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Changes induced by *meloidogyne incognita* on nutrient content of mentha (*Mentha arvensis*)

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ABSTRACT

Mineral nutrient Nitrogen, Phosphorus and Calcium showed increasing trends with increasing nematode inoculum. However, Nitrogen and Phosphorus showed significant increase at 100 nematodes and above per pot where as Ca increase significantly at 10 nematodes and above levels per pot .Potassium and Magnesium did not showed inconsistent trends, more over Mg declined at higher nematode inoculum .*Meloidogyne incognita* increased macro nutrient levels in roots which left adverse impact on plant physiology.

Introduction

The nematode usually causes a clear reduction in the vitality and growth of host plants without being detrimental. The effect of infection on shoot growth have reflects as nutrient deficiencies. Root –knot nematode modifies root tissues and restricts plant growth and reduce crop yield. The severity of crop yield loss due to root-knot infestation in the field is influenced by several biological and physiological factors Seinhorst, (1961). Bird and Lovey (1975). Trudgill (1980). Concluded that poor growth of potato plants, heavily infested with *Globodera rostochiensis* might be due to nematode induced deficiency.Sheifiee and Jenkins(1963) reported increase of potassium(K), nitrogen(N), Phosphorus (P) and sodium (Na)ranging from 150-266% in pepper roots infected with *M.incognita acrita* Chit wood (1949), however, concentration of their minerals in the foliage remained unchanged. Hunter (1958) reported that 5 weeks old root-knot infested had no effect on p32 translocation, but reported that low nutrient levels, infected roots absorbed less p32 than healthy roots. He also reported that N,P,Mg. and K were in higher concentration in infected than in healthy roots.Otiefa(1952) reported lower total amount N,P,K,Ca and Mg as compare to control plants on lima bean. He also reported that the nematode damage appears to be correlated with the amount of K available to the host plant. Wilcox et al (1955) found no difference in the contents of N, P, K, Ca, Mg, and Na between nematode infected and non-infected plants .Most of the information regarding variation of contents due to nematodes are other than medicinal and aromatic crops. Hence, present study was undertaken to determine the effect of *M. incognita* on the content of micronutrient of mentha roots

Materials And Methods

Healthy suckers (7-10cm) long having at least two buds of mentha cv.Shivalik, surface sterilized in 0.01% Hg Cl_2 and followed by several washing in sterilized water, were transplanted in earthen pots of (30x20cm^2) containing 5kg autoclave sterilized soil. Experiment was initiated on 15 January and plants having 4-6 leaves were inoculated with different inoculum of freshly hatched 2nd stage juvenile of *M.incognita* on 30th of January. Each treatment was replicated three times .All the treatments were watered daily with tap water and once weekly with full strength of Hoagland solution (Hoagland and Arnon 1950) Experiment was terminated after four months. Observations were recorded .Among the mineral contents Nitrogen of plant materials was determined by the method of Linder (1944).The phosphorus content was estimated using molybdate –vane do reagent yellow color method as described by Jackson (1973).The potassium of mentha roots was determined by the method of piper (1966) Calcium and Magnesium were estimated by EDTA titration according to the method given Anonymous (1960).These macro nutrient of mentha roots were determined from the oven dried material at 50-60^{0}c for 3-4 days. Five hundred milligram of oven dried and well grinded root of mentha from each treatment was taken in a 50 ml conical flask to which 10 ml of 4:1 sulphuric acid (97-100%) and perchloric acid (70%) mixture was added. These flasks were heated gently in central unit of digestion of University, on hot plate till the formation of dense white fumes .When fumes reduced, the heating was increased and digestion continued for 25-30 minute to obtain a colour less digest. The digest was cooled and diluted to 50ml in a volumetric flask with distilled water. This diacid digest served as stock solution and was used for the estimation of N, P, K, Ca, Mg, and.

Nitrogen: an aliquot of 0.5ml of stock solution was taken in 25 ml volumetric flask. One ml of 10% sodium silicate solution was added and neck of flask washed. One ml of 1N Na OH was mixed to partially neutralize the acid. The volume was made to 20ml and the contents were then thoroughly mixed. One ml of Nessler's reagent was added drop wise in course of shaking. Now volume was made 25ml.The solution was allowed to stand for 30 minute at room temperature. The absorbance was read at 440 nm against a reagent blank. A standard curve was prepared from graded concentration of ammonium sulfate. The data are expressed in per cent age

$$\text{Per cent age} = \frac{\text{PPM reading} \times \text{Dilution}}{10{,}000}$$

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Phosphorus: five ml of stock solution was taken in 25ml volumetric flask, using 2, 4 dinitrophenol as indicator, pHof the aliquot was brought to 2.8-3.00 with ammonia solution till the solution became yellow, followed by the addition of 6NHCl to make it just colorless .Five ml of vendomolybdate reagent was added and final volume was made to 25ml by adding distilled water. After appearance of yellow colour, absorbance was read at 440nm against a reagent blank. The standard curve was prepared with the graded concentration of KH_2PO_5.The data are expressed as per centge of Phosphorus after multiplying with dilution factor

Potassium: Two ml of stock solution was taken in 25ml volumetric flask. Volume was made 25mlby adding distilled water .Potassium content was determined with flame photometer using standard KCl for potassium. The volumes were calculated and expressed as per cent age of K after multiplying with dilution factor.

