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Effect on macronutrient of *Cajanus cajan* root infected by increase inoculum of *M. incognita*

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ABSTRACT: *M. incognita* is the most common and economically significant species of root knot nematode parasitizing most of the crop. Due to infection of nematodes, there is change in the physiological and biochemical pathways in host which responsible for the susceptibility of host to nematode. Since work on biochemical changes in response to nematode infection in pigeon pea is limited, the present study is conductedin order to study effect of increase in inoculum level of *M. incognita* on macronutrients (Nitrogen, Phosphorus, Potassium) of pigeonpea root. The pot culture research was carried out in Complete randomized design (CRD) with 5 treatments i.e T_1 (500 J_2/plant), T_2 (1000J_2 / Plant), T_3 (1500J_2/plant), T_4 (2000J_2/plant), T_5 (Control) and 4 varieties were UPAS-120(R), IPA-15-1 (MR), IPA 14-7(S), CO-6(HS) in Department of Nematology, OUAT, BBSR in kharif season. With increase in inoculum level there was increase in macronutrients content. Highest increase in Macronutrient nitrogen in treatment T_4 then T_3, T_2 and then T_1 over control $T_5$and the N content increased in highest in variety CO-6 followed by IPA-14-7, IPA-15-1 and UPAS-120 varieties. Similar result found in P and K content. The results have demonstrated that nematode infestation leads to highest increased by 60.7%, 75% and 37.22% total N, P and K respectively in the roots of highly susceptible variety of Pigeon pea.

Keywords: Root knot nematode, *M incognita,* Pigeon pea (*Cajanus cajan*), Nitrogen, Phosphorus, Potassium.

INTRODUCTION

Pigeonpea, *Cajanus cajan*, is one of the major grain legumes of in the Indian subcontinent and in other part of world. It is occupied about 4.9 m ha area globally out of which India alone occupies 3.5 m ha *i.e.* 72% of the total area (Saxena, 2009). According to Sasser and Freckman (1987), crop is highly vulnerable to many nematodes, about annual loss of 13% globally. The southern root-knot nematode, *Meloidogyne incognita*, is an important nematode pest of pigeonpea. Infestations of this nematode result in yellowish leaves and poor plant growth. The pathogenic effect of root-knot nematodes not only hampers the nutrient uptake of leguminous plants and also alter the host physiology. In the recent past Mahapatra and Nayak (2019) investigated that increase in macronutrient level after inoculation of nematode in bitter gourd and highest increase found in case of susceptible var. than resistant var. alters the host physiology and metabolism process which indirectly affect the biochemical parameters in host. Earlier, Thakur (2015); Pandey and Nayak (2019); Mohanty *et al*. (1995) also reported similar findings. Due to nematode infection root tissue system hampered which affect the absorption and translocation of minerals through root and ultimately affect the yield potential. Therefore, it is necessary to study the role of *M. incognita* on nutritional content of pigeonpea plant.

MATERIALS AND METHODS

The experiment was conducted to know the resistance to nematode (*Meloidogyne incognita*) inoculated four varieties UPAS-120 (Resistant), IPA-15-1 (Moderately resistant), IPA-14-7(Susceptible) and CO-6 (Highly susceptible) using Complete Randomized Design (CRD) with five treatments.Two weeks after seedling emergence nematodes released into the holes @ 500J_2,1000 J_2, 1500 J_2, 2000 J_2 per seedling and one control. For analysis three sets of plants were maintained. Each set was arranged on separate platform in the green house in order to avoid cross infection. At 30 days after inoculation, plants were removed from the pot and the nutritional compositions were estimated

Estimation of Nitrogen: 200 mg of the material were taken in digestion flasks. 4 ml of conc. H_2SO_4 and 200 mg of the digestion mixture (K_2SO_4: $CuSO_4$ = 5:1) were added. These flasks were left an hour before being gradually heated until foaming developed. Two sodium thio-sulphate crystals were introduced to each digestion flask to check foaming. The digestion was then maintained until the liquid was fully clear, blue, and syrupy with no bubbling. The flask was chilled before the contents were diluted with distilled water to 25 ml. The sample extract was then diluted and put into a micro Kjeldahl distillation unit with 10 ml. Following the addition of 10 ml of 40% NaOH, distillation was continued for an additional 10 minutes. Ammonia released during the distillation process was absorbed by conical flask and distillate was titrated against 0.05N H_2SO_4.

