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Biochemical and physiochemical changes in susceptible and resistant bitter gourd cultivars/varieties as influenced by root knot nematode, *Meloidogyne incognita*

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Abstract
Seventeen gourd seeds were collected and examined under greenhouse conditions to determine the susceptibility and biochemical nematode galling reactions (RKN), *Meloidogyne incognita*. Of the seventeen tested genotypes, only one variety was resistant, four varieties were moderately resistant, five varieties were susceptible, and seven varieties were classified as susceptible / resistant to nematode infections based on the number of root galls and galls. Only one variety showed a resistant reaction with an average of 7-67 galls per plant, while others were moderately resistant to very susceptible. The maximum reduction of chlorophyll 'a', 'b' and all was observed in local Nakhara (6.97%) and lowest in SundargarhLocal-1 (0.371%) on their control. The same trend was observed in the two varieties in the content of chlorophyll "b" with a maximum of 3.281% and the lowest as 1.631% and a total content of chlorophyll with a maximum of 1.278% and the lowest with a 0.236% respectively. The total content of phenolic and Proline compounds (average shoot and root) increased significantly in most of the infected plants compared to uninfected plants and maximum was observed in the roots with 42.48% compared to the control in the Sundargarh local-1 variety and the lowest was 5.15% Rajsunakhala local-1. The same tendency was achieved in the infected outbreaks of both varieties. A similar trend was also observed in the roots and shoots, both the variety of Proline content as 25.00% and 2.44% in the roots and 47.06% of 8.077% and the leaves respectively.

Keywords: Biochemical, physiological, *Meloidogyne incognita*, chlorophyll, starch, sugar, Proline, phenol

1. Introduction
Plant parasitic nematodes are obligatory parasites. During feeding on the roots penetrate into the cells and inject salivary fluid into the host's tissues. Clearly various digestive enzymes such as amylases, proteases are released during the feeding process, resulting in hydrolysis of host components and leads to an altered metabolism host. Vital metabolites for growth and maintenance of host tissues are often blocked at the infestation site. The food accident would compromise the proper functioning of the organs involved.

The use of resistant cultivars to handle unpleasant nematodes is an ideal medium, but the reproduction of resistant varieties usually takes a long time and sometimes the quality of the product can't be up to the farmer's satisfaction. Among the biotic constraints that hinder the production of eggplant, nematode galling, *Meloidogyne incognita* is one of the plant parasitic nematodes with the maximum potential to cause loss of yield about 27.30-32.00 percent in brinjal [1, 3, 12, 13].

Traditional approaches to developing nematode-resistant cultivars are time-consuming and are often limited by intraspecific barriers. Biotechnology and genetic engineering offer potential for the efficient development of nematode-resistant plants, which can be improved by clarifying the mechanisms that limit the development of nematodes.

Resistant responses of the host plant during the post-infection period have often been regulated by several internal factors. In conditions of disease, sequences of biochemical changes are much more important than external symptoms, which are nothing but the manifestation of the internal disorders. Oesophageal secretion disorders carry signals for upregulation and downward-specific genes that eventually lead to compatible or incompatible interactions with host plants. The biochemical changes induced by plant parasitic nematodes are related to various crops have been well documented in numerous publications [5, 9, 10, 14].

A series of biochemical and physiological reactions occur in host plants in response to nematode root knot infection as a result of which the plant is overcome by the nematodes and ascertained disease or nematodes is found by the plant and the development of the disease is limited. The detailed characterization of these biochemical and physiological processes is essential to improve our understanding of plant-nematode interaction. This information would be of great help to plant breeders and nematologists in the work of reproduction for the development of cultivars resistant to root knot nematodes.

2. Materials and Methods

In order to understand the basics of resistance to nematodes, six varieties are Sundargarh Local-1, Amatalla Beejghar Karala long green, Ankur hybrid (Moderately resistant) and local Nakhara, Indojapane hybrid Rajsunakhala Local-1 (very sensitive) were grown in pots of top soil in the greenhouse of Department of Nematology, CA, OUAT in 15 cm x 15 cm diameter clay pots sterilized formaldehyde solution (1.0%) and filled with autoclave earth (15 lbs / 20min). Four replicas in a completely random design. The water used for irrigation had a five hundred mesh screen before use.

2.1 Estimation of chlorophyll (mg / g) on the basis of fresh weight

100 mg of leaf from each treatment of compound sheets were cut were immersed in 10 ml of 80 ml. % acetone in a conical flask and kept in the dark for 24 hours for the extraction of chlorophyll from samples of leaves. Thus, the pigment extracts were filtered through the Whatman filter paper no. 1. The absorbance of the pigment extract was measured at 645 nm and 663 nm using a measuring device. The amount of chlorophyll a, b and total chlorophyll chlorophyll was calculated in mg / g of contemporary weight according to the following equations.

