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Effect of integrated nutrient management on soil fertility, yield and quality of Greengram [*Vigna radiata* (L.) Wilczek]

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Abstract
A field experiment was conducted during *kharif* season of 2014 on clay loam soil to study the effect of fertility and biofertilizer levels on soil fertility, yield and quality of greengram. Results indicated that application of 100% RDF + VC @ 2 t/ha significantly increases the dry matter accumulation, number of pods/plant, number of seeds/pod, seed, haulm and biological yield, protein content, net returns and remained at par with the application of 75% RDF + VC @ 2 t/ha over 75% RDF. But seed inoculation with *Rhizobium* and PSB significantly increases the dry matter accumulation, number of pods/plant, number of seeds/pod, seed, haulm and biological yield, protein content and net returns over rest of treatments. However, the test weight unchanged under different levels of fertility and biofertilizers.

Keywords: Greengram, fertility levels, PSB, rhizobium

Introduction
Greengram [*Vigna radiata* (L.) Wilczek] commonly known as *Mungbean and Goldengram*, is one of the important *kharif* pulse crops. It ranks third among all pulses grown in India after chickpea and pigeonpea. It is quite versatile crop grown for seeds, green manure and forage; as mixed or sole crop either on residual moisture of the previous crop or as a catch crop to make use of the land left fallow between two main season crops. It makes a good manure if incorporated into soil. Further, it enriches the soil by atmospheric nitrogen fixation through root nodules. The crop give such a heavy vegetative growth and covers the ground so well that it checks the soil erosion in problem areas and can later be ploughed down for green manure. It has considerable promise as an alternative pulse crop in dry land farming. This crop is of great importance because of availability of short duration (65-70 days), high yielding and quick growing varieties.

Nitrogen plays an important role in various metabolic process of plant. Nitrogen is an essential constituent of protein and chlorophyll and is present in many other compounds helps in plant metabolism. Phosphorus is an essential constituent of nucleic acids and stimulates root growth as well as increase nodule activity in plant. The seed of pulses is inoculated with *Rhizobium* with an objective of increasing their number in the rhizosphere, so that there is substantial increase in the microbiologically fixed nitrogen for the plant growth. The association of *Rhizobium* and pulse plants helps in improving fertility of soil and is a cost effective method of nitrogen fertilization in legumes. Vermicompost is a recent innovation in composting technology. It is a mixture of earthworm's castings, organic materials humus and other organisms. Agricultural residues, animal wastes, dairy and poultry wastes, food industry wastes, sludge can all be recycled to give vermicompost.

Material and Methods
A field experiment was conducted during kharif season of 2014 at Department of Agricultural Chemistry and Soil Science, Rajasthan College of Agriculture, Udaipur, under FRBD with three replications. The soil of the experimental site was clay loam in texture, slightly alkaline in reaction (pH 8.13), medium in available nitrogen (252.30 kg ha^{-1}) and phosphorus (19.69 kg ha^{-1}), while high in potassium (387.60 kg ha^{-1}) and DTPA extractable micronutrients sufficiently above the critical limits. The experiment consisted four fertility levels (75% RDF, 75% RDF+VC @ 2t ha^{-1}, 100% RDF and 100% RDF+VC @ 2t ha^{-1}) and four biofertiliizers levels (control, *Rhizobium*, PSB and *Rhizobium* + PSB), thereby, making sixteen treatment

combinations. Fertilizers were applied as per treatment through urea and DAP at the time of sowing as basal dose. The greengram cv. 'SML-668' was sown on 18th July, 2014 using seed rate of 20 kg/ha with a row spacing of 30 cm. The crop was harvested on 4th October, 2014. Intercultural operations viz., thinning, hoeing and weeding were followed after 19 and 28 days of sowing to maintain recommended spacing and weed control. For weed management pendimethelen 1.0 kg a.i./ha was applied as pre-emergence to control the weeds in early stages of the crop. Fully mature and develop pods from randomly selected five plants from each plot were plucked and number of seeds were counted. The average number of pods and seeds/plants was worked out. After threshing and winnowing the weight of seeds for each net plot area was recorded in kg/plot and then converted to kg/ha.

