Effect of Organic Sources onSoil Chemical and Biological Properties of Soil under the Cultivation of Greengram (*Vigna radiate* L.) in Sandy Loam Soil

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ABSTRACT

Background: The organic manures (FYN, Vermicompost and Castor cake) has potential to play the role in promoting growth and providing immunity in the plant system, resulting in increase overall yields and improve soil fertility. Hence, the present study was carried out to assess the fertilization effect of organic sources on available nutrients (N, P_2O_5, K_2O), microbial count,organic carbon, EC, pH of soil after cultivation of greengram.

Methods: During semi *rabi* season 2021, a field experiment was undertaken at the Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, comprising ten nutrient management strategies, laid out in a randomized complete block design with three replications.

Result: Application of 100% Nthrough FYMin greengram resulted in significantly higher available nitrogenand organic carbonof soil while significantly higher microbial count found under the application of 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/hato others.

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Key words: Greengram, organic sources, yield, soil fertility and nutrient stress

Introduction

Agriculture accounts for roughly 17.0% of national GDP and about 70% of the population is reliant on agriculture and allied activities for their livelihood (Anonymous, 2019a). Pulses, which have a high amount of protein (20-25%) contribute about 14% of total protein supplements in the Indian diet. According to the Indian Council of Medical Research (ICMR), the minimum requirement for pulse is 70 gm capita-1 day-1, while only 35.8 grammes per person per day are available (Chopra, 2018). Among pulses, mungbean (*Vigna radiata* L.) is one of India's most important crops grown on 4.48-million-hectare area, producing 2.83 million tonnes with an average productivity of 641 kg ha-1 (Directorate of Economics and Statics, 2018-19).In Gujarat, it is grown on area of 2.30 lakhha with the production of 1.21 lakh tonnes and productivity of 526 kg/ha. It is mainly grown in the districts Kheda, Panchmahal, Vadodara, Mehsana, Banaskantha, Kutch in *kharif* season under inadequate and erratic rainfall. However, it is grown

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in very large area in summer season in Kheda, Baroda and Panchmahal districts where irrigation facilities are available (Anonymous., 2018b). It contains 60% carbohydrates, 22.3% protein, 154 mg calcium, 9.1 mg iron, 1.4 g fat, 0.37 g riboflavin and 0.42 mg thiamine in 100 gm-1 (Asaduzzaman et al., 2010).Green gram protein is deficient in methionine and cysteine but rich in lysine (460 mg/g N) and tryptophan (60 mg/g N) making it an excellent complement to rice (Azadi *et al.*, 2013).

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Contribution of pulses to agriculture and daily life has been tremendous besides being one of the important constituent of our diet. Greengram is one of the most ancient and extensively grown pulse crops of India. The productivity of greengram in India is very low and far below the other greengram-growing countries. The adoption of modern farming practices and nutrient management is essential to produce crops in line with the observed global standards of quantity and quality. The high cost of chemical nitrogen fertilizer and low purchasing power of Indian farmers restricts its use on proper amounts, hampering crop production. Reliance on the increased use of chemical fertilizers and associated hazards put back attention on organic sources which are effective in promoting health and productivity of the soil.The basic concept of organic nutrient management is the supply of the required plant nutrients for sustaining the desired crop productivity with minimum deleterious effect on soil health environment. In addition to supply of nutrients, organic source improves the physical condition and biological health of soil, which improves the availability of applied and native nutrients. With a view to reduce the losses and indiscriminate use of chemical fertilizers, substitution of part of the chemical fertilizer by locally available organic sources of nutrients (FYM, Vermicompost and Castor cake) and biofertilizers (*Rhzobium* and Bio NPK consortium) is inevitable.FYM is an important fertilizer. According to Parihar *et al.*, 2012, well decomposed farmyard manure contains nitrogen (0.53%), phosphorous (0.22%), potassium (0.59%), iron (2100 mg/kg), zinc (61 mg/kg), boron (2.2 mg/kg) and molybdenum (0.75 mg/kg). FYM helps in the growth of microbes and their activities, which are important for the easy availability of complex nutrients to plants. FYM improves the physio-chemical properties of the soil as well as the direct release of macro and micronutrients, resulting in increased crop yields.Vermicompost is an organic manure produced by earthworm feeding on biological waste material and plant residue & it contains 2.1-2.6% N, 1.5-1.7% P and 1.4-1.6% K, 10 to 52 ppm Cu, 186.60 ppm Zn, 930.00 ppm Fe and plant growth promoting substances such as, NAA, cytokinins, gibberellins, *etc.* (Giraddi, 2001 and Giraddi *et al.*, 2006). Bio NPK

