The Bioscan 11(3): 1755-1758, 2016 (Supplement on Agronomy)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.com

STUDIES ON IMPACT OF INORGANIC AND INTEGRATED USE OF NUTRIENTS ON YIELD, QUALITY OF GREEN GRAM (*VIGNA RADIATE* L.) VIS-À-VIS CHEMICAL PROPERTIES OF CALCAREOUS SOIL OF GUJARAT

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KEYWORDS
Green gram
INM
Soil available nutrients
protein content

Received on :
12.12.2016

Accepted on :
19.06.2016

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ABSTRACT
A field experiment was conducted on a clayey soil texture and alkaline in reaction with $pH_{2.5}$ 8.0 and $EC_{2.5}$ 0.56 dSm^{-1}on green gram with ten treatments in a randomized block design during the year 2012-13 at the Research Farm of JAU, Junagadh (Gujarat) to assess the impact of different management practices on growth, yield, and quality parameters of green gram and soil properties. Application of RDF (20:40, N:P_2O_5 kg ha^{-1}) + 20kg K_2O ha^{-1} + 20 kg S ha^{-1} + FYM at 5 t ha^{-1} + *Rhizobium* at 20 g kg^{-1} seed + PSB 20g kg^{-1} seed + 1% $FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum*at 2.5 $kgha^{-1}$at the time of sowing significantly influenced on growth parameter *viz.,* plant height at harvest and number of branch per plant, seed and straw yield, yield attributes and quality parameter *viz.,* seeds per pod, number of pod per plant, nodules at 45 DAS, test weight, protein content and soil available nutrient N, P_2O_5, K_2O, S and micronutrient(Fe, Mn, Zn and Cu) over the absolute control.

INTRODUCTION

The basic concept of Integrated Nutrient Management (INM) is the maintenance or adjustment of soil fertility and of plant nutrients supply to an optimum level for sustaining the desired crop productivity through optimization of benefits from all possible sources of plant nutrients in an integrated manner (Tondon, 1992). The appropriate combination of mineral fertilizers, organic manures, crop residues and N fixing crops varies according to the system, land use and ecological, social and economic conditions. In spite of increase use of fertilizer nutrients, there is a gap between the nutrients applied and nutrients harvested, which is likely to widen further with the achievement of targets, leading to mining of soil. Over use of certain potential areas and sub-optional use of larger areas are crucial issues. Indiscriminate use of chemical fertilizers is creating lot of problems especially of soil degradation and pollution. There fore, the aforesaid consequences have paved way to increase the productivity of crops using the combination of organics, inorganic sources and biofertilizers. Thus, integrated approach of nutrient supply by chemical fertilizers along with organic manures and biofertilizers is gaining importance as this system not only reduces the use of inorganic fertilizers but sustaining the crop productivity by improving soil health and is also an environment-friendly approach. Integration of inorganic fertilizers and organic manures resulted in better growth, yield and nutrient uptakes in black gram (Kumpawat,2010), green gram (Mandal and Pramanick, 2014), sesame (Nayek *et al*., 2014) and rice (Kumar *et al*., 2014) as compared to sole application of organic manures and inorganic fertilizers. However, information on the conjunctive use of inorganic fertilizers and organic manure along with biofertilizers is lacking in many crops including green gram. Hence, keeping above facts in view, the present investigation was carried out to study the effect of integrated nutrient management practices on growth, yield, and nutrient content of green gram.

MATERIALS AND METHODS

A field experiment was conducted during *rabi*season of 2012-13 at Instructional Farm, Department of Agronomy, College of Agriculture, Junagadh Agricultural University, Junagadh. Junagadh is situated in South Saurashtra Agro-climatic region of Gujarat state. Geographically Junagadh is situated at 21.5º N latitude and 70.5º E longitudes with an altitude of 60 m above the mean sea level. The soil was low in available nitrogen and potassium but medium in available phosphorus and $pH_{2.5}$ 8.0 and $EC_{2.5}$ 0.56 $dSm^{-1.}$ The experiment was laid out in randomized block design with ten treatments comprising ofT_1 - Absolute Control, T_2 - RDF at 20: 40 - N: P_2O_5 kg/ha, T_3 - RDF + 20 kg K_2O/ha, T_4 - RDF + 20 kg K_2O/ha + 20 kg S/ha, T_5 - RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha, T_6 - RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g kg/ha seed, T_7 - RDF + 20 kg K_2O/

ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB at 30 g/kg seed, T_8 - RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB 30 g/kg seed + 1 % $FeSO_4$ foliar spray at 30 and 45 DAS, T_9 - RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB at 30 g/kg seed + 1 % $FeSO_4$ foliar spray at 30 and 45 DAS + $ZnSO_4$ at 1 % foliar spray at 30 and 45 DAS, T_{10} - RDF (20:40, N:P_2O_5 kg/ha) + 20kg K_2O/ha + 20kg S/ha + FYM at 5t/ha + *Rhizobium* at 20 g/kg seed + PSB 20g/kgseed + 1%$FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum*at 2.5kg/ha at time of sowing. Seed treatment, organic manure, Bio-fertilizers, *T. harzianum* and recommended dose of fertilizers were applied as per the treatments before sowing the crop in previously opened furrows. The plots with foliar spray of 1 % $FeSO_4$ and $ZnSO_4$ at 30 and 45 DAS were given as per the treatments. Plant protection measures and other agronomic practices were followed as and when required. Observations on growth and yield parameters were recorded at harvest from the plants drawn randomly. Plant and soil samples were taken before the experiment and after the harvest of crop. Plot-wise analysis of soil samples for available nitrogen, phosphorus, potassium,sulphur,iron, manganese, zinc and copper from each of the treatment. Statistical analysis for all the growth and yield parameters was done as per the standard procedures.

RESULTS AND DISCUSSION

Crop performance

The chemical (RDF), absolute control and INM systems had significant influence on plant height, number of branches, number of pods per plant and seed yield of green gram. However, INM recorded numerically higher seed yield of green gram (Table 1and2) compared with that of absolute control and RDF and this may be attributed due to increasing availability of NPKS and micronutrient in INM treatments than RDF and absolute control (Table 3).The results of the experiment also indicated that INM significantly influence growth parameters *viz*., plant height, number of branches, number of root nodules per plant at 40 DAS and highest number of seeds per pod, number of pods per plant and test weight and recoded higher under treatment RDF (20:40, N:P_2O_5 kg ha^{-1}) + 20kg K_2O ha^{-1} + 20 kg S ha^{-1} + FYM at 5t ha^{-1} + *Rhizobium* at 20 g kg^{-1} seed + PSB 20g kg^{-1} seed + 1% $FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum* at 2.5 $kgha^{-1}$ at the time of sowing over absolute control and least value was found with absolute control. Per cent increase in yield of green gram under T_{10} and RDF was 50 and 23.92 % over absolute control (Table 1) and all INM treatment had more seed yield and yield attributes than absolute control and RDF and this was confirmed by Yakadri *et al*. (2002), Karwasra *et al*. (2006) and Tyagi *et al*. (2014).

Crude protein content in seed

With more N uptake more protein synthesis takes place significantly(Wani *et al*. 2007)and higher crude protein content of 22.5 percent was recorded in the treatment RDF (20:40, N:P_2O_5 kg ha^{-1}) + 20kg K_2O ha^{-1} + 20 kg S ha^{-1} + FYM at 5t ha^{-1} + *Rhizobium* at 20 g kg^{-1} seed + PSB 20g kg^{-1} seed + 1% $FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum* at 2.5$kgha^{-1}$at the time of sowing over absolute control (Table 2). Protein yield of green gram was affected by application of FYM (Kuligod *et al*., 2011 and Mathan *et al*., 1994)and *Rhizobium*(Patel and Patel, 1991).

