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INFLUENCE ON SOIL PHYSICO-CHEMICAL PROPERTIES IN GREEN GRAM DUE TO APPLICATION OF MULTIPLE PHOSPHORUS AND SULPHUR LEVELS

AMRITA SHARMA[1], AMREEN HASAN[2*], ARUN ALFRED DAVID[3], TARENCE THOMAS[4] AND RAGHUNANDAN KHATANA[5]

Department of Soil Science and Agricultural Chemistry,
(Naini Agricultural Institute)
Sam Higginbottom University of Agriculture, Technology and Sciences
Prayagraj 211 007, U.P. India

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Abstract– An experiment was conducted during *Zaid* season (May-July) 2021 on crop research farm Department of Soil Science & Agricultural Chemistry. The experiment was laid out in Randomized Block Design having three levels of Phosphorus @ 0%, 50 %, 100% and three levels of Sulphur @ 0%, 50% and 100% respectively. The treatment combinations were replicated three times and allocated at random in each replication. The result shows that the application of different levels combination of Phosphorus and Sulphur increased growth and yield of green gram and improved soil chemical properties. However, some parameters of soil physical properties decreased. It was recorded from the application of Phosphorus and Sulphur treatment T_9 has maximum Bulk density 1.285 Mg m^{-3} in 0-15 cm and 1.286 Mg m^{-3} in 15-30 cm, Particle density 2.551 Mg m^{-3} in 0-15 cm and 2.552 Mg m^{-3} in 15-30 cm, % pore space 50.372% in 0-15 cm and 50.391% in 15-30 cm, Water holding Capacity 45.89 % in 0-15 cm and 45.78 % in 15-30 cm, pH 8.001 in 0-15 cm and 8.003 in 15-30 cm, EC 0.411 dSm^{-1} in 0-15cm and 0.413 dSm^{-1} in 15-30 cm, % Organic Carbon 0.413 % in 0-15 cm and 0.435 % in 15-30 cm, Available Nitrogen 238.152 kg ha^{-1} in 0-15 cm and 237.792 in 15-30 cm kg ha^{-1}, Available Phosphorus 20.351 kg ha^{-1} in 0-15 cm and 16.432 kg ha^{-1} in 15-30 cm, Available Potassium 193.257 kg ha^{-1} in 0-15 cm and 182.975 kg ha^{-1} in 15-30 cm, Available Sulphur 15.986 kg ha^{-1} in 0-15 cm and 15.724 kg ha^{-1} in 15-30 cm.

INTRODUCTION

Green gram is one of the India's oldest and most widely planted leguminous crops. It is a seasonal crop that is high in protein and vitamin B. It is grown in Maharashtra, Andhra Pradesh, Rajasthan, Orissa and Karnataka. It can be cultivated in a variety of soil conditions. It is typically grown as a rain-fed crop, although it can also be grown as a pre-monsoon or post-monsoon crop. It covers 3.4 million ha in India, producing 1.4 million tonnes with an average yield of 475 kg per ha (2014-15). Phosphorus is required for the conversion of important metabolic reactions in plants and as a component of several key plant structural compounds. Phosphorus is an essential component of ATP, plants' "energy unit." ATP is formed during photosynthesis and is involved in a variety of activities from seedling growth through grain formation and maturity. Root stimulation, increased stalk and stem strength, improved flower formation and seed production, more uniform crop maturity, greater N-fixing capacity of legumes, improved crop quality, and increased resistance to plant diseases are some of the specific growth factors linked to phosphorus. Plants require the same amount of sulphur as phosphorus, one of the most important plant nutrients. Sulphur is required for the production of vitamins (biotin and thiamine), S containing amino acids (cystine, cysteine, and methionine), and legume nodulation. It activates certain enzyme systems and is a component of some vitamin (vitamin-A) (Parashar *et al.*, 2020).

Phosphorus is a key nutrient for increasing productivity of pulses. Phosphorus has very positive effects on root growth, nodule formation and nitrogen fixation in legume crops. Fixation of atmospheric nitrogen in leguminous crops is an energy intensive process which needs phosphorus supply to meet its ATP requirement (Sipai *et al.*, 2016).

