EFFECT OF NPK FERTILISERS AND SEASON ON THE ROOT REGION MICROFLORA IN CASHEW *(Anacardium occidentale* L.)

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Summary

Effect of NPK fertilisers and season on the root region microflora of cashew was studied. Population build up of the microflora interacted conspicuously with the season under various fertiliser treatments. Bacteria and actinomycete population build up was recorded in post monsoon season. Fungal population and urease activity were more during pre-monsoon period. Phosphate solubilisers did not show conspicuous variations.

Introduction

Cashew *(Anacardium occidentale L.)* is a tropical plantation crop grown mainly for its nuts which are rich source of protein. This crop is grown mainly in poor to marginal lands where no other crop is normally cultivated. It is also cultivated in timber cleared forest lands in vast areas of Karnataka. As the crop removes large amounts of nitrogen, phosphorus and potassium from the soil (Mohapatra, *et al.* 1973), application of fertilisers is essential to get optimum yields. Soil amendment with fertilisers is known to directly influence the microbial population (Bagyaraj and Rangaswami, 1967). Katznelson (1965) pointed out that the effect of soil treatment in the rhizosphere population is usually unpredictable. Several workers have reported the decreased soil microbial population and activity with the addition of ammonium sulphate or urea (Zottl, 1960, Leuken, *et al.* 1962, Roberge, 1976, Foster, *et al.* 1980).

However, several others have indicated the increase in microflora and activity (Solonius, 1972, Roberge, 1976).

The aim of the present investigation was to study the effect of different levels of NPK fertilisers on the root region microflora and urease activity during the pre-monsoon and post-monsoon seasons. The influence of different levels of fertilisers on the fertility status of the soil was also assessed.

Materials and Methods

Experimental details

Soil samples were collected during 1983 from a 3^3 confounded factorial design experiment laid out during August, 1979 with three levels each of NPK fertilisers (N 150, 300 and 450 g/tree/year; P_2O_5 and K_2O each at 50, 100 and 150 g/tree/year) using cashew layers as test plant (Var. H4-7). All the experimental trees have been receiving nitrogen in the form of urea, phosphorus in the form of single super phosphate and potassium in the form of muriate of potash.

The soil of the experimental plot is of clay loam with

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lateritic in origin. The chemical properties of the soil at the time of planting (1979) are given in Table 1.

Table-1
Soil pH, available nitrogen, phosphorus and potassium contents of the experimental plot

Nutrient (%)	
Available Nitrogen	0.0171
Available Phosphorus	0.0018
Available Potassium	0.0066
Soil reaction	4.85

Weather Data

A total of 3766.7 mm rainfall was received from May 1983 to September, 1983 and a total of 3931.3 mm for the entire year. The maximum temperature ranged from 35.9°C to 28.5°C and minimum temperature ranged from 23.0°C to 24.8°C during the period under study.

Soil Sample Collection

Soil samples were collected from the root region of cashew trees from ten selected treatments which represent the main effect of nitrogen and combined effect of phosphorus and potassium during May (pre-monsoon) and September (post-monsoon) of 1983. Sampling was done at 0.30 cm soil depth using core sampler. From each tree, three core samples were drawn and homogenised to get a composite sample. The soil dilution and plate count method was followed to enumerate the soil microflora (Allen, 1957). The counts of bacteria, fungi, actinomycetes and P solubilisers were enumerated using soil extract agar, Martin's rose bengal agar, Kusters agar and modified Pikovyakas medium respectively. The urease enzyme activity of the soil was determined using the method outlined by Pancholy and Rice (1973).

Soil reaction, organic carbon and total nitrogen were determined (Jackson, 1958) and the C/N ratio was computed (Table 3).

Results and Discussion

The data on the effect of different levels of NPK fertilisers and season on the root region microflora are presented in Table 2.

Bacteria

Increasing levels of nitrogen showed a poor build up of bacterial population in cashew root region both in May and September whereas the trend was almost reverse with the levels of phosphorus and potassium. In general bacterial population build up was recorded from May (pre-monsoon season) to September (post-monsoon). The maximum population was recorded under $N_2P_3K_3$ treatment during May and under $N_3P_3K_3$ treatment during September.

Fungi

Fungal population increased during both the seasons with the increase in the level of nitrogenous fertilisers. However, the rate of increase from N_2 to N_3 is far less during September compared to May population. Though phosphorus and potassium levels showed a positive trend in fungal population during May, increasing levels of P and K fertilisers brought

Table-2
Effect of different levels of NPK fertilizers and season on the cashew root region microflora and urease activity

Treatments	Bacteria (10^5)		Fungi (10^3)		Actinomycetes (10^4)		P'solubilizers (10^3)		Urease activity (µg/g soil/h)	
	May	Sept.	May	Sept.	May	Sept.	May	Sept.	May	Sept.
Control	4.00	37.70	27.50	19.58	1.66	12.5	2.33	4.50	45.33	16.46
N_1	9.85	116.11	42.22	31.52	3.05	19.40	7.33	3.58	98.30	41.60
N_2	10.08	84.16	38.89	36.11	3.61	28.40	4.78	5.20	91.44	47.52
N_3	7.74	68.47	66.66	47.22	1.81	16.76	3.67	10.33	74.92	76.28
P_1K_1	7.49	77.50	44.44	51.39	3.33	22.20	3.22	7.75	85.88	64.48
P_2K_2	9.93	101.53	52.92	22.36	2.91	14.50	1.33	5.83	99.10	44.23
P_3K_3	10.25	89.72	50.41	4.11	2.22	27.80	11.22	5.53	79.70	56.69
Gen.Mean	9.22	89.58	49.25	25.95	2.82	21.5	5.26	6.37	88.22	55.13