1. Chlorophyll -a (mg / g fresh leaf weight) = 12.7 x (D-663) - 2.69 x (D-645) $\times \frac{V}{1000 \times W}$
2. Chlorophyll-b (mg / g fresh leaf weight) = 22.9 x (D-645) - 4.68 x (D-663) $\times \frac{V}{1000 \times W}$
3. Total chlorophyll (mg / g of fresh leaf weight) = 20.2 x (D-645) + 8.02 x (D-663) $\times \frac{V}{1000 \times W}$

Where is it
D -645 = optical density at 645 nm
D-663 = optical density at 663 nm
V = final volume of the acetone 80% chlorophyll 80% extract (ml)
W = fresh weight(g) of the corresponding quantity of fresh leaves used in chlorophyll extraction

2.2 Estimation of total sugar content

The total sugar content of the root was determined using the following procedure.

2.3 Extraction of shoot sugar

One hundred milligram samples of ground roots were taken in 15 ml centrifuge tubes and 10 ml of 80% ethanol were added. The mouth of the centrifuge tube was covered with polyethylene paper and kept in water at 80-85 ° C for 30 minutes. It was then cooled and centrifuged for 15 minutes at 2000 rpm. After centrifugation, the supernatant was decanted in a 25 ml graduated flask. This extraction procedure was repeated again and the supernatant was collected in the previous 25 ml flask. The final volume was brought to 25 ml with distilled water and filtered through the Whatman filter paper no. 1. This was the sugar extract saved for the sugar estimate.

2.4 Estimation of total sugar

Two ml of sugar extract were transferred into a 50 ml graduated flask and the volume was completed to 50 ml of the volumetric flask and the volume was increased to 50 ml with distilled water. Five ml of this extract were taken in a 25 ml graduated flask. Simultaneously standard of 0 ml, 1 ml and 1.5 ml. A 100 ppm glucose solution was withdrawn into 25 ml graduated flasks. The volume of these standards was increased to 5 ml with the addition of distilled water and 2 drops of 80% ethanol. Volumetric flasks containing samples and models were kept in an ice bath. To each volumetric flask 10 ml of anthrone reagent (2 g of anthrone in one liter of 95% H_2SO_4) were added, which allowed it to flow on the side of the volumetric flask. The contents of the flasks were slowly mixed by rotating the flask and then shaken completely. Volumetric flasks were kept in a boiling water bath for exactly 7.5 minutes. Immediately after, the flasks were cooled in the ice. After cooling, the absorbance was measured at 630 nm and the sugar content was calculated with the help of the standard curve.

2.5 Estimation of total starch content

1 ml of starch extract was taken from a 100 ml volumetric flask and diluted to 100 ml with distilled water. Five ml of the extract above were transferred to a 50 ml tube. Then, all sample standards and tubes were kept in an ice bath for cooling and 10 ml of anthrone reagent were added to each tube, which allowed the reagent to flow along the side of the flask. It was slowly mixed with a glass rod and then mixed thoroughly. The flask was kept in a boiling water bath for exactly 7.5 minutes. Then the tube was immediately cooled in an ice bath. After cooling, the O.D. at 630 nm it was measured and the starch content was calculated with the help of the standard curve, which was multiplied by 0.91 to get its exact value.

2.6 Estimation of total phenol substance

Exactly 0.1 g of each shoot and root sample were ground with a pestle and a mortar in 10 ml of 80% ethanol until it became a pulp. The material was centrifuged at 5000 revolutions per minute for twenty minutes. The process was repeated with another 5 ml of 80% ethanol. Both supernatants were grouped and evaporated to dryness. The residue was dissolved in ten milliliters of distilled H_2O. The aliquot was pipetted into 0.5 ml tubes each. The volume was created up to three milliliters with distilled H_2O. Exactly 0.5 ml of folin-ciocalteu reagent was added. After 3 minutes, 2 ml of 20% Na_2CO_3 solution was added to each tube. The contents were carefully mixed,

placed in boiling water for 1 minute and then cooled. The absorbance was measured at 650 nm in a colorimeter and compared to a blank. A standard curve was ready to exploit totally different concentrations of catechol. Calculation The phenol concentrations in the test samples were calculated by comparing with the standard curve and expressed as mg / g of material (catechol).