Estimation of phosphorus. Phosphorus estimated by Jackson (1973) procedure.

Chemical reagents. 1. Molybdate-vanadate solution,

(a) Combine 125 ml of distilled water with 6.250 g of ammonium molybdate.

(b) Mix 125 ml of 1(N) HNO_3 and 313 mg of ammonium vanadate to dissolve.

In a 250 ml volumetric flask, combine the reagents (a) and (b).

Molybdate-vanadate solution is the name of the resulting mixture.

2. 2(N) HNO_3: Use distilled water to dilute the concentrated HNO_3 from 60 ml to 480 ml.

3. To make the standard phosphorus solution (25 ppm), mix 55 mg of monobasic potassium phosphate (KH_2PO_4) with 500 ml of distilled water.

Sample analysis. In 25 ml volumetric flasks, standards of 0, 2.5, 5.0, 7.5, and 10.0 ml of 25 ppm phosphorus solution and 2 ml of digested sample extracts were collected. To each flask, five ml. of 2N HNO_3 solution were added. Each flask was then filled with the distilled water to make the final volume 15 ml. Add 2.5 ml of the molybdate-vanadate solution. With distilled water, the final volume to 25 ml, and thoroughly shaken. After 20 minutes, the absorbance at 420 nm in spectrophotometer. Using the standard curve, the phosphorus content of plant samples was estimated.

Estimation of potassium. Using 25 ml volumetric flasks, 1 ml sample of digested root extract was obtained, and the volume to 25 ml using distilled water. In 100 ml volumetric flasks with water, identical 1, 2, 3, 4, and 5 ppm standard K solutions (i.e. 0.1907 g KCL/lit) were taken. In a digital flame photometer, readings for standards and samples were taken.

RESULT AND DISCUSSION

In all the three varieties percentage nitrogen content increases over the control but maximum increases recorded in the T_4 treatment followed by T_3, T_2 and T_1 (Table 1). But when compared among the varieties, highly susceptible variety shows the maximum root nitrogen content than that of resistant, moderately resistant and susceptible varieties.

Change in Phosphorus content (% dry weight) in roots (Table 2): In all the four varieties percentage phosphorus content increases over the control but maximum increases recorded in the T_4 treatment followed by T_3, T_2 and T_1. But when compared among the varieties, highly susceptible variety shows the maximum root phosphorus content than that of resistant, moderately resistant and susceptible varieties.

Table 1: Effect of increase level of inoculum on Nitrogen content (% dry weight) of pigeonpea roots.

Treatment	UPAS-120(R)		IPA-15-1(MR)		IPA-14-7(S)		CO-6(HS)	
	Root	% change over control	Root	% change over control	Root	% change over control	Root	% change over control
T_1 500J_2	0.72	9.14	0.78	9.81	0.86	10.26	0.97	12.84
T_2 1000J_2	0.83	26.40	0.91	27.57	1.00	27.78	1.11	29.18
T_3 1500J_2	0.93	41.62	1.02	42.99	1.13	44.87	1.26	46.69
T_4 2000J_2	1.02	55.84	1.13	57.94	1.23	58.12	1.38	60.70
T_5 (Control)	0.66		0.71		0.78		0.86	
SE(m)±	0.02		0.01		0.02		0.01	
CD(0.05)	0.06		0.03		0.06		0.03	

Table 2: Effect of increase level of inoculum on Phosphorus content (% dry weight) of pigeonpea roots.

Treatment	UPAS-120(R)		IPA-15-1(MR)		IPA-14-7(S)		CO-6(HS)	
	Root	% change over control	Root	% change over control	Root	% change over control	Root	% change over control
T_1 500J_2	0.27	14.29	0.30	15.38	0.36	16.13	0.40	16.35
T_2 1000J_2	0.30	27.14	0.35	35.90	0.42	36.56	0.49	40.38
T_3 1500J_2	0.35	48.57	0.39	51.28	0.47	52.69	0.53	53.85
T_4 2000J_2	0.40	72.86	0.45	73.08	0.54	73.12	0.61	75.00
T_5(Control)	0.23		0.26		0.31		0.35	
SE(m)±	0.02		0.02		0.01		0.02	
CD(0.05)	0.06		0.06		0.03		0.06	

Table 3: Effect of increase level of inoculum on Potassium content (% dry weight) of pigeonpea roots.