Sulphur is required for the biosynthesis of proteins, vitamins, and important amino acids that include sulphur, as well as for nitrogen metabolism. Sulphur boosts crop output as well as quality. Sulphur deficiency is becoming increasingly common as a result of the continued use of S-free fertilisers and increased cropping intensity with high yielding cultivars, and it is especially noticeable in coarse grained, low-organic-matter soils (Sipai *et al.*, 2016).

MATERIALS AND METHOD

Experimental site

The research methodologies and materials used to perform the study on the topic under field investigation is conducted on *var.* Gujarat Anand Mungbean 5 in *Zaid* season 2021 at Research Farm, Department of Soil Science and Agricultural Chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The test was carried out on sandy loam soil. The field was arranged in a Randomized Block Design with three duplicates using varied levels of Phosphorus (0%, 50%, 100%) and Sulphur (0%, 50%, 100%). Basal doses of nitrogen and potassium are administered to the field. The sources of NPK and S were Urea, SSP, MOP and Sulphur Dust. The Phosphorus and Sulphur were applied at their recommended doses Phosphorus@60kg ha^{-1} and Sulphur@60kg ha^{-1}. The soil physico-chemical characteristics were examined at two depths: 0-15 cm and 15-30 cm. Chemical properties include pH by digital pH meter (Jackson,1973), EC by digital EC meter (Wilcox,1950), Organic carbon by wet oxidation method (Walkley and Black,1934), available nitrogen by alkaline permanganate method (Subbiah and Asija,1956), available phosphorus by photoelectric calorimetric method (Olsen *et al.*,1954), available potassium by flame photometer method (Toth and Prince,1949), and available sulphur by turbiditmetric method (Bardsley and Lancaster, 1960). Physical properties include bulk density, partical density, pore space, and water holding capacity was done by 100ml measuring cylinder (muthuevel *et al.*, 1992).

RESULTS AND DISCUSSION

Effect on soil physical properties

At 0-15 cm and 15-30 cm soil depths, phosphorus and sulphur fertilizer application changes bulk density. T_9 has the lowest bulk density, which increases in the following order. T_8, T_7, T_6, T_5, T_4, T_3, T_2, and maximum bulk density were measured in absolute control into T_1, which was 1.285 Mg m^{-3} at 0-15 cm and 1.286 Mg m^{-3} at 15-30 cm soil level. T_9 had the lowest bulk density, 1.267 Mg m^{-3} at 0-15 cm and 1.269 Mg m^{-3} at 15-30 cm soil depth. T_1 had the lowest particle density of 2.551 Mg m^{-3} and 2.552 Mg m^{-3} at 0-15 cm and 15-30 cm soil depths, respectively, (which was at par with T_2 and T_3) followed by T_4 and T_9 had the highest particle density of 2.574 Mg m^{-3} and 2.576 Mg m^{-3} at 0-15 cm and 15-30 cm soil depths, respectively. Porosity varied between 49.922 % to 50.372 % in 0-15 cm soil depth but when depth increase porosity decreased means at 15-30 cm soil depth porosity varied between 49.262 % to 50.391 %. At a soil level of 0-15 cm, water holding capacity ranged from 43.21 % in absolute control (T_1) to 45.89 % in T_9. When soil depth is increased, the water holding capacity of the soil changes slightly. At 15-30 cm soil depth, it ranged from 43.11 % to 45.78 %. A similar outcome was documented by Kumar *et al.*, 2008 and Reddy *et al.*, 2005.

Effect on soil chemical properties

The pH of the soil is influenced by the presence of phosphorus and sulphur at depths of 0-15 cm and 15-30 cm. At 0-15 cm and 15-30 cm soil depths, maximum soil pH was reported in (T_9 8.01, 8.02 and minimum in absolute control T_1 (T_1 7.82, 7.84). A similar outcome was documented by Takase *et al.* (2011) and Cakmak *et al.* (2008) Maximum electrical conductivity (dSm^{-1}) was observed in absolute control T_9 i.e. 0.411, 0.413 dSm^{-1} and minimum in absolute control, i.e. T_1 0.314, 0.316 dSm^{-1} at 0-15 cm and 15-30 cm soil depths respectively (which was at par with T_2 and T_3). The highest percentage organic carbon was found in T_9, i.e. 0.435 %, 0.433 % in 0-15 cm and 15-30 cm soil depths respectively, while the lowest percentage organic carbon was found in absolute control, i.e. T_1 0.421, 0.419 % in 0-15 cm and

Table 2. Effect of different level of Phosphorus and Sulphur on Physico-Chemical properties of soil.