2.7 Estimation of total Proline substance

Exactly 100 mg of each shoot and root were macerated with 5 ml of Sulfo-salicylic acid. The residue was centrifuged at 4000 rpm. for 15 minutes. The supernatant liquid was decanted in a 50 ml tube. 5 ml of glacial acetic acid and 5 ml of ninhydrin acid were added. The mouth of the tube was closed with polyethylene paper and elastic device. It is boiled for 1 hour in a water bath at 100ºC. After the standards and sample were boiled, the reaction mixture was transferred to sixty milliliters of separation funnels. 20 ml of toluene are added and vigorously stirred. Then he was allowed to settle down. The chromophore containing toluene was separated through the lower hole of the separation funnels. The absorbance was measured at 520 nm. With the help of standard curve data, the proline present in the plant sample was calculated and expressed as mg proline / gram or fresh sample.

3. Results and Discussion

3.1 Effect of nematode infection on Chlorophyll content of leaves

The chlorophyll content is the most important component of plants since it makes food, which is necessary for the growth and development of all parts of the plant. It correlates directly with crop yield. It is known that root nematode node reduces the chlorophyll content of plants to stop the absorption of nutrients and assimilates partition. In the experiment it was observed that the chlorophyll content was reduced from 0.338 mg / g to 0336 mg / g in Local-1 Sundargarh variety. Similarly, in the Amatalla Beejghar Karala long green varieties, Ankur hybrid, local Nakhara, Indojapane hybrid and Rajsunakhala Local-1 chlorophyll 'a' reduced 0.343-0.342, 0.341-0.336, 0.344-0.320, 0.347-0.322 and 0.345-0.334 mg / g respectively. Therefore, the nematode caused a reduction of 0.371 percent chlorophyll content in Sundargarh local-1, a 0.364 percent reduction in green along Amatalla Beejghar Karala, a reduction of 1.392 percent in the Ankur hybrid, reduction of the 6.977 percent in Nakhara local, 4.228 percent reduction in Indiojapane hybrids and 2.898 percentreduction in Rajsunakhala local-1.

For chlorophyll 'b', the reduction of healthy plants to infected plants was 0.184-0.181, 0.184-0.182, of 0.181-0.178, 0.190-0.184, of 0.189-0.180 and 0.190-0.184 mg / g in the case of the Sundargarh local-1 varieties variety. Likewise, in the long green varieties Amatalla Beejghar Karala, hybrid Ankur, local Nakhara, Indojapane hybrid and local Rajsunakhala-1, respectively. Therefore, the nematode caused a reduction of 1.631 percent chlorophyll content 'b' Sundargarh local-1, a reduction of 1.085 percent long green Amatalla Beejghar Karala, a reduction of 1.515 percent in Ankur hybrid a reduction of 3.281 percent Nakhara local, a reduction of 4.762 percent in the Indojapane hybrid and 3.158 percent reduction in Rajsunakhala Local-1.

Similarly, the total content of chlorophyll dropped to 0.528 mg 0.529 mg/ g in Sundargarh Local-1, ranging from 0.528 to 0.527 mg / g in long green Amatalla Beejghar Karala long green, from 0.522 to 0.505 mg / g Ankur hybrid, 0.528 to 0.521 mg / gin Nakhara local, 0.528 to 0.523 mg / g in Indojapane hybrids and from 0.522 to 0.513 mg / g in Rajsunakhala local-1. Therefore, the nematode caused a reduction of 0.236 percent of the total chlorophyll content Sundargarh Local-1, a reduction of 0.095 percent in Amatalla Beejghar Karala long green, a reduction of 0.032 percent in the Ankur hybrid a reduction of 1.278 percent in the local Nakhara, a reduction of the 0.899 percent in the Indojapane hybrid, a reduction of 1.628 percent in Rajsunakhala Local-1 (Table 1 and Fig. 1) However, the decrease was not significant in the resistant varieties, which clearly indicate that the reduction of chlorophyll is limited in inoculated resistant varieties compared to the sensitive variety. Similar results have also been reported by [15-17]. The decrease in chlorophyll content may be due to nutrition and physiology impaired host-nematode infection.

3.2 Effect of nematode infection on Total sugar content

Total sugar in roots The amount of total sugars content in healthy variety roots was 0.82, 1.08, 0.88, 0.93, 0.96 and 1.29 percent in the Sundargarh local-1, Amatalla Beejghar Karala long green, Ankur hybrid, Nakhara local, Indojapane hybrid and Rajsunakhala local-1 respectively (Table 2) based on fresh weight. In the infected roots of these varieties, the sugar content was 1.25, 1.42, 1.13, 1.14, 1.13 and 1.47 % respectively. The percentage increase in the total sugar content due to the control of root node nematode infection was 52.43, 31.48, 28.40, 18.42, 17.70 and 13.95 percent, respectively (Fig. 2). Total sugar in shoots The amount of sugar present in the shoot portion of the inoculated plants were recorded as 1.84, 0.91, 0.85, 0.30, 0.85 and 0.99 percent of the Sundargarh local-1, Amatalla Beejghar Karala long green, Ankur hybrids, Nakhara local, Indojapane hybrid and Rajsunakhala Local-1 respectively, based on fresh weight (Table 2). In contrast, this amount was reduced in all cases compared to healthy plants, i.e., 1.75, 0.85, 0.79, 0.25, 0.67 and 0.78 percent on the outbreak portion of these varieties due to root knot infection (Fig. 2).

