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EFFECT OF POTASSIUM FERTILIZATION AND OF SOIL TEMPERATURE ON THE INCIDENCE AND PATHOGENICITY OF THE ROOT-LESION NEMATODE, *PRATYLENCHUS LOOSI* LOOF, ON TEA (*CAMELLIA SINENSIS* L.)

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The results of the present investigation have clearly shown that the pathogenicity of the root-lesion nematode of tea, *Pratylenchus loosi*, was alleviated by doubling the dosage of potassium fertilization from 554 mg of K_2O/plant/year to 1108 mg/plant/year. At the higher level of K application, the nematode population was significantly suppressed. Irrespective of nematode infestation, the higher levels of K application had a significant reducing effect on the levels of Ca and Mg in the leaves of young tea plants. However, no deficiency symptoms of these two minerals were observed. Nematode infestation was found to influence the accumulation of phosphorous in the plant.

INTRODUCTION

Potassium fertilization is known to have significant influence on the general physiology of plants. Application of higher levels of potassium fertilizer have been known to reduce incidence of certain pests and diseases (Janssen, 1928; Chaboussou, 1976; Kovanci & Colakoglu, 1976). Reduction in nematode populations have been reported through higher levels of application of potassium fertilizers by Oteifa (1952), Kirkpatrick *et al*, (1959) and Elgindi (1976).

The present investigation was undertaken to study in detail the effects of higher potassium fertilizer applications on plant growth, nematode population build up and the pathogenicity effects of the latter on young tea, maintained at different soil temperatures.

MATERIALS & METHODS

Thermostatistically-controlled constant temperature tanks measuring 2×lm and 30cm in depth (described by Sivapalan & Gnanapragasam, 1975), were used to maintain steady temperature of soil contained in 15cm diameter clay pots.

Nursery soil mixed in the proportion of 3 parts gravel and one part clay soil, and fumigated with methyl bromide at 0.5kg./2.83 m^3 was used in this experiment. Six-month old tea plants (clone TRI 2025) of uniform size were transplanted into the pots and maintained in the green house for a period of 2 weeks prior to transferring them to the respective temperature tanks. A total of 36 potted plants were thus transferred to each of the 4 temperature tanks maintained at 12, 18, 24 and 30°C respectively. Half the plants in the respective tanks received the recommended dosage of the T65 fertilizer mixture (Tolhurst & Visser 1961) delivering 554mg of K_2O /plant/year. The other half received double this dosage and consequently the K level in T65 was so adjusted to deliver 1108mg of K_2O/plant/year.

After a period of 3 months in the respective temperature tanks, half the number of plants receiving the respective levels of K were inoculated with a suspension of 3000 nematodes per plant. The treatments in the respective temperature tanks were arranged in a complete randomized block design. Following inoculation with nematodes, the plants were maintained at the respective soil temperature for a period of 12 months, at the end of which they were removed for assessments.

Each plant was carefully removed from its respective pots, with special attention being paid to recover all roots. Fresh shoot and root weights were determined and the leaves from the respective plants were all removed and oven-dried at 85°C and ground for mineral analysis. Nematodes were recovered from root samples by the modified Baerman funnel technique described by Hutchinson (1962).

The total nitrogen was determined by the Kjeldahl method, phosphorous by the vanado-molybdophosphoric yellow colour method, potassium and calcium by flame photometry (Jackson, 1958). Magnesium was determined by the titan yellow method (Chenery, 1964).

RESULTS

The results of analysis of the mean shoot and root weights of both infested and control plants at the two levels of potassium fertilization are presented in Table 1, along with the assessments of nematode counts.

TABLE 1 — *Mean shoot and root weights of infested and uninfested plants maintained at 2 levels of potassium fertilization and nematode counts in roots at these 2 levels of potassium*

	Shoot weight (g)		*Root weight (g)*		*Nematode/g root* $\sqrt{n+1}$	
	K1	*K2*	*K1*	*K2*	*K1*	*K2*
Control	76.94	77.03	42.9	44.7	—	—
Infested	68.31	73.70	35.3	42.7	14.83	11.64
LSD (P=0.05)	5.93		6.0		1.88	

As seen from the above Table, nematode infestation was found to bring about a significant reduction in both shoot and root weight (P=0.05) at the lower level of potassium fertilization, whilst no such reduction was observed at the higher level. Nematode population was also found to be significantly suppressed at the high potassium fertilization level.

