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Changes in the Physical Properties of Soil Due to the Growth of Greengram (*phaseolus aureus* Roxb.)

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Greengram Co. 2 variety (*Phaseolus aureus* Roxb.) was grown in a red, sandy loam soil in circular earthern-ware pots with recommended doses of fertilizers. The soil samples collected from the root zone of the crop on 30th, 40th and 50th days of the crop growth were analysed for their physical properties viz., (i) apparent density (ii) absolute specific gravity, (iii) water holding capacity, (iv) percentage pore space, (v) aggregate stability and (vi) hydraulic conductivity. In general, the crop growth had a fovourable influence on the soil in increasing pore space, water-holding capacity, aggregate stability and hydraulic conductivity. The second stage of the crop is found to be more favourable. The correlation coefficients among the soil parameters are also presented. The observed improvements in the physical properties have been explained in terms of the rhizosphere effect and the synthesis of microbial polysaccharides as the binding materials.

The soil is said to be physically improved as it becomes friable due to the formation of waterstable aggregates, wherein its primary particles, sand, silt and clay may bound together. The improvement of soil physical properties due to inoculation of Rhizobium spp. isolated from greengram as well as due to the growth of the greengram crop has been explained in terms of the rhizosphere effect. Similar studies with maize, bengalgram and cotton in red and black soils have been undertaken to explain the changes in the physical properties of soil over a period of thirty days (Arunachalam, 1975). In the present study, the changes in the physical properties of soil under greengram, at three different stages of the crop growth have been reported.

MATERIAL AND METHODS

The soil used in the present study was collected from the Millet Breeding Station of Tamil Nadu Agricultural University, Coimbatore which is red in colour and sandy loam in texture. The soil was passed through 2 mm sieve and filled in twelve circular mud pots 12 x 8 inch, with 8 kg of soil in each. Nitrogen and phosphorus were applied basally @ 25 kg N/ha and 45 kg P_2O_5/ha as urea and superphosphate respectively.

Nine of the pots were sown with Co. 2 greengram (*Phaseolus aureus* Roxb.) and in each pot five plants were maintained. Three of the remaining pots served as control. During the vegetative stage on the 30th day one plant from each pot was removed carefully along

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with the root system and the soil adhering to the roots was collected. A sizable amount of soil was also collected from the control pots. Similar collections of soil samples were made on the flowering and pod filling stages on 40th and 50th days of the crop.

The soil samples were air dried and at each stage four samples were drawn for the following analysis. The single value constants of these soil samples were evaluated using Keen-Raczkowski box measurements as described by Piper (1950). Yoder's wet sieve analysis was followed and the percentage aggregate stability has been evaluated as described by Andrew *et al*. (1962). The hydraulic conductivity of the soil samples was evaluated using a constant pressure head method described by Klute (1965). The results were subject to statistical scrutiny using standard procedure (Snedecor, 1961).

RESULTS AND DISCUSSION

The data on the physical properties of the soil are presented in Table I. The statistical analyses are presented in Tables II to IV. A scrutiny of the tables reveals that the apparent density and absolute specific gravity of the soils sown with the crop decreased in values compared to control, without the crop, though the absolute specific gravity is statistically significant at 5% level only. The crop influences the soil by exerting root pressure during the growth to bind the primary particles. Moreover, the rhizosphere favours a comfortable environment harbouring more micro-organisms due to their root exudates. The microbes in turn synthesis their microbial gums consisting of the polysaccharides and uronides which act as the binding materials for aggregate formation. The binding materials, the microbial cells and the root exudates may contribute to the soil organrc matter in the rhizosphere region, which will be lighter than the other soil constituents. Hence there could have been a reduction in apparent density and absolute specific gravity. The percentage pore space, water holding capacity and percentage agreegate stability have improved due to the crop, the latter two, significant at 1 per cent level. The hydraulic conductivity is also improved with a statistical significance at 1 per cent level. A[illegible]

TABLE I. The physical properties of the soil

Stages	Apparent density		Absolute specific gravity		Maximum water-holding capacity per cent		Porespace per cent		Stability of aggregates per cent		Hydraulic conductivit (cm/hr)	
	C	R	C	R	C	R	C	R	C	R	C	R
Vegetative	1.46	1.37	2.32	2.33	30.3	33.2	32.7	44.7	25.4	33.3	28.8	41.
Flowering	1.40	1.37	2.45	2.43	33.1	34.1	45.2	46.3	25.4	36.4	35.2	46.
Pod-filling	1.40	1.33	2.45	2.29	33.1	33.9	45.2	44.4	25.4	46.2	35.2	50.

C = Control R = Rhizosphere

TABLE II. Statistical analysis with reference to treatments

property	Treatmeet	Mean	S.E.	C.D	Influence
Apparent Density	C	1.42	—	—	NS
	R	1.36	—	—	
Absolute Specific gravity	C	2.40	0.0235	0.07*	C, R
	R	2.35			
Maximum water holding capacity	C	32.20	0.3253	0.772**	R, C
	R	33.40			
Percentage Pore space	C	44.30	—	—	NS
	R	45.10			
Percentage aggregate stability	C	25.40	0.604	1.796**	R, C
	R	38.60			
Hydraulic Conductivity	C	33.10	1.116	3.237**	R, C
	R	46.20			

C = Control R = Rhizhosphere

* Significant at 5 per cent level

** Significant at 1 per cent level

NS - Not significant

TABLE III. Statistical analysis with reference to stages

Property	Stages	Mean	S.E.	C.D.	Influence
Apparent Density	I	1.42	—	—	NS
	II	1.38			
	III	1.36			
Absolute specific Gravity	I	2.32	0.0132	0.0672**	II, III, I
	II	2.44			
	III	2.37			
Maximum waterholding Capacity	I	31.7	0.265	0.6368**	II, III, I
	II	33.6			
	III	33.5			
Percentage Porespace	I	43.7	0.3571	0.8424*	II, III, I
	II	45.7			
	III	44.8			
Percentage Aggregate Stability	I	29.35	—	—	NS
	II	30.9			
	III	35.8			
Hydraulic Conductivity	I	35.15	1.116	2.562*	III, II, I
	II	40.9			
	III	42.7			

I = Vegetative stage

II = Flowering stage

III = Pod filling stage

* = Significant at 5 per cent level

** = Significant at 1 per cent level

NS = Not significant

TABLE IV. Correlation coefficients among the physical properties

	Waterholding capacity	Per cent porespace	Per cent Aggregate	Hydraulic conductivity
Waterholding capacity	—	0.852*	0.592 (N.S)	0.737 (N.S)
Percent porespace	—	—	0.214 (N.S)	0.756 (N.S)
Per cent aggregate stability	—	—	—	0.615 (N.S)

* Significant at 5 per cent level

N.S. Not significant

the soil is bound into ag... ... ... have resulted in improving the porosity and thereby the water holding capacity. This is supported by the fact that the correlation coefficients are 0.852*, 0.592 between water holding capacity and pore space and water holding capacity and aggregate stability. Since the microbial gums bind the particles well, though for a short period before decomposition, there is an improved stability of the aggregates. The correlation coefficient between porosity and hydraulic conductivity is 0.756. On comparing the three different stages, we find that, except apparent density and percentage aggregate stability all are statistically significant. The second stage seems to be more favourable than the other two, followed by the third stage and then the first. The correlation coefficients have been found for the different soil parameters. Probably the root activities are much more in the late I stage, through II stages where a better growth stage is set up. In the third stage the root growth would have attained its maximum proliferation. Hence from the point of view of root proliferation, the II stage has shown better improvement. The changes in physical properties are in the lines of the early work.

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