Sugar is the main source of metabolic energy in all living organisms. The reading of the data clearly predicted a significant increase in the amount of total sugars in both shoots and the roots of plants inoculated with nematodes. The increase in the sugar content after nematode infection is confirmatory with the results of previous workers [6, 9] The higher sugar content in the infected samples may be due to the movement of various metabolites at the site of infection from other parts of the plants. Alternatively, the cell produces more of these metabolites at the site of infection, therefore, more carbohydrates are required for respiration and metabolism.

3.3 Effect of nematode infection on total starch content

The amount of starch present in the shoots of the inoculated plants were recorded as 0.44, 0.48, 0.43, 0.62, 0.65 and 0.42 mg / g and the percentage of decline was 16.98, 27.2, 27.91, 28.73, 41.54 and 50.00 in the Sundargarh local-1,AmatallaBeejgharKarala long green, Ankur hybrid, Nakhara local, Indojapane hybridand Rajsunakhalalocal-1 respectively based on fresh weight (Table 3, Fig. 3). The amount of total starch was higher both in the shoots and in the roots of the susceptible varieties than the resistant ones. Plants inoculated with root node nematodes had a reduced percentage of starch content in the shoots of bitter gourd varieties. The starch content (%) in shoots was significantly higher in highly

susceptible varieties compared to moderately resistant varieties. These results are confirmed by the observation [4] which provided that there was a decrease in starch content in infested nematodes.

3.4 Effect of nematode infection on the content of phenolic substances

The phenolic content of bitter gourd inoculated cultivar sprouts was 0.45, 0.42, 0.62, 0.39, 0.22 and 0.24µg / g in Sundargarh local-1, Amatalla Beejghar Karala long green, Ankur hybrid, local Nakhara, Indojapane hybrid and Rajsunakhala local-1 respectively. In addition, due to root knot nematode infection, the phenolic content of these varieties increased by 33.56, 21.71, 19.30, 18.38, 12.74 and 11.31 percent in shoots and 42.48, 36.66, 24.75, 12.94, 7.40 and 5.15 percent in the roots respectively in the previously said varieties (Table 4, Fig. 4).

A significant increase in phenolic compounds in moderately resistant varieties due to nematode infection compared to highly susceptible varieties, increased phenolic moderately resistant varieties were remarkably observed. The increase in the phenolic content was confirmed by the results of [2] in chickpea plants infected with *M. incognita*.

Synthetic resin compounds are the most effective responses remarkable factors and there is a clear correlation between the degree of resistance of the plant and, therefore, the synthetic resin sample inoculated with worms, presumably due to the rapid release of conjugated phenols of the glycosidic compounds created by the action of hydrolytic enzymes throughout the feeding method.

Furthermore, the increase in phenolic compounds during infection could be attributed to the rapid decomposition of phenols or phenols to change for different paths leading to the formation of various compounds such as the polymer that plays a vital role in the resistant reaction.

3.5 Effect of nematode infection on the content of Proline substances

Proline content of infected cultivars of bitter gourd shoots was 0.25, 0.39, 0.28, 0.60, 0.85 and 0.62 µg / g sample in Sundargarh Local-1, Amatalla Beejghar Karala long green, Ankur Hybrid, Nakhara local, Indojapane Hybrid and Rajsunakhala local-1 respectively. In addition, due to root knot nematode infection, the Proline content of these varieties increased by 47.06, 44.44 40.00, 25.00, 10.38 and 8.77 percent in outbreaks and 25.00, 16.66, 9.34, 5.00, 3.85 and 2.44 percent in roots respectively in previous varieties (Table 5, Fig. 5). The amount of Proline content was greater in both the shoots and the roots of resistant cultivars than susceptible bitter gourd cultivars, which confirmed the results of [7, 8] The Proline content of cultivars infected bitter gourd shoots was 0.25, 0.39, 0.28, 0.60, 0.85 and 0.62 µg / g sample and revealed by [8]. Furthermore, it has been established that the Proline content of infected vulnerable cultivars has increased with time, however, the highest content of Proline found in infected (healthy leaf) of resistant cultivars.