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consortium was used as liquid biofertilizer. It is a consortium of nitrogen fixing (*Azotobacter chroococcum, Azospirillum lipoferum*), phosphate solubilizing and potash mobilizing native bacteria (*Bacillus spp*.), which are all compatible with each other.*Rhizobium* inoculants are specific for different leguminous crop as they fixes the atmospheric nitrogen and made available to crop (Meena *et al.*, 2016).Therefore, in the present context, a judicious combination of organic, inorganic fertilizers and biofertilzers helps to maintain soil and crop productivity.

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MATERIALS AND METHODS

The present field experiment was carried out during the semi *rabi* season (2021) at the Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat, India. The experimental site is located at 22°-35' N latitude 72°-55' longitude and an altitude of 45.1 meters above mean sea level in the Anand district of Gujarat. The relative humidity fluctuates between 47.7 to 89.9 per cent. The maximum and minimum temperature ranged between 26.1 to 35°C and 11.2 to 25.8 °C respectively. The total amount of rainfall received during greengram crop growth in 2021 was 192.6 mm and this was well distributed during the crop growth period. The soil of top 15 cm depth of experimental site was loamy sand in texture, low in organic carbon (0.30%) and available nitrogen(210 kg/ha), medium in available phosphorus (40 kg/ha) and available potash (285 kg/ha) with 8.05 soil pH. The details of the ten treatments viz., (T_1)100% RDF(20:40:0 kg NPK/ha),(T_2)100% N through FYM, (T_3)100% N through vermicompost, (T_4)100% N through castor cake, (T_5)75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha, (T_6)75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha, (T_7)75% N through castor cake + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha, (T_8)50% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha, (T_9)50% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha and (T_{10})50% N through castor cake + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha. The organic manures (FYM, Vermicompost and Castor cake) was applied 10 days before sowing, incorporated in soil, *Rhizobium* was applied as seed treatment and Bio NPK Consortium was applied through drenching followed by irrigation. The greengram variety ''GAM 5'' was released in 2015 from Pulse Research Station, Vadodara, AAU, Anand (Gujarat). It is one of the most popular of

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variety among farmers and is cultivated in the greengram growing area of Gujarat. It is an early maturing variety and matures in 60-65 days. Greengram was sown on 30 cm between the rows and 10-cm spacing within the plants. The soil samples were kept in the oven for drying at 65 °C for 24-72 hours to obtain a constant weight. Since most soil analytical methods require grinding of a dry sample. The pH and EC(dS/m) of soil evaluated by Potentiometric method(Jackson, 1973) and Conductivity metric method(Jackson, 1973) with (1:2.5, Soil:Water at 25 ^{0}C)respectively. Available N, P_2O_5,K_2O (kg/ha) of soil evaluated by Alkaline $KMnO_4$ method(Subbiah and Asija, 1956), Spectrophotometric method(Olsen *et al.*, 1954),Flame Photometric method(Jackson, 1973)respectively. While Organic carbon (%) and Microbial count (cfu/g) 117.6 x 10^7evaluated by Wet oxidation method (Walkley and Black, 1934), Serial dilution method (Dhingra and Sinclair, 1993) respectively.

