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RESEARCH ARTICLE

A STUDY OF PHYSICO-CHEMICAL PROPERTIES OF THE SOYBEAN CULTIVATED SOIL FROM SEMIARID TROPIC OF TAMIL NADU

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The nutrient status of soil is more essential for root nodulation. The Soybean soil samples were collected from 30 different locations of the semiarid tropics viz., Salem, Namakkal and Dharmapuri belonged to 3 textural groups viz., Red loam, Clay loam and Black soils. The soil samples were analysed for it's Soil pH, Electrical conductivity, soil organic carbon available N, P and K content. The nodulation pattern and it's rhizobial populations on the rhizosphere soil of soybean plants were also studied. The nodulation pattern was ranged from 5.00 to 21.00 plant^{1}. Native rhizobial populations were also estimated for the 30 locations of the above mentioned Districts of semiarid tropics of Tamil Nadu. Among the 30 locations, 13 locations recorded more than $3x10^3 g^{-1}$.

Key words: Physio-chemical, Soybean, Semiarid tropics, Nodulation

INTRODUCTION

Soybean is indigenous to China and it was introduced in India, has multiplicity of use as pulses, oil seed, vegetarian meat, milk and also as an antibiotic. There is a pressing need to improve the yield of soybean in order to meet the protein malnutrition and the edible oil needs of our country (Caldwell, 1973). Like most legumes, soybeans performs N_2 fixation by establishing a symbiotic relationship with the *Rhizobia.* Numerous abiotic and biotic factors are known to influence the competitiveness of specific rhizobial inoculants. (Bottomley, 1992; Turco and Sadowsky, 1995)

Semi Arid Tropics (SAT) regions spread over 11.6 million square kilometers in the developing world, and they did not benefit greatly from the green revolution and there is a need for "Grey to Green Revolution" in the SAT to feed and provide proper nourishment to the ever increasing population of the developing world (Singh, *et al.,* 1999). The crop growing environment in the semiarid tropics is highly variable due to erratic spacing and timing of season rainfall. High yields of top quality crops require an abundant supply of nutrients. Soil is the best source for the most of the essential nutrients required by the crop. So soil analysis became important criteria to be done before cultivation. The present study aims to analyze physico-chemical properties of soil, existing rhizobial population and nodulation pattern of Soybean in semiarid tropics of Tamil Nadu.

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MATERIALS AND METHODS

Soil Analysis (pH)

Soil pH was determined in *Elico* model LT-10T pH meter by preparing 1:2.5 soil: water suspension and stirring by means of a glass rod (Jackson, 1973).

Estimation of Electrical conductivity (EC)

Soil suspension was prepared and used to determine the EC using Conductivity Bridge and expressed in dsm^{-1} (Jackson, 1973).

Estimation of Organic Carbon

The organic carbon content of the soil sample was estimated by Walkley and Black method (1947). One gram of finely ground soil sample was transferred to 500 ml conical flask to which 10 ml of 1N $K_2Cr_2O_7$ solution and 200 ml of concentrated H_2SO_4 were added and allowed to stand for 30 min. After 30 minutes, 10 ml of NaF solution and 2 ml of diphenylamine indicator were added.The solution was titrated with the standard $FeSO_4$ solution to brilliant green colour from dark blue colour. A blank without soil was run simultaneously; organic carbon in the soil was calculated as per the following formula.

$$\text{Organic carbon percent} = \frac{10}{S}\ (\text{S-T})\ \text{x}\ \frac{0.003\text{x}100}{\text{weight of soil}}\ \text{x M.F}$$

Where, S = ml $FeSO_4$ solution required for blank
T = ml $FeSO_4$ solution required for sample
M.F = Moisture percent factor of the soil sample.

Estimation of soil available nutrients

Available nitrogen and phosphorous were estimated by Alkaline permanganate and sodium bicarbonate method vice-versa (Subbiah and Asija, 1956; Watanabe and Olsen 1965).