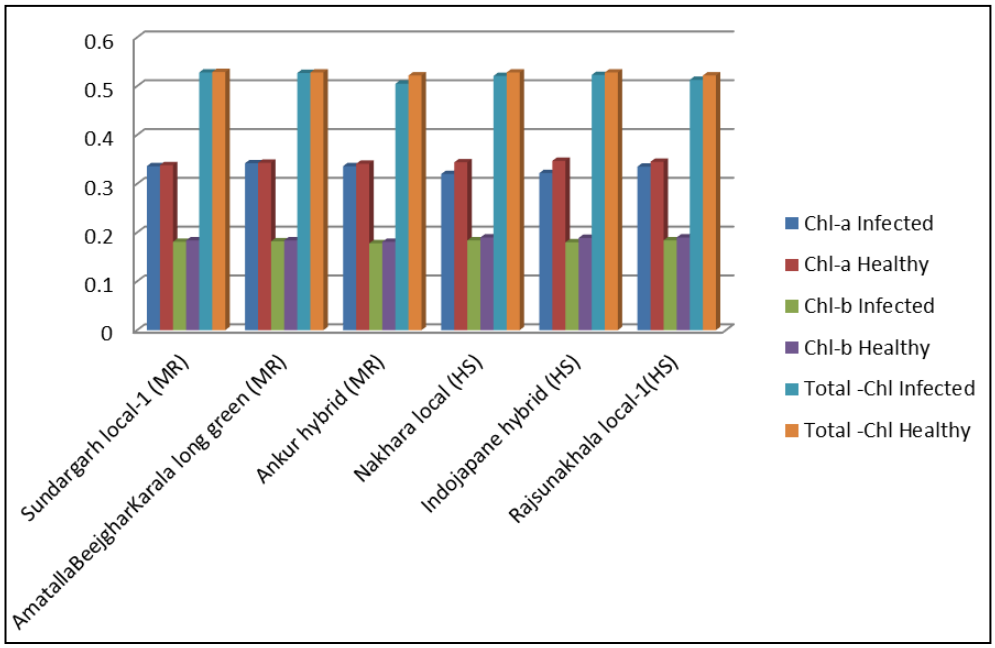

Fig 1: Reduction in chlorophyll content (a, b, total) in the varieties of bitter gourd due to the infection of root-knot nematode

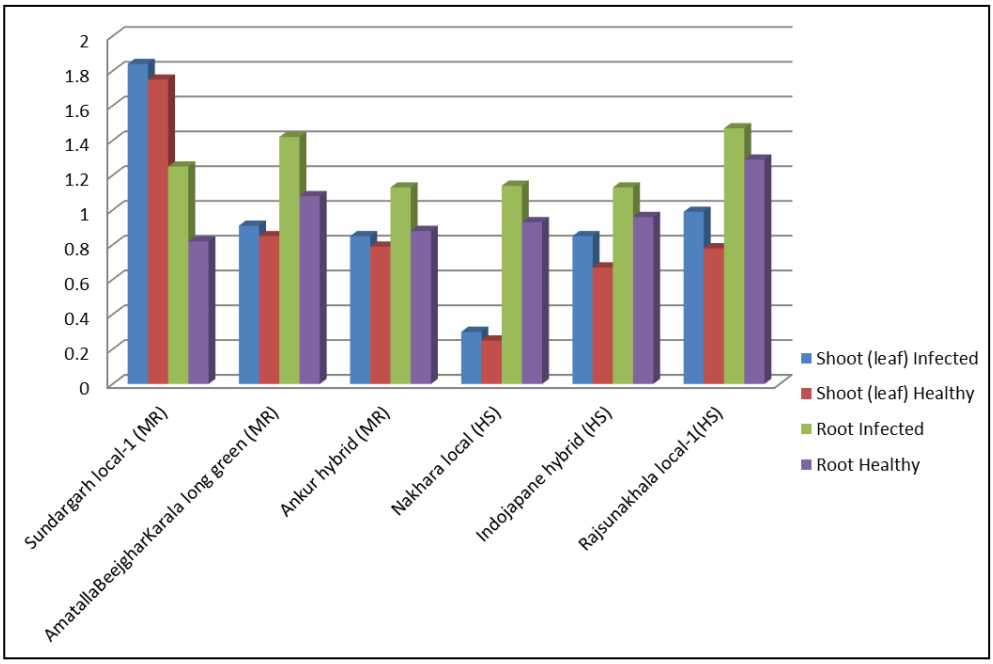

Fig 2: Total sugar content in healthy (H) and root-knot infected (I) varieties of bitter gourd