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RESULTS AND DISCUSSION

EFFECT ON AVAILABLE NUTRIENTS OF SOIL(N, P_2O_5 and K_2O)

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Data presented in Table 1 indicated that the treatment T_2 (100% N through FYM) recorded significantly higher available nitrogen content in soil (259kg/ha) after harvest of greengram. However, it was remained at par with application of 100% N through vermicompost (T_3), 100% N through castor cake (T_4) and 70% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (T_5), Use of FYM and vermicompost might have attributed to the mineralization of nitrogen in soil and due to high enzyme activities in the soil amended with organic manures might have increased the transformation of nutrients into available form. Role of FYM and vermicompost in releasing nitrogen and improving nitrogen availability in soil.It might also be due to accumulation of residual nitrogen through FYM and increase C: N ratio in the soil and it is close agreement with findings of Prajapati (2014) and David & David (2017) in green gram.While Table 1 indicated that effect of different treatments of organic sources did not show any significant differences with respect to available phosphorus and potassium content in soil after harvest of crop.

EFFECT ON SOIL MICROBIAL COUNT (cfu/g)

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The data showed in Table 1 revealed that the microbial count after harvest of cropwas significantly influenced with application of different organic sourcesin greengram.

The treatment T_5 (75% N through FYM +ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha) recorded significantly higher microbial count in soil (195.33 x 10^7 cfu/g) after harvest of crop. However, it was remained at par with application of 75% N through VC + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (T_6), 75% N through CC + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha(T_7) and 50% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (T_8).Higher microbial population might be due to availability of abundant organic matter and effective microbial activities because of sufficient supply of feeding material for microorganism in the form of humus. The results are in close proximity to tune reported by Prajapati (2014) and David & David (2017) in green gram.

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EFFECT ON ORGANIC CARBON CONTENT OF SOIL

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A critical examination of data given in Table 2 indicated that application of 100% N through FYM (T_2) recorded significantly higher organic carbon content of soil after harvest of greengram (0.397%). However, it remained statistically at par with treatments T_3 (100% N through vermicompost), T_4 (100% N through castor cake) and T_5 (75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha). FYM contain low nutrient status as compare to other organic manure like vermicompost and castor cake that's why FYM apply in large amount in experiment plot as compare to vermicompost and castore cake so FYM has organic matter in large amount respect to others that's why FYM applied plot contain high organic carbon in soil.

Organic manure released nutrients slowly than mineral nutrients and contributed to the residual pool of organic nitrogen, phosphorus and potassium in the soil and reduces nutrient loss from the soil by improving soil organic matter than increased organic carbon content in the soil.Similar results were also noticed by Kachariya (2015) and shariff *et al.* (2017) in green gram.

EFFECT ON EC (dS/m) AND pH

The data from Table 2 revealed that the EC and pH of soil after harvest were not significantly altered due to application of different organic sourcesin greengram.

EFFECT ON YIELD AND B:C RATIO

Critical perusal of data presented in Fig. 1 indicated that application of 75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha significantly increased pods plant-1 (33.20), length of pod (8.60 cm), test weight (45.41g) over other treatments. Application of 75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha was at par with that of application of 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha. Significantly higher seed and straw yield was recorded with the application 75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (14.80 and 2008 kg/ha) over other treatments.In case of benefit cost ratio, the highest benefit cost ratio of 2.66 was recorded under application 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (T_5) followed by (T_6) 75% N throughVC + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (2.54).It might be due to the highest B:C observed under application of 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha (T_5) (2.66) was might be due to high selling price of organic seed and lower cost of FYM as compared to other organic manures (vermicompost and castor cake). The results are in close proximity to tune reported by Tak *et al.*, (2013).

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Table 1: Effect of different organic sources on available nutrients and microbial count of soil.

