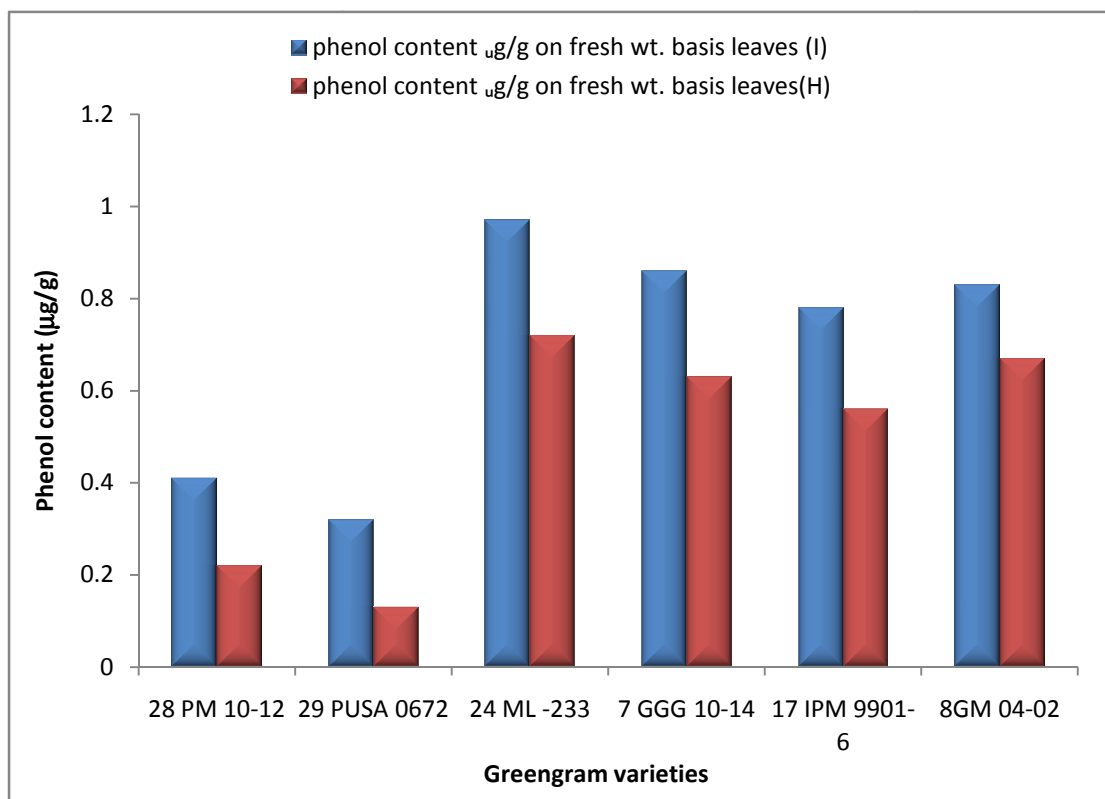


Fig. 1 Phenol content of infected and control plants on fresh wt. basis

DISCUSSIONS

Chemical analysis of plant samples

Effects on phenolic substance

The significant increase of phenolic compounds were observed in resistant varieties due to nematode infection compared with the susceptible variety, 29 PUSA 0672, the increase of phenolic compound in the resistant varieties was remarkable. The increase in phenolic content was confirmed by the findings of Chakraborty and Mishra, 2002[2], in chickpea plant infected by *M. incognita*. The phenolic compounds are the best known factors responses and there is distinct correlation between the degree of plant resistance and the phenolic compounds in nematode inoculated samples possibly due to rapid liberation of conjugated phenols from the glycosidic compounds produced by the action of hydrolytic enzymes during feeding process. Further, the increase in phenolic compounds during the infection period might be attributed to the rapid breakdown of bound phenols or switching over of phenols to different pathways leading to the formation of various compounds like lignin which plays significant role in resistant reaction.

CONCLUSIONS

Some selective changes occur in the metabolism either as a consequence of the establishment of a compatible (susceptible) host-pathogen interaction or as a result of incompatibility (resistant) between host and parasite. There is some knowledge of biochemical changes that occurs in plants following nematode attack that has not been extended to an overall interpretation of the defense mechanism. The root-knot nematode develops a sophisticated interrelationship with the roots of their host where they induce specific types of nurse cell system. It was depicted from the table 1, that the phenol content ranged from 0.13 to 0.72 μ g/g in healthy greengram varieties and ranged from 0.32 to 0.97 μ g/g in infected greengram varieties. A greater percentage in phenol content was observed as 146.15 % in the variety 29 PUSA 0672. The total phenol content in shoots of healthy plants increases but in the infected plants phenols are reduced in shoots because the nematode infection interfere in the phenol metabolism and the basipetal translocation of free phenols contributed to the reduction of phenols in the shoots. The effect of nematode infection on contents of phenolic substances of infected greengram plants increased by 146.15% in variety 29 PUSA 0672 and lowest 23.88% in the variety 8 GM 04-02. The phenolic compounds are the best known factors responses and there is distinct correlation between the degree of plant resistance and the phenolic compounds in nematode inoculated samples possibly due to rapid liberation of conjugated phenols from the glycosidic compounds produced by the action of hydrolytic enzymes during feeding process. The increase in phenolic compounds during the infection period might be attributed to the rapid break down of bound phenols or switching over of phenols to different pathways leading to the formation of various compounds like lignin which plays significant role in resistant reaction.

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