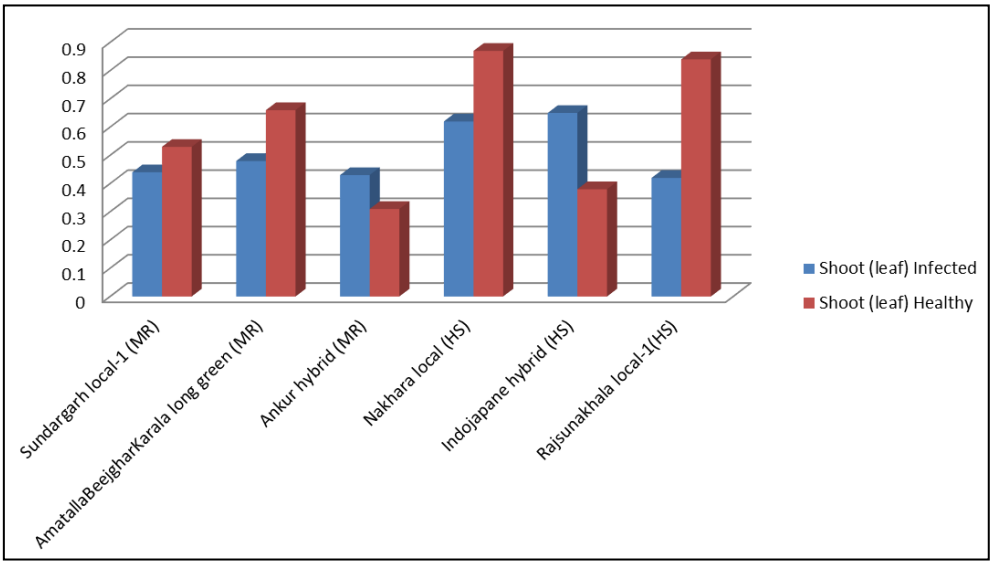

Fig 3: Percentage increase /decrease in total starch content in healthy (H) and root-knot infected (I) varieties of bitter gourd

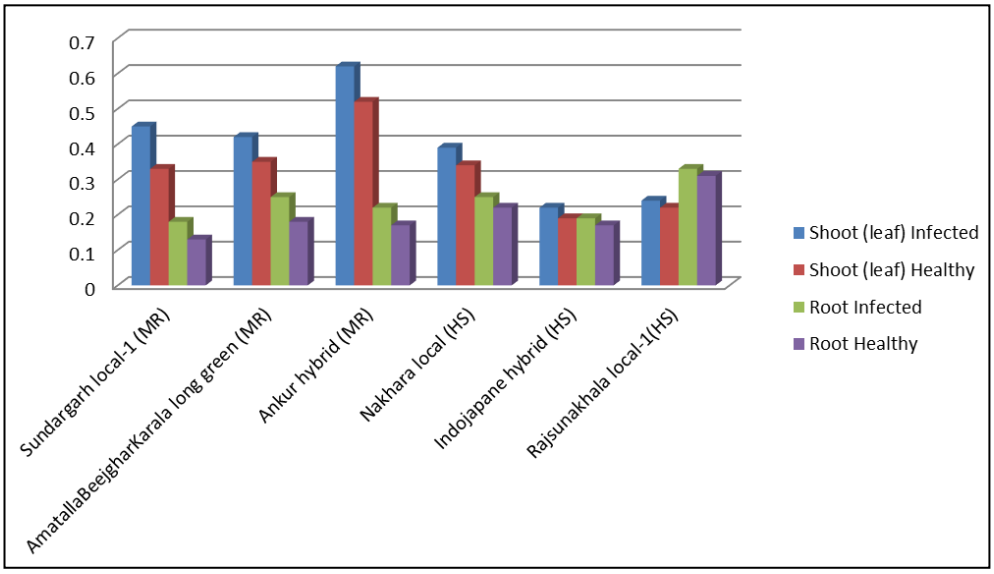

Fig 4: Percentage increase /decrease in Phenol content in Healthy (H) and root-knot infected (I) varieties of bitter gourd