Table 1. Physico-chemical Characteristics of Soyabean Soil Samples of Semiarid Tropics of Tamil Nadu

S. No.	Locations	Soil type	Soil pH	EC (dsm^{-1})	Organic carbon (%)	N ($Kg\ ha^{-1}$)	p ($Kg\ ha^{-1}$)	K ($Kg\ ha^{-1}$)
1	Attayyampatti	Red loam	6.90	0.41	0.62	68.20	17.20	170.38
2	Sankagiri	Red loam	7.15	0.55	0.66	75.10	17.80	175.40
3	Idappadi	Red loam	7.10	0.17	0.65	98.15	18.00	190.30
4	Tharamangalam	Red loam	7.20	0.16	0.50	95.17	17.00	190.00
5	Mallur	Red loam	7.35	0.90	0.59	113.35	12.00	128.00
6	Malliyakaral	Red loam	7.25	0.80	0.49	100.20	11.00	118.00
7	Attur	Red loam	7.30	0.80	0.49	110.25	11.00	127.00
8	Vazhappadi	Red loam	7.35	0.98	0.69	118.85	13.00	130.00
9	Konganapuram	Red loam	7.40	1.20	0.78	110.00	10.00	117.00
10	Poolampatti	Red loam	7.45	1.28	0.88	112.00	11.50	118.00
11	Rasipuram	Loam	7.50	1.30	0.89	100.00	12.00	120.00
12	Namagiripettai	Clay loam	7.55	1.35	0.91	114.00	11.00	130.00
13	Kalangani	Red loam	7.50	1.38	0.79	98.00	11.89	119.00
14	Tiruchengode	Red loam	7.00	0.10	0.85	138.80	10.00	200.00
15	Erumaippati	Red loam	7.50	1.38	0.79	98.00	11.89	119.60
16	Mallasamudram	Red loam	7.35	0.85	0.69	111.00	11.00	127.10
17	Elachipalayam	Clay loam	7.75	1.00	0.70	100.50	15.20	152.70
18	Jedarpalayam	Clay loam	7.80	1.70	0.57	122.00	10.00	97.00
19	Mohanur	Clay loam	7.85	1.75	0.67	128.00	11.00	98.00
20	Velakavundanpatti	Red loam	7.20	0.88	0.72	105.50	13.80	145.10
21	Mallapuram	Red loam	7.15	0.69	0.55	128.00	14.00	116.00
22	Nallampalle	Red loam	6.95	0.52	0.77	69.20	19.10	170.00
23	Papireddipatti	Clay loam	6.85	0.39	0.62	67.00	17.89	178.25
24	Adiyaman Kottai	Black	6.85	0.50	0.70	68.00	18.00	169.85
25	Morappur	Red loam	6.90	0.86	0.68	100.50	11.85	130.10
26	Singarapettai	Clay loam	6.85	0.39	0.62	67.00	17.89	178.25
27	karimangalam	Red loam	6.65	0.30	0.59	68.00	18.00	77.00
28	Samalpatti	Clay loam	7.80	1.00	0.58	126.00	9.00	98.00
29	Ballurpettai	Red loam	7.10	0.17	0.73	97.35	18.00	185.00
30	Pennagaram	Clay loam	7.70	0.12	0.62	98.65	16.10	158.50

Table 2. Survey on the Nodulation Pattern of soybean in Semiarid Tropics of Tamil Nadu

S. No.	Location	No. of Nodules Green	No. of pink Nodules	Total No. of Nodules
1	Attayyampatti	4	5	9.00
2	Sankarigiri	7	11	18
3	Idappadi	3	4	7
4	Tharamangalam	4	7	11
5	Mallur	5	7	12
6	Malliyakaral	2	5	7
7	Attur	7	10	17
8	Vazhapadi	7	9	16
9	Konganapuram	2	4	6
10	Pollampatti	7	11	18
11	Rasipuram	3	4	7.00
12	Namagiripettai	6	8	14
13	Kalangani	1	4	5
14	Tiruchengodu	9	12	21.00
15	Erumaippati	5	8	13
16	Mailasamudram	5	10	15
17	Elachipalayam	2	4	6.00
18	Jedarpalayam	3	5	8.00
19	Mohanur	4	7	11.00
20	Velakavundanpatti	2	4	6.00
21	Mallapuram	2	6	8.00
22	Nallampalle	3	6	9.00
23	Papireddipatti	9	10	19
24	Adiyamenkottai	4	5	9.00
25	Morappur	4	6	10.00
26	Singarapettai	3	7	10.00
27	Karimangalam	2	5	7.00
28	Samalpatti	3	5	8.00
29	Ballmpettai	2	5	7
30	Pennagaram	4	5	9.00