Treatments	Depth (cm)	BD (Mg m^{-3})	PD (Mg m^{-3})	Pore Space (%)	WHC (%)	pH	EC dSm^{-1}	OC (%)	N (Kg/ha)	P (Kg/ha)	K (Kg/ha)	S (Kg/ha)
T_1 Absolute control	0-15	1.285	2.551	50.372	43.21	7.826	0.314	0.421	230.246	12.252	185.292	12.252
	15-30	1.286	2.552	50.391	43.11	7.828	0.316	0.419	229.552	9.552	173.121	12.005
T_2 P@ 0% + S@ 0%+RDF	0-15	1.285	2.554	50.313	43.77	7.875	0.319	0.423	231.481	13.211	186.241	12.736
	15-30	1.286	2.556	50.312	43.64	7.877	0.321	0.421	230.654	9.564	173.421	12.539
T_3 P@ 0% + S@ 0%+RDF	0-15	1.283	2.558	50.234	43.97	7.898	0.323	0.425	232.585	14.528	187.532	13.286
	15-30	1.284	2.559	50.175	43.88	7.801	0.324	0.423	231.771	10.527	175.243	13.011
T_4 P@ 0% + S@ 0%+RDF	0-15	1.282	2.562	50.156	44.15	7.911	0.326	0.426	233.552	15.328	188.552	13.727
	15-30	1.283	2.563	50.058	44.05	7.913	0.327	0.425	232.846	11.121	177.128	13.524
T_5 P@ 0% + S@ 0%+RDF	0-15	1.280	2.564	50.117	44.59	7.931	0.329	0.428	234.512	16.383	189.357	14.355
	15-30	1.281	2.566	49.922	44.48	7.933	0.330	0.427	233.834	12.834	178.451	14.158
T_6 P@ 0% + S@ 0%+RDF	0-15	1.275	2.567	50.058	44.91	7.943	0.331	0.429	235.275	17.286	190.245	14.827
	15-30	1.277	2.568	49.727	44.82	7.945	0.333	0.427	234.732	13.521	180.237	14.676
T_7 P@ 0% + S@ 0%+RDF	0-15	1.275	2.568	50.038	45.26	7.966	0.334	0.431	236.141	18.863	191.251	15.198
	15-30	1.276	2.569	49.669	45.15	7.967	0.335	0.430	235.618	14.263	181.939	14.986
T_8 P@ 0% + S@ 0%+RDF	0-15	1.271	2.571	49.980	45.61	7.984	0.337	0.432	237.526	19.279	192.246	15.642
	15-30	1.272	2.573	49.436	45.52	7.986	0.339	0.431	235.839	15.357	182.183	15.493
T_9 P@ 0% + S@ 0%+RDF	0-15	1.267	2.574	49.922	45.89	8.001	0.411	0.435	238.152	20.351	193.257	15.986
	15-30	1.269	2.576	49.262	45.78	8.003	0.413	0.433	237.792	16.432	182.975	15.724
F-test		NS	NS	S	S	NS	S	S	S	S	S	S
		NS	NS	S	S	NS	S	S	S	S	S	S