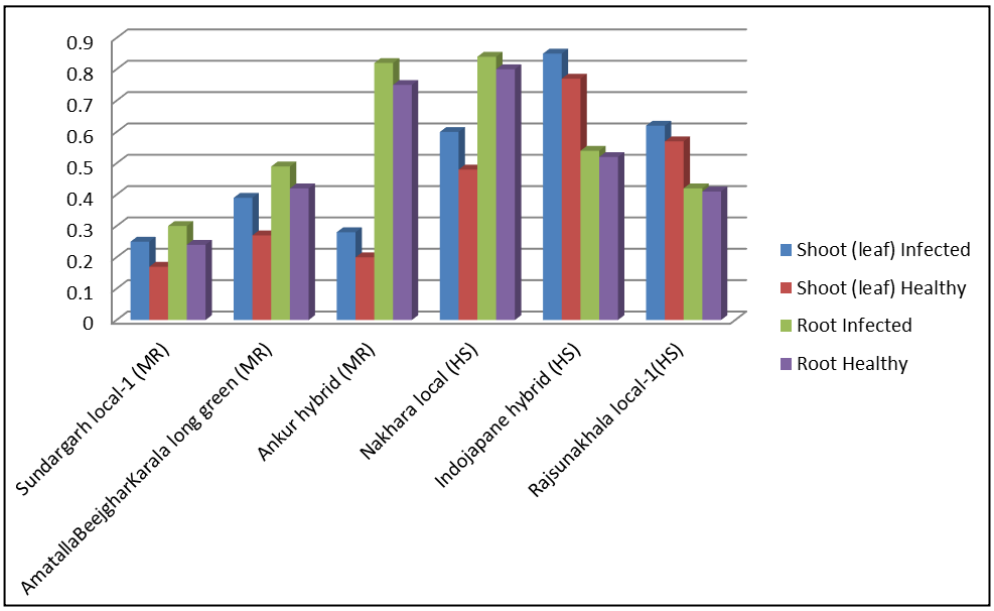

Fig 5: Percentage increase /decrease in Proline content in healthy (H) and root-knot infected (I) varieties of bitter gourd

Table 1: Reduction in chlorophyll content (a, b, total) in the varieties of bitter gourd due to the infection of root-knot nematode

Sl. No.	Varieties	Chlorophyll 'a' content mg/g leaf				Chlorophyll 'b' content mg/g leaf				Total chlorophyll content mg/g leaf			
		Infected Leaf	Healthy Leaf	Mean Leaf	% increase(+)/ decrease(-) over healthy	Infected Leaf	Healthy Leaf	Mean Leaf	% increase(+)/ decrease(-) over healthy	Infected Leaf	Healthy Leaf	Mean Leaf	% increase(+)/ decrease(-) over healthy
01	Sundargarh local-1 (MR)	0.336	0.338	0.337	-0.371	0.181	0.184	0.182	-1.631	0.528	0.529	0.528	-0.236
02	AmatallaBeejgharKarala long green (MR)	0.342	0.343	0.342	-0.364	0.182	0.184	0.183	-1.085	0.527	0.528	0.527	-0.095
03	Ankur hybrid (MR)	0.336	0.341	0.338	-1.392	0.178	0.181	0.179	-1.515	0.505	0.522	0.513	-0.032
04	Nakhara local (HS)	0.320	0.344	0.332	-6.977	0.184	0.190	0.187	-3.281	0.521	0.528	0.524	-1.278
05	Indojapane hybrid (HS)	0.322	0.347	0.329	-4.228	0.180	0.189	0.184	-4.762	0.523	0.528	0.525	-0.899
06	Rajsunakhala local-1(HS)	0.335	0.345	0.340	-2.898	0.184	0.190	0.187	-3.158	0.513	0.522	0.517	-1.628
	SE(m)±	0.0034	0.0030			0.0030	0.0036			0.0027	0.0024		
	CD(P= 0.05)	**0.0101**	**0.0089**			**0.0092**	**0.0110**			**0.0081**	**0.0074**		

Table 2: Percentage increase /decrease in total sugar content in healthy (H) and root-knot infected (I) varieties of bitter gourd.

Sl. No.	Varieties	Total sugar content mg/g on fresh weight basis							
		Shoot (leaf)				Root			
		Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy	Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy
01	Sundargarh local-1 (MR)	1.84	1.75	1.79	+5.14	1.25	0.82	1.03	+52.43
02	Amatalla Beejghar Karala long green (MR)	0.91	0.85	0.88	+7.05	1.42	1.08	1.25	+31.48
03	Ankur hybrid (MR)	0.85	0.79	0.82	+7.59	1.13	0.88	1.01	+28.40
04	Nakhara local (HS)	0.30	0.25	0.28	+20.00	1.14	0.93	1.03	+18.42
05	Indojapane hybrid (HS)	0.85	0.67	0.76	+26.86	1.13	0.96	1.05	+17.70
06	Rajsunakhala local-1(HS)	0.99	0.78	0.89	+26.92	1.47	1.29	1.38	+13.95
	SE(m)±	0.012	0.030			0.006	0.015		
	CD(P=0.05)	0.036	0.089			0.017	0.044		

Table 3: Percentage increase /decrease in total starch content in healthy (H) and root-knot infected (I) varieties of bitter gourd.