The results of analysis of the mean shoot and root weights of plants maintained at the 2 levels of potassium fertilization at different soil temperatures are presented in Table 2, along with the results of analysis of nematode counts.

TABLE 2 — *Mean shoot and root weights of plants maintained at 2 levels of potassium fertilization and at different soil temperatures, along with the corresponding nematode counts in roots.*

Temperature (°C)	*Shoot weight (g)*		*Root weight (g)*		*Nematode/g root $\sqrt{n+1}$*	
	K1	*K2*	*K1*	*K2*	*K1*	*K2*
12	22.0	24.3	34.6	45.7	6.69	3.98
18	81.3	81.7	50.2	54.7	21.34	16.02
24	86.0	94.8	39.4	43.1	21.52	17.53
30	101.3	100.7	37.0	25.0	9.78	9.00
LSD (P=0.05)	8.4		6.0		3.78	

A linear increase in shoot weight was observed with increase in soil temperature at both levels of K. A significant increase in shoot weight with increase in K level was observed only at 24°, whilst there was no such response at other temperatures. With respect to root weights, though no specific trend was observed with increase in soil temperature, the highest weight was recorded at 18° at both levels of K.

At 12°, a significant increase in root weight was observed at the higher potassium fertilization level, whilst at 30° there was a significant reduction. No such significant changes were observed at 18 and 24°.

A significantly high nematode population was observed only at 18 and 24°, at both levels of K. However, the nematode population count was found to be significantly suppressed at the higher level of K, at both these temperatures.

The results of analysis of shoot and root weights of both control and infested plants maintained at the different soil temperatures are presented in Table 3, along with the results of analysis of the mean nematode count at these respective temperatures.

TABLE 3 — *Mean shoot and root weight of infested and uninfested plants maintained at different soil temperatures, along with the corresponding nematode population in roots.*

Temperature (°C)	*Shoot weight (g)*		*Root weight (g)*		*Nematode/g root*
	Control	*Infested*	*Control*	*Infested*	$\sqrt{n+1}$
12	23.4	22.7	38.7	41.9	5.34
18	86.7	76.2	59.0	45.9	18.67
24	98.3	82.4	44.4	38.1	19.53
30	99.4	102.5	31.9	30.1	9.38
LSD (P=0.05)	8.4		6.0		4.51

A significant reduction in both shoot and root weight was observed with nematode infestation, only at 18 and 24°. No change was observed at 12 and 30° respectively. As was seen in Table 2, the nematode population at 18 and 24° was significantly higher than at 12 and 30°.

The results of the foliar mineral analysis of infested and unifested plants maintained at the 2 levels of K fertilization are presented in Table 4.

TABLE 4 — *Mean assessments of foliar nutrients in infested and uninfested plants maintained at 2 levels of potassium fertilization.*

Treatment	*Nutrient content (mg/g dry matter)*									
	N		*P*		*K*		*Ca*		*Mg*	
	K1	*K2*	*K1*	*K2*	*K1*	*K2*	*K1*	*K2*	*K1*	*K2*
Control	32.44	33.80	1.65	1.62	13.58	16.57	8.58	7.89	2.47	2.29
Infested	33.50	32.36	1.74	1.69	13.42	17.75	8.69	8.36	2.53	2.24
LSD (P=0.05)	NS		0.07		1.14		0.47		0.09	

As seen from Table 4, no significant changes in total nitrogen was observed in respect to both infestation as well as potassium levels. On the other hand, a significant accumulation of phospohrous was observed with infestation, at both levels of potassium. In the case of calcium, a significant increase was observed with infestation only at the higher level of potassium fertilization. No significant change in magnesium content was observed with infestation at both levels of potassium. However, irrespective of nematode infestation, a significant reduction in magnesium content was observed at the higher level of K application whilst a significant reduction of Ca was observed only in the uninfested plants.

The results of foliar mineral analysis of plants maintained at the 2 levels of potassium fertilization and at 4 different soil temperature are presented in Table 5.