15-30 cm soil depths respectively (which was at par with T_2 and T_3) and followed by T_4. Kumar *et al.* (2008), Reddy *et al.* (2005) all confirmed identical results . Treatment T_9 had the highest amount of nitrogen (kg ha^{-1}) with 238.152 kg ha^{-1} and 237.792 kg ha^{-1} for 0-15 cm and 15-30 cm soil depths, respectively. Treatment T_1 had the lowest nitrogen availability, with 230.246 kg ha^{-1} and 229.552 kg ha^{-1} for 0-15 cm and 15-30 cm soil depths, respectively and which was further increased by T_2 and T_3. Kumar *et al*. (2008) reported a similar outcome. Treatment T_9 had the most accessible phosphorus at 20.351 kg ha^{-1} and 16.432 kg ha^{-1} at 0-15 cm and 15-30 cm soil depths, respectively (which was at par with T_8 and T_7) and followed by T_6, while treatment T_1 had the lowest available phosphorus at 12.252 kg ha^{-1} and 9.552 kg ha^{-1} at 0-15 cm and 15-30 cm soil depths, respectively. Kumar *et al.* (2008) and Reddy *et al.* (2009) both found similar findings (2005). Maximum Available Potassium (kg ha^{-1}) in the 0-15 cm and 15-30 cm soil depths, respectively, is 139.257 kg ha^{-1} and 182.975 kg ha^{-1} in Treatment T_9 and which was further decreased in following order T_8, T_7, T_6, T_5, T_4, T_3, T_2, T_1. Reddy *et al.* (2005) reported a similar conclusion. Treatment T_9 had the most accessible Sulphur at 15.986 kg ha^{-1} and 15.724 kg ha^{-1} at 0-15 cm and 15-30 cm soil depths, respectively, while treatment T_1 had the lowest available sulphur at 12.252 kg ha^{-1} and 12.005 kg ha^{-1} at 0-15 cm and 15-30 cm soil depths, respectively, which was additionally levelled up with respect to different treatment combination in increased order i.e. T_2 T_3, T_4 and so on. Bera and Ghosh (2015) also discovered consistent patterns.

CONCLUSION

This study found that combining 100 % Phosphorus with 100 % Sulphur and RDF was beneficial to soil physical and chemical features because it improved soil nutrient status and elevated Green Gram growth and yield attributes. In comparison to other treatment

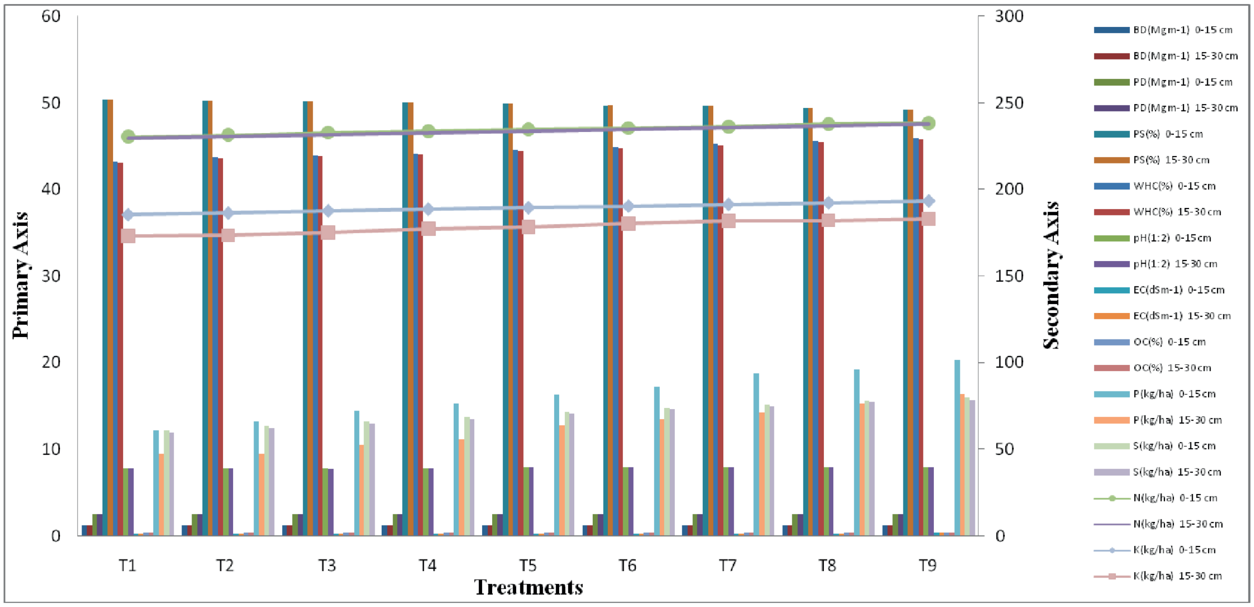

Fig. 1. Effect of different level of Phosphorus and Sulphur on Physico-Chemical properties of soil.

combinations, the application of Phosphorus and Sulphur increases the soil Physico-chemical properties and is an excellent nutrient for promoting growth, increasing yield attributes, and raising the probability of Green Gram. For Green gram growth, farmers must maintain soil nutrient status, use appropriate management strategies, and offer adequate nutrition to the soil.

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