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INFLUENCE OF SOIL CHEMICAL PROPERTIES ON ROOT NODULATION BY *BRADYRHIZOBIUM SP.* IN COWPEA, BLACKGRAM AND GREENGRAM

Unfavourable soil conditions such as acidity and poor organic matter content often adversely affect the successful cultivation of pulses in Kerala. This is due to the relatively low population of *Rhizobium* or *Bradyrhizobium* and the toxic effects of cations such as Fe and Al in such soils (Munns, 1978; Keyser and Munns, 1979; Franco and Munns, 1982). Besides, the availability of Mo, which is essential for nodule initiation and nitrogen fixation, is also low in acid soils.

In the present investigation, an attempt was made to evaluate the native root nodulation status in cowpea, blackgram and greengram at seven different locations in Kerala in relation to the inherent soil chemical properties. These locations were broadly divided into two categories such as those with regular cultivation of pulses - Category A (Vellayani, Kayamkulam, Pattambi, Pilicode) and those without any regular cultivation of pulses either due to extreme soil acidity or saline acid conditions - Category B (Ambalapuzha, Kuttanad and Vytila). In both these locations, cowpea (variety-Kanakamani), blackgram (variety Syama) and greengram (variety Co-2) were cultivated without resorting to either any seed treatment with *Bradyrhizobium* or addition of soil amendments such as lime or organic manures. While in Category A locations, the different pulses were raised in 1 m^2 plots, in Category B locations they were raised under pot culture conditions. In both the situations, the plants were grown for 45 days when they were harvested for observations such as nodule number, nodule dry weight and plant dry weight. Different soil factors such as pH, organic carbon, Fe, Al and Mo content of all the soil samples were also estimated (Jackson, 1958).

Root nodulation and plant growth characters of cowpea, blackgram and greengram were uniformly better at Category A locations.

Table 1. Root nodulation and plant growth characteristics[1] of cowpea, blackgram and greengram at different locations

Location	Code	Cowpea			Blackgram			Greengram		
		Nodule No.	Nodule dry wt. (mg)	Plant dry wt. (g)	Nodule No.	Nodule dry wt. (mg)	Plant dry wt. (g)	Nodule No.	Nodule dry wt. (mg)	Plant dry wt. (g)
Category A										
Vellayani	VE									
Garden land	G	12.3	13.8	20.5	8.9	32.9	16.1	9.7	54.3	9.7
Rice fallow	F	9.7	42.9	23.3	2.4	21.6	20.4	3.2	17.3	17.8
Kayamkulam	KA									
Garden land	G	10.4	23.8	14.5	4.8	3.8	2.8	11.1	17.6	8.1
Rice fallow	F	2.9	5.7	13.8	3.2	27.0	19.0	2.7	4.2	17.7
Pattambi	PA									
Garden land	G	7.3	12.5	0.64	11.6	6.9	0.36	10.3	5.2	0.48
Rice fallow	F	5.8	14.3	0.85	8.7	7.7	0.36	6.7	0.5	1.2
Pilicode	PI									
Garden land	G	8.1	9.2	2.00	12.3	7.3	1.0	9.7	5.9	1.3
Rice fallow	F	6.3	11.8	1.7	17.8	4.4	0.7	11.9	5.5	1.2
Mean of A		7.9	16.8	9.7	8.7	14.0	7.6	8.2	13.8	7.2
Category B										
Ambalapuzha	AM	2.1	3.1	0.47	2.2	1.3	0.2	7.6	4.4	0.29
Kuttanad	KU	3.1	11.9	0.54	3.9	8.4	0.4	5.6	5.9	0.17
Vytilla	VY	5.2	41.2	10.2	3.6	27.6	1.3	2.8	23.8	4.6
Mean		3.5	18.7	3.7	3.2	12.4	2.7	5.3	11.4	1.7

[1]Mean of 10 plants

Table 2. Chemical properties of soils at different locations

Location	pH	Org. carbon, %	Mo, ppm	Fe, ppm	Al, ppm
Category A					
Vellayani					
Garden land	4.50	0.71	0.0145	94.3	17.6
Rice fallow	4.45	0.68	0.0175	86.5	11.2
Kayamkulam					
Garden land	5.10	0.77	0.0085	88.5	15.6
Rice fallow	4.42	0.47	0.0170	87.6	13.6
Pattambi					
Garden land	5.45	0.78	0.0050	82.1	90.0
Rice fallow	5.52	0.81	0.0105	80.3	61.5
Pilicode					
Garden land	5.51	0.90	0.0185	97.8	54.5
Rice fallow	5.45	0.93	0.0200	80.7	144.0
Mean of A	5.05	0.76	0.0139	87.2	51.0
Category B					
Ambalapuzha	3.20	2.69	0.0050	96.5	407.0
Kuttanad	3.55	1.95	0.0075	98.4	395.0
Vyttila	4.10	0.73	0.0150	85.2	35.3
Mean of B	3.62	1.79	0.0092	93.4	279.1

Here the average nodule number and plant dry weight were 7.9, 8.7 and 8.2 and 9.7 g 7.6 g and 7.2 g respectively for cowpea, blackgram and greengram (Table 1). However, at Category B locations these were only 3.5, 3.2 and 5.3 and 3.7 g and 2.7 g and 1.7 g respectively. A similar trend was also noticed in nodule dry weight of blackgram (14.0 mg) and greengram (13.8 mg). Soil samples collected from rice fallows at Pattambi had the maximum pH of 5.52 (Table 2) while the kari soils of Ambalapuzha recorded the lowest pH of 3.20. The average soil pH (5.05) of Category A locations was higher than that for category B locations (3.62). Marked variations in the organic carbon content were observed with different soil samples. The highest organic carbon content of 2.69 % was in the kari soils of Ambalapuzha. It was considerably low (0.47 %) in the rice fallows of Kayamkulam.

The average content of Mo was 0.0139 ppm for Category A and 0.0092 ppm for Category B locations respectively. The Fe and Al contents of soil samples were uniformly higher in Category B locations. These were 93.4 and 279.1 ppm in Category B compared to only 87.2 and 51.0 ppm respectively in Category A location.

The negative influence of soil factors such as extreme acidity (pH 3.62), high content of Fe (93.4 ppm) and Al (279.1 ppm) content may be responsible for the poor nodulation. Besides, the Mo content of the soil was also very low. The deleterious effects of high Fe and Al content particularly that of Al on root nodulation have been reported earlier also by several workers (Andrew *et al.*, 1973; Kim *et al.*, 1985; Wood and Cooper, 1988, Coventry and Evans, 1989).

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