Calcium and Magnesium: one ml of stock solutition was taken in china dish and 5ml of distilled water was added .The content was stirred on a magnetic stirrer on slow speed. Five crystals of carbonates were added into china –dish and 2ml of NH_4OH-NH_4Cl buffer and 4 drops of EBT indicator were added. The content of the china-dish was filtered with N/100 EDTA till blush green colour (end point) from purple red colour appeared. The volume of EDTA solution used was noted and following calculation were made

Ca+Mg (meq/ml) =EDTA used in titration ×Normality of EDTA
Stock solution (ml)

Magnesium is calculated as Mg (me/ml) = [Ca+ Mg (meq/ml)] – Ca (meq/ml)

Results And Discussion

The data recorded on macronutrient content viz., nitrogen, phosphorus, potash ,calcium, and magnesium in mentha roots inoculated with *M.incognita* @10,100,1,000 and 10,000 per pot per plant over check(zero nematode) are presented in (Table 1 and fig.2)

Table Effect of *Meloidogyne incognita* on nitrogen, phosphorus, potassium, calcium and magnesium content of *Mentha arvensis* Mean of three replicates Nematode Inoculum Mineral nutrient (% 0.5g root)

(J_2 /pot)	N	P	K	Ca	Mg
10	0.34	0.15	1.56	0.012*	0.029*
100	0.41*	0.20*	1.11*	0.014*	0.032*
1000	0.44*	0.22*	1.42*	0.016*	0.046*
10,000	0.53*	0.26*	1.80*	0.017*	0.029*
0 (Check)	0.31	0.10	1.62	0.010	0.028
C.D (P=0.05)	0.09	0.05	0.08	0.0002	0.0002

*Significant

N: Nitrogen; P: Phosphorus; K: Potassium; Ca: Calcium; Mg: Magnesium

J_2 :2nd stages juveniles of *M.incognita*

Nitrogen: The effect of *M.incognita* showed increase in nitrogen content progressively with increase in nematode increase level. Significant increase was found at 100 nematodes /pot and above. The maximum increase (0.53%) was recorded in 10,000 nematodes inoculum level over check.

Phosphorus: The P content of mentha roots showed increase with increase in nematode increase. Significant increase in P content was recorded at 100 nematodes and above over check. The maximum increase (0.26%) was observed in 10,000 nematode inoculum levels over check (Table1)

Potassium: The amount of K significantly reduced at 100 and 1,000 nematodes /pot, but no definite trend was observed at these inoculum levels. The significant increase in K content of roots of mentha was observed only at higher inoculum (10,000 nematodes/pot)

Calcium: All the treatments showed significant increase in Ca content over check. The maximum increase (0.017%) in Ca content was observed at 10,000 nematode inoculum levels over check. All treatments were significantly different to each other (Table 1)

Magnesium: All the nematode inoculated plants showed significant increase in Mg content of mentha roots over check. The maximum increase (0.046%) was recorded in 1000 nematodes inoculum level over check (Table 1) the increase in Mg content was observed at inoculum 10,100 and 1000 per pot At 10,000 nematodes per pot, there was a decline in Mg content although it was significantly more than check.

Nematode effects on plant mineral content are do not only to nematode consumption of some of the elements absorbed by plants as suggested by Chit wood et al (1952) but also may be due to disturbance in the physiology of the plants as a whole. Histological studies of mentha roots revealed a disruption in the vascular tissues. Such altercation directly disrupt nutrient of water flow to foliage resulted in accumulation of nutrient.Nasr et al (1980) also reported similar result on bitter almond and peach roots .Berge son (19690 reported that excess of N and K in the roots of tomato infected with *M.incognita* are primarily due to metabolic upsets in which these minerals are mobilized to the infection site and due to the failure of infected roots to translocate the minerals to other plant parts. The effect of excess minerals in galled roots on the vigor of the plant is not known, but under nutrient stress, infected roots perhaps accumulate nutrients at the expanse of the foliage or the excesses may be toxic as suggested by Shiefiee and Jenkins (1963) Meyer et al (1960) emphasized the fate of increased nutrient .They correlated the increased amount to toxic effects, when concentration exceeding physiological requirements resulted in disorganization and detrimental effect on host. Contrary to this observation, Oteifa (1982) on lima bean with M.incognita and Wilcox (1955) non corn plan found no difference in nutrient. The concentration in infected plants increased as the photosynthetic rate and chlorophyll content decreased, which indicated that nitrogen may occur in strong form (Melakeberhan et al 1987).The potassium content of roots showed reduction at early inoculum level ,but amount of potassium increased as the number of nematode multiplied .This suggest that the plants with healthy roots system accumulates fair amount of K in their top, but any impairment of root system may directly depress uptake of K and plants became vulnerable to the attacks of pathogen. Magnesium content showed declining trends at higher inoculums level ,because infected plants also showed lesser photosynthesis due to less magnesium .Due to mobilization of nutrient from foliage to root s and change in metabolic activity that would mobilize mineral t the infection site .our findings get supports from others workers (Melakeberhan et al,1985.,Bean and Shoemaker 1986

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