Treatment	UPAS-120(R)		IPA-15-1(MR)		IPA-14-7(S)		CO-6(HS)	
	Root	% change over control	Root	% change over control	Root	% change over control	Root	% change over control
T_1 500J_2	2.22	7.94	2.36	8.24	2.52	10.19	2.65	11.80
T_2 1000J_2	2.42	17.67	2.58	18.02	2.75	20.23	2.90	22.05
T_3 1500J_2	2.59	26.09	2.78	27.33	2.95	28.97	3.07	29.49
T_4 2000J_2	2.79	35.66	2.97	35.88	3.12	36.24	3.26	37.22
T_5 (Control)	2.06		2.18		2.29		2.37	
SE(m)±	0.03		0.02		0.02		0.02	
CD(0.05)	0.10		0.06		0.07		0.06	

Change in Potassium content (% dry weight) in roots (Table 3): In all the four varieties percentage potassium content increases over the control but maximum increases recorded in the T_4 treatment followed by T_3, T_2 and T_1. But when compared among the varieties, highly susceptible variety shows the maximum root potassium content than that of resistant, moderately resistant and susceptible varieties.

DISCUSSION

After feeding nematode developed a giant cell around the head region, which act as a nutrient sink. That means all the nutrients and water deposited in that region. There is disturbed free flow of water and nutrients to upper part of plant body and ultimately affect the normal physiology and metabolism. Chandramani *et al.* (2022) also stated that nutrients contents of the mungbean *viz*., N, P, K, Ca and Mg were significantly reduced in shoots while in roots these was increased with an increase of inoculum levels. Nasr *et al.* (1980) also founded similar findings on bitter almond and peach roots. There is increase in content of nitrogen and potassium in roots of tomato plants due to nematode infection reported by Bergeson (1966) due to metabolic change in plant. The increase in nutrient content in galled roots also supported by Meyer *et al.* (1960). Thakur (2015) also explained that the conc. of macronutrients content in infected plants increased as the photosynthetic rate and chlorophyll decreased with increase in inoculum level. Mahapatra and Nayak (2019) investigated that increase in macronutrient level after inoculation of nematode in bitter gourd. The investigation showed that high conc. of macronutrients in roots of highly susceptible followed by susceptible, moderately resistant and resistant varieties. Hunter (1958) also founded that maximum increase in nutrient content highly susceptible root-knot nematode infected plants. The infected plants fail to properly utilize the different amino acids, protein, sugar, absorbed N_2, P_2O_5, and K_2O as well as other elements, which eventually find their way into the growth and production of nematode. This could be one of the causes of the phosphorus buildup in nematode-infected plants. Carneiro *et al*. (2002) observed that roots of infected plants accumulated more N and P than the uninfected controls. Since the infected roots were heavier than those of the controls, this higher amount of nutrients is probably a consequence of an increased root system absorbing surface, although gall formation would have contributed significantly to the final root mass. The plant may be more vulnerable to root knot nematode infestation due to an increase in nitrogen concentration. This higher amount of nutrients is likely the result of an enlarged root system absorbing surface. Gall formation would have considerably contributed to the final root mass given that the infected roots were heavier than the control roots. It's possible that root galling, which impairs upward migration, is to blame for the accumulation of NPK at the infected roots.

CONCLUSION

The attack of nematode on roots of pigeon pea plant has been shown to cause imbalances in the biochemical and nutrients level. The increase level of inoculum of root knot nematode cause disrupted in free flow of water and nutrients to upper part of plant due to blockage of xylem vessels. There is more accumulation of macronutrients (Nitrogen, Phosphorus, potassium) on roots of pigeon pea plant.

FUTURE SCOPE

Under the mechanisms of host plant resistance, Macronutrients in plants act as major line of defense against nematodes. So, information regarding the Macronutrients status in the roots which are responsible for defense against plant parasitic nematodes will be helpful in breeding of resistant cultivars in pigeon pea.

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Conflict of Interest. None.

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