Table-3
Effect of different levels of NPK fertilizers and season on the soil pH, organic carbon, total nitrogen and C/N ratio

Treatments	Organic carbon %		pH		Total N%		C/N Ratio	
	May	Sept.	May	Sept.	May	Sept.	May	Sept.
Control	4.05	1.68	6.80	5.75	0.060	0.070	67.45	23.93
N_1	3.48	1.67	5.88	5.40	0.157	0.120	22.17	13.92
N_2	2.77	1.08	5.91	5.63	0.155	0.140	17.87	7.71
N_3	2.69	0.94	5.78	5.61	0.233	0.170	11.55	5.53
P_1K_1	2.74	1.27	5.81	5.50	0.163	0.110	16.81	11.55
P_2K_2	2.83	1.32	5.84	5.49	0.188	0.140	15.05	8.79
P_3K_3	3.38	1.20	5.91	5.65	0.193	0.180	17.51	6.67
Gen.Mean	2.98	1.23	5.85	5.54	0.181	0.143	16.45	8.99

down the fungal population nearly 91.94 per cent during September. In general, fungal population maintained at lower profile during September compared to May in all the treatments.

Actinomycetes

Maximum population of actinomycetes was recorded at N_2 level (300g N/year/tree) in both the seasons. Increasing or decreasing levels of nitrogen over 300g N/year/tree brought down the population. Increasing levels of P and K fertilizers showed a negative trend on population count during summer and during post-monsoon season, maximum count was recorded at P_3K_3 level of fertilisers.

Phosphate solubilisers

During pre-monsoon season P solubilisers showed a declining trend with the increase in the level of nitrogenous fertilisers. Whereas an opposite trend was recorded during post-monsoon season. Such type of results were revealed by Soderstrem *et al.* (1983) who observed decreasing microbial biomass and activity after an application of 150 kg NH_4 NO_3 N ha^{-1} to different conifeirns forest podzols. Some workers have reported that application of fertilisers to soil has no or little effect on the number of organisms in the rhizosphere (Papavo'zas and DaVey, 1961). The bacterial and actinomycetes population increased with lower rates of fertilisers (Shivashankar *et al* , 1981). However, Bagyaraj and Ramaswami observed selective activity of bacteria by the additional doses of ammonium sulphate.

Urease activity

Urease activity decreased from 98.30 µg/g soil/h at 150g N/tree/year to 74.92 µg/g soil/h at 450g N/tree/year during pre-monsoon season. Though the activity of this enzyme during post-monsoon season is at low profile at N_1 and N_2 levels, it is comparable at N_3 level with that of in pre-monsoon period. In general, the maximum activity of this enzyme 133.33 µg/g soil/h was recorded at $N_3P_3K_3$ levels of fertilisers during post-monsoon season. It is noted from the data that urease activity was low during post-monsoon compared to pre-monsoon period.

Studies concerning the effect of urea on urease activity in soils have been reported by many workers and the data showed very marked fluctuations. Zantua and Bremner, 1976 found that treatment of soils with urea had no effect on urease activity. Further, their studies on the effect fourteen fertiliser materials on urease activity showed that NPK or S fertilisers had no effect when applied at rates equivalent to 500 ppm (soil basis) (Zantua and Bremner, 1977). Similar observations were recorded in this present study also.

The influence of different NPK levels on soil chemical properties were determined. Soil pH, organic carbon, total nitrogen and C/N ratio showed an increasing and decreasing trend during pre-monsoon and post-monsoon build up in the soil has revealed with higher dose of nitrogen (450g/tree/year). In the control, organic carbon build up was recorded maximum during both the seasons (4.05% and 1.68% respectively), but the nitrogen level was in the lowest side (0.06%-0.07%) as compared to the treatments where fertilisers was applied. Hence, C/N ratio was wider in control plots.

The correlation coefficients were worked out for all the microorganisms and urease activity with that of organic carbon, total nitrogen and pH of the soil (Table 4). Bacterial population showed a significantly positive

correlation with organic carbon (%) and C/N ratio whereas a negatively significant correlation was observed with pH and total nitrogen. The positive relation of bacterial population with that of C/N ratio could be explained on the basis of the fact that C/N ratios in all the treatments were less than 20 and 20 being the optimum level of C/N ratio for bacterial build up. The possibility of negative correlation between C/N ratio and bacterial population cannot be ruled out if C/N ratio in all the treatments increase beyond optimum ratio.

Table-4
Correlation constituents (r) of microbial population with soil organic carbon, pH and total nitrogen

	Organic carbon	pH	Total nitrogen	C/N Ratio
Bacteria	0.30**	−0.35**	−0.031**	0.44**
Fungi	0.048	0.56**	0.067	0.16
Actinomycetes	−0.34**	0.52**	0.07	0.24
P'solubilizers	0.09	0.21	0.20	0.24
Urease activity	−0.53**	−0.004	0.37**	0.35**

** Significant at 1% level probability

Fungal growth was mainly dependent on soil reaction. It increased with the increase in pH. Actinomycetes decreased significantly with the increase in organic carbon and increased with the increase in the soil reaction whereas P solubilisers were not significantly effected by any soil factors studied. Urease activity significantly decreased with the increase in the organic carbon and the same has established positively significant relation with total nitrogen and C/N ratio.

McGarity and Myers (1967) found that urease activity was highly correlated with organic carbon and weakly with pH. Silva and Perera (1971) reported that urease activity in rubber soils of Sri Lanka was not significantly correlated with organic carbon.

Conclusion

From the foregoing results it is concluded that in post-monsoon season, the populations of bacteria and actinomycetes increase compared to pre-monsoon period. Whereas fungal population and urease activities were higher during pre-monsoon period when compared to post-monsoon period. Phosphorus solubilisers did not show any conspicuous change in the population both in pre-and post-monsoon periods.

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