Results and Discussion

Effect of fertility levels

Results revealed that application of 100% RDF + VC (2 t/ha) significantly increases the number of pods/plant, number of seeds/pod, seed, haulm and biological yield, protein content, net returns and remained at par with the application of 75% RDF +VC (2 t/ha) over the rest of treatments (Table 1 and Table 2). However, the test weight unchanged under different fertility levels. This may be attributed primarily due to the beneficial effect of fertility on overall physical condition of the soil. The reason for better growth and development in the above treatments might be due to increased availability of nitrogen and phosphorus to the plant initially through fertilizers and then through vermicompost in the cropping season. Since the fertility being a store house of almost all the plant nutrient required for proper growth and development of plants, its addition in the soil enhanced availability of these nutrients. The efficiency of inorganic fertilizer is much pronounced when it is combined with organic manures (vermicompost). The increased vegetative growth and the balanced C: N ratio might have increased the synthesis of carbohydrates, which ultimately promoted yield (Sammauria *et al.,* 2009; Choudhary and Yadav, 2011, Shinde *et al*. 2013 and Meena *et al*. 2014) [5, 1, 6, 4].

Table 1: Effect of fertility and biofertilizer levels on yield attributes and quality of greengram

Treatments	No. of pods plant^{-1}	No.of seeds pod^{-1}	Test weight (g)	Protein (%)
Fertility levels				
75%RDF	16.83	6.27	45.83	19.71
75% RDF+VC (2 t ha^{-1})	19.82	7.09	46.31	23.36
100%RDF	17.63	6.47	46.00	20.63
100%RDF+ VC (2 t ha^{-1})	20.09	7.11	46.35	24.08
SEm ±	0.22	0.05	0.47	0.29
CD (P= 0.05)	0.62	0.15	NS	0.84
Biofertilizer levels				
Control	16.15	6.17	45.05	18.23
Rhizobium	19.23	6.85	46.52	22.89
PSB	18.99	6.84	46.33	22.79
Rhizobium + PSB	20.00	7.08	46.58	23.87
SEm ±	0.22	0.05	0.47	0.29
CD (P= 0.05)	0.62	0.15	NS	0.84

Table 2: Effect of fertility and biofertilizer levels on yield and net returns of greengram

Treatments	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Net returns (ha^{-1})
Fertility levels				
75%RDF	900.81	1111.15	2011.96	28424
75% RDF+VC (2 t ha^{-1})	1149.02	1502.95	2651.97	36661
100%RDF	992.49	1244.15	2236.64	32549
100%RDF+ VC (2 t ha^{-1})	1205.39	1546.15	2751.54	38837
SEm ±	27.69	44.30	71.99	1422
CD (P= 0.05)	79.97	127.95	207.92	4108
Biofertilizer levels				
Control	900.05	1109.35	2009.40	25944
Rhizobium	1096.55	1400.75	2497.30	35882
PSB	1070.80	1359.55	2430.35	34543
Rhizobium + PSB	1180.30	1534.75	2715.05	40102
SEm ±	27.69	44.30	71.99	1422
CD (P= 0.05)	79.97	127.95	207.92	4108

Effect of biofertilizers

Results further indicated that inoculation of seed with *Rhizobium* + PSB significantly higher the number of pods/plant, number of seeds/pod, seed, haulm and biological yield, protein content, net returns over the rest of treatments (Table 1). *Rhizobium* + PSB might have improved both nitrogen and available phosphorus in rhizosphere as they are symbiotic nitrogen fixers and phosphorus solubilizers, respectively. Thus, the increased availability of nitrogen due to *Rhizobium* coupled with phosphorus due to PSB might open the door for increased utilization of others nutrient also and have resulted in more increase in growth in comparison to *Rhizobium* and PSB inoculations alone (Kausale *et al.,* 2009; Kumawat *et al.,* 2010) [2, 3]. However, the test weight unchanged under different levels of biofertilizers. The available P was medium in soil, PSB might have helped in reducing P fixation by its effect and also solubilized the unavailable form of P leading to more uptake of nutrient and

reflected in better yield attributes (Vikram and Hamzehzarghani, 2008; Tyagi *et al.*, 2014) [8, 7].

Conclusion

On the basis of one year field experimentation, it seems quite logical to conclude that the Application of 100% RDF+VC @ 2t/ha and inoculation of Rhizobium + PSB improved yield, protein and economic of greengram.

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