Table 3. Native population of *Rhizobium* in Soybean fields of Thirty different locations of semiarid Tropics of Tamil Nadu.

S. No.	Location	Population $1X10^3$ /g of moisture free soil
1	Attayyampatti	4.10
2	Sankarigiri	7.10
3	Idappadi	2.98
4	Tharamangalam	4.80
5	Mallur	5.10
6	Malliyakaral	2.25
7	Attur	6.85
8	Vazhapadi	6.80
9	Konganapuram	0.97
10	Pollampatti	7.20
11	Rasipuram	2.80
12	Namagiripettai	5.72
13	Kalangani	0.65
14	Tiruchengodu	8.10
15	Erumaippati	5.20
16	Mailasamudram	6.00
17	Elachipalayam	0.82
18	Jedarpalayam	1.20
19	Mohanur	7.20
20	Velakavundanpatti	1.25
21	Mallapuram	1.85
22	Nallampalle	2.00
23	Papireddipatti	7.10
24	Adiyamenkottai	2.20
25	Morappur	2.52
26	Singarapettai	2.25
27	Karimangalam	1.75
28	Samalpatti	1.25
29	Ballmpettai	0.98
30	Pennagaram	2.15

Determination of Rhizobial Population

The rhizosphere soil samples from different locations were collected, 10g of the soil samples were serially diluted upto 10^{-6} dilution and 1 ml were transferred to sterile YEMA petriplates. The plates were incubated at room temperature and the colonies were counted by using colony counter.

Nodulation pattern of soybean

The nodulation pattern of the soybean is not uniform, so the soybean plants were collected from each location at random without damaging the roots. The average of ten plants were taken to give the nodulation pattern of that place. The total number of nodules as well as the number of pink and white nodules were counted and recorded.

RESULT AND DISCUSSION

In the present study soil samples were collected from 30 different semiarid locations of 3 districts of Tamil Nadu, namely Salem, Namakkal and Dharmapuri and they were subjected to physiochemical analysis. In our findings most of the soils from these regions were belonged to 3 textural groups, namely Red loam, Clay loam and Black soils. Soil pH ranged from 6.65-7.85, EC ranged from 0.10-1.75 dsm^{-1}.

The nutrient content of the soil is most important for root nodulation and nitrogen fixation. In our study, soil organic carbon contents were low and ranged from 0.49-0.89% Nitrogen content ranged from 67.00-138.00 kg ha^{-1}, phosphorous and potassium contents ranged from 9.00-19.00, 77-200.00kg ha^{-1} EC respectivelyand concluded that organic Carbon N, P and K status of semiarid tropics were low. This was proved by earlier workers that the wide variation in rhizobial cell counts and nodule mass in soybeans are related to variation in physio-chemical characteristics of the soil (Vincent, 1965). The organic matter content, salinity, texture and pH was found to affect mycorrhizal development in soils. (Saif *et al.,* 1975).

The nodulation pattern of Soybean and native rhizobial populations of the above 30 locations were also studied. Among the 30 locations, 4 locations were recorded less then $1x103g^{-1}$, 13 locations were recorded $1x10^3$ to $3x10^3g^{-1}$ and 13 locations recorded more than $3x10^3g^{-1}$ of rhizobial populations from the rhizosphere of Soybean plants. The number of nodules/plant was also recorded. The total number of nodules ranged from 5.00 to 21.00. Tiruchengodu location recorded highest number of nodules of 21.00 $plant^{-1}$. The lowest nodule number was recorded in Kalangani i.e. 5.00 $Plant^{-1}$ in Namakkal District.

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