Treatments	Available nutrient (kg/ha) after harvest			Microbial count at harvest (10^7 cfu/g)
	N	P_2O_5	K_2O	
Initial	210	40	285	117.6
T1	221	42	295	122.67
T2	259	43	299	146.33
T3	256	43	304	152.67
T4	254	42	298	140.33
T5	249	45	316	195.33
T6	244	45	318	190.00
T7	241	44	312	186.33
T8	234	44	311	183.33
T9	233	44	311	178.33

T10	227	43	306	173.67
SEm ±	4.37	1.09	7.64	5.16
CD (p=0.05)	12.98	NS	NS	15.34

Table 2: Effect of different organic sources on EC, pH and organic carbon of soil.

Treatments	EC (dS/m)	pH	O.C. (%)
Initial	0.30	8.05	0.30
T1	0.32	8.11	0.30
T2	0.31	8.06	0.39
T3	0.30	8.04	0.38
T4	0.31	8.04	0.37
T5	0.31	8.01	0.37
T6	0.29	7.99	0.36
T7	0.30	8.07	0.35
T8	0.31	8.05	0.34
T9	0.31	8.03	0.33
T10	0.30	8.08	0.32
SEm ±	0.01	0.19	0.010
CD (p=0.05)	NS	NS	0.029

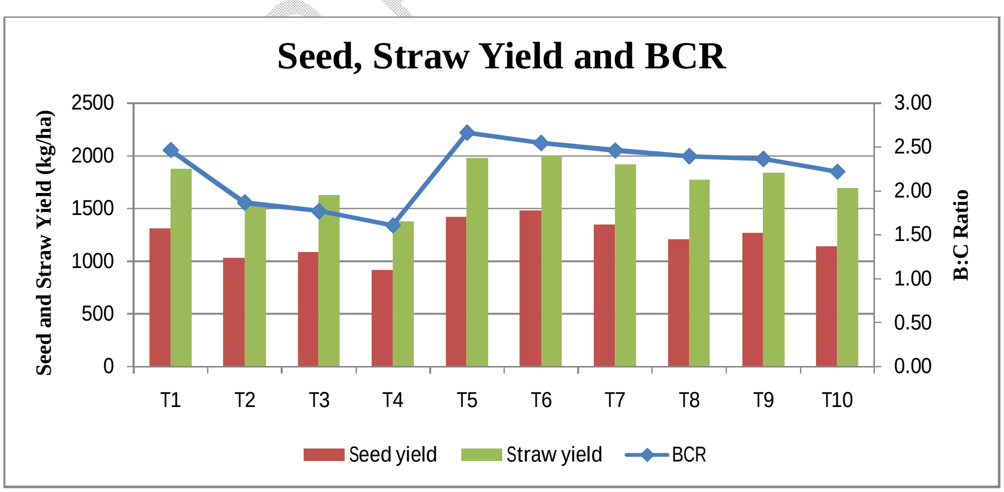

Fig 1: Effect of different organic sources on seed, straw yield and B:C ratio.

CONCLUSION

In order to increase available nitrogen and organic carbon content of soil after experiment, use of the FYMwhich have residual effect of nitrogen on soil and safeguard soil human-environment health is recommended. Thus, it can be inferred that the application of 100% N through FYM for enhancing available nitrogen in soil because FYM has high organic matter while soil microbial count found significantly higher with the application of 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha

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In order to increase yield of greengram, use of the organic sources for fulfilling nutrient requirement to sustain crop productivity and safeguard soil human-environment health is recommended. Thus, it can be inferred that the application of 75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha for enhancing greengram productivity in the Gujarat (India) and similar eco-regions elsewhere for advancing nutritional security. Application of 75% N through vermicompost + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha gave significantly, higher seed yield (1480 kg/ha), net return (₹ 51231/ha) and B:C ratio (2.66) with the application of 75% N through FYM + ST (5ml/kg seed) of *Rhizobium* + Bio NPK consortium 1L/ha over the treatments.

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