Sl. No.	Varieties	Total Starch content mg/g on fresh weight basis			
		Infected Leaf	Healthy Leaf	Mean Leaf	increase(+)/ decrease(-) over healthy
01	Sundargarh local-1 (MR)	0.44	0.53	0.48	-16.98
02	Amatalla Beejghar Karala long green (MR)	0.48	0.66	0.57	-27.2
03	Ankur hybrid (MR)	0.43	0.31	0.37	-27.91
04	Nakhara local (HS)	0.62	0.87	0.75	-28.73
05	Indojapane hybrid (HS)	0.65	0.38	0.57	-41.54
06	Rajsunakhala local-1(HS)	0.42	0.84	0.63	-50.00
	SE(m)±	0.0044	0.0045		
	CD(P=0.05)	0.0134	0.0135		

Table 4: Percentage increase /decrease in Phenol content in Healthy (H) and root-knot infected (I) varieties of bitter gourd

Sl. No.	Varieties	Phenol content µg/g on fresh weight basis							
		Shoot (leaf)				Root			
		Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy	Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy
01	Sundargarh local-1 (MR)	0.45	0.33	0.39	+33.56	0.18	0.13	0.16	+42.48
02	Amatalla Beejghar Karala long green (MR)	0.42	0.35	0.38	+21.71	0.25	0.18	0.22	+36.66
03	Ankur hybrid (MR)	0.62	0.52	0.57	+19.30	0.22	0.17	0.19	+24.75
04	Nakhara local (HS)	0.39	0.34	0.37	+18.38	0.25	0.22	0.23	+12.94
05	Indojapane hybrid (HS)	0.22	0.19	0.21	+12.74	0.19	0.17	0.18	+7.40
06	Rajsunakhala local-1(HS)	0.24	0.22	0.23	+11.31	0.33	0.31	0.32	+5.15
	SE(m)±	0.0134	0.0065			0.0072	0.0051		
	CD(P= 0.05)	0.0402	0.0195			0.0217	0.0155		

Table 5: Percentage increase /decrease in proline content in healthy (H) and root-knot infected (I) varieties of bitter gourd.

Sl. No.	Variety	Proline content mg/g on fresh weight basis							
		Shoot (leaf)				Root			
		Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy	Infected (I)	Healthy (H)	Mean	increase(+)/ decrease(-) over healthy
01	Sundargarh local-1 (MR)	0.25	0.17	0.21	+47.06	0.30	0.24	0.27	+25.00
02	Amatalla Beejghar Karala long green (MR)	0.39	0.27	0.33	+44.44	0.49	0.42	0.46	+16.66
03	Ankur hybrid (MR)	0.28	0.20	0.24	+40.00	0.82	0.75	0.78	+9.34
04	Nakhara local (HS)	0.60	0.48	0.54	+25.00	0.84	0.80	0.82	+5.00
05	Indojapane hybrid (HS)	0.85	0.77	0.81	+10.38	0.54	0.52	0.53	+3.85
06	Rajsunakhala local-1(HS)	0.62	0.57	0.59	+8.77	0.42	0.41	0.42	+2.44
	SE(m)±	0.0057	0.0040			0.0050	0.0137		
	CD(P=0.05)	0.0171	0.0122			0.0151	0.0413		

4. Conclusion

It was evident from the observations that due to nematode infection all the six varieties taken for biochemical studies exhibited a significant reduction in different growth parameters like chlorophyll ‘a’ (maximum 4.228% in Nakhara local and minimum 0.364% in Amatalla Beejghar Karala long green), chlorophyll ‘b’ (maximum 4.762% in Indojapane hybrid and minimum 1.085% in Amatalla Beejghar Karala long green) and total chlorophyll (maximum 1.628% in Rajsunakhala local-1 and minimum 0.032% in Ankur hybrid) but the total phenolic and proline contents (mean of both shoot & root) increased significantly which was maximum as 33.56% and 47.06% respectively in the variety Sundargarh local-1 and minimum as 11.31% and 8.77% respectively in variety Rajsunakhala local-1 in shoots and maximum 42.48% and 25.00% respectively in variety Sundargarh local-1 and minimum 5.15% and 2.44% respectively in variety Rajsunakhala local-1 in the roots of the tested varieties. The total sugar contents (mean of both shoot & root) increased significantly maximum of 26.92% in variety Rajsunakhala local-1 and minimum of 5.14% in variety Sundargarh local-1 in shoots and maximum of 52.43% in variety Sundargarh local-1 and minimum of 13.95% in variety Rajsunakhala local-1 in the roots of the tested varieties. It was observed there was a decrease trend of starch contents of the varieties.

5. References

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