TABLE 5 — *Mean assessments of foliar nutrients in plants maintained at 2 levels of potassium fertilization and 4 soil temperatures*

Temperature	*N*		*P*		*K*		*Ca*		*Mg*	
	K1	*K2*	*K1*	*K2*	*K1*	*K2*	*K1*	*K2*	*K1*	*K2*
12	42.78	41.00	1.20	1.12	11.39	13.11	10.30	9.20	2.51	2.22
18	30.50	31.61	1.92	1.88	14.67	17.39	8.00	8.10	2.50	2.33
24	30.33	28.78	2.14	2.00	15.11	19.05	8.00	7.90	2.57	2.42
30	28.28	30.94	1.52	1.61	12.83	19.28	8.20	7.30	2.43	2.08
LSD (P=0.05)	3.74		0.09		2.00		0.70		0.13	

As seen from the above Table, calcium content was found to be significantly higher at 12° than at all other higher soil temperatures. Other than at 18 and 24° (the two temperatures suitable for rapid nematode population build-up), the level of calcium was found to be significantly reduced at the higher potassium fertilizer level. The level of magnesium was found to be significantly reduced at the higher level of potassium fertilization, at all tested soil temperatures. Phosphorous content was found to be significantly high at both 18 and 24°, at the 2 levels of potassium fertilizer application. Whilst the total nitrogen content was found to be significantly higher at 12° compared to all other tested temperatures, the level of potassium was least at this temperature.

DISCUSSION

The results of the present investigation have shown that both soil temperature as well as the level of K fertilization had a definite influence on the population of the root-lesion nematode of tea, *Pratylenchus loosi* Loof and its consequent pathogenicity to young tea plants. Even though the clone used in the present experiment is known to be tolerant to the above nematode, definite pathogenicity symptoms were observed at the lower level of K application (Table 1). No such pathogenic effect was observed when the level of K was doubled at 2600 ppm at which level the nematode population was found significantly suppressed. Similar effects of suppression in nematode population with increase in K fertilization have been reported by other investigators for other nematodes as well (Oteifa, 1952; Kirkpatrick *et al*, 1959; Oteifa & Elgindi, 1976).

These results suggest a negative correlation between nematode injury and K levels thus indicating greater injury in plants deficient in K.

As reported earlier (Sivapalan & Gnanapragasam, 1975) the nematode population was found to be significantly high only at soil temperatures of 18 and 24°C and the pathogenicity symptoms in the form of reduced root and shoot weight was also significant only at these two temperatures. Even though the nematode population was high at these two temperatures, a significant suppression in their numbers was observed when the level of soil application of K was doubled. It is thus possible that such suppressions in the nematode population have alleviated the pathogenicity symptoms at this level of K fertilization, as observed in this experiment.

The results of mineral analysis have shown a significant suppression in Ca and Mg at the higher level of K, in both infested as well as unifested plants in the case of Mg and in uninfested plants in the case of Ca. Such reduced uptake of Ca and Mg with increase in K fertilization has been also reported for rice plants (Mengal *et al*, 1976).

Nematode infestation was found to affect the uptake of only P and Ca. Phosphorous was found to accumulate in infested plants at both levels of K, whilst Ca was accumulating only at the higher level of K.

Even though, there was a significant accumulation of Ca at the higher level of K, this does not seem to be on account of reduced uptake of K, since no significant changes in the latter were observed with nematode infestation at both levels of K.

Although in general, the level of Ca in leaves was found reduced at the higher level of K fertilization, the temperature × level of Potassium × mineral elements interactions showed that there was no such reduction at 18 and 24°, the two temperatures at which there was a significantly high build up of nematode population. The damaged roots of infested plants are likely to lose the selective absorbtion capacity and consequently there could be a passive uptake of more Ca compared to the uninfested plants.

Since nematode infestation was observed to be significantly higher at 18 and 24°, and the level of P too was significantly high at these temperatures, there seems to be a relationship between accumulation of P and nematode infestation. Such relationship has been reported for root-knot nematodes where the amount of P was found to be high in infested plants (David & Triantaphyllou, 1967). Infested plant roots are likely to passively leach out more organic acids, which in turn could lead to a higher uptake of P.

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