Effect of different INM treatment on chemical properties

By increasing the use efficiency of fertilizers, the surplus on nutrient balance sheet was decreases. It recommended that all possible measures be integrated at the farm level in a system of integratednutrient management. The application of RDF

Table 1 : Effect of different INM treatments on seed yield, straw yield and per cent increase over absolute control of green gram

Treatments	Seed yield ($kg\ ha^{-1}$)	Straw yield ($kg\ ha^{-1}$)	% increase in seed yield over absolute control
T_1 Absolute Control	794	1323	-
T_2 RDF at 20: 40 - N: P_2O_5 kg/ha,	984	1493	23.92
T_3 RDF + 20 kg K_2O/ha	996	1522	25.44
T_4 RDF + 20 kg K_2O/ha + 20 kg S/ha	1012	1555	27.45
T_5 RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha	1089	1585	37.15
T_6 RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g kg/ha seed	1135	1650	42.94
T_7 RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB at 30 g/kg seed	1144	1658	44.08
T_8 RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB 30 g/kg seed + 1 % $FeSO_4$ foliar spray at 30 and 45 DAS	1157	1686	45.71
T_9 RDF + 20 kg K_2O/ha + 20 kg S/ha + FYM at 5 t/ha + *Rhizobium* at 20 g/kg seed + PSB at 30 g/kg seed + 1 % $FeSO_4$ foliar spray at 30 and 45 DAS + $ZnSO_4$ at 1 % foliar spray at 30 and 45 DAS	1171	1702	47.48
T_{10} RDF (20:40, N:P_2O_5 kg/ha) + 20kg K_2O/ha + 20kg S/ha + FYM at 5t/ha + *Rhizobium* at 20 g /kg seed + PSB 20g/kg seed + 1% $FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum*at 2.5 kg/ha at time of sowing	1191	1712	50
S.Em. ±	45	67	-
C.D.(p = 0.05)	133	200	-

Table 2 : Effect of different INM treatments on growth, yield attributes and quality parameters of green gram

Treatment	Plant height cm)	No. of branches /plant	No. of nodules/plant At 40 DAS	No. of Seeds/pod	No. of Pod /plant	Test wt. (1000 seeds) (g)	Protein content (%)
T_1	36.80	4.99	17.20	9.04	11.38	65.38	19.07
T_2	38.20	6.07	18.17	9.32	3.29	66.85	19.92
T_3	41.20	6.13	18.48	9.65	13.90	70.95	20.17
T_4	43.07	6.17	18.82	9.57	14.65	71.48	20.82
T_5	45.48	6.35	19.38	10.29	14.96	71.89	21.38
T_6	46.24	6.66	19.57	10.80	15.35	77.33	21.57
T_7	46.65	6.74	20.25	10.93	15.60	77.55	22.25
T_8	47.27	6.92	20.40	10.99	15.63	77.55	22.40
T_9	49.33	7.08	20.45	11.30	15.87	77.79	22.45
T_{10}	50.18	7.25	20.58	11.56	16.13	81.21	22.75
S.Em. ±	1.94	0.39	0.68	0.50	0.79	3.15	0.79
C.D.(p=0.05)	5.77	1.15	2.02	1.48	2.35	9.37	2.34

Table 3 : Effect of different INM treatments on soil available nutrients after harvest of green gram

Treatments	Available soil major nutrients (kg ha^{-1})				Available soil micronutrient (mg kg^{-1})			
	N	P_2O_5	K_2O	S	Fe	Zn	Mn	Cu
T1	191.46	30.01	166.33	39.03	4.33	0.550	16.01	1.13
T2	200.03	34.67	173.33	40.90	4.36	0.618	16.04	1.16
T3	203.53	34.38	184.00	42.10	4.48	0.623	16.32	1.20
T4	205.07	34.99	185.67	42.61	4.56	0.628	16.67	1.23
T5	215.84	41.97	193.33	46.49	4.64	0.640	16.97	1.27
T6	217.58	42.05	195.00	48.24	4.71	0.644	17.05	1.28
T7	217.68	42.13	197.67	51.59	4.79	0.649	17.43	1.30
T8	219.95	42.31	203.00	55.00	4.99	0.653	17.61	1.31
T9	240.67	42.82	205.00	55.41	5.06	0.673	18.12	1.35
T10	246.33	43.23	219.67	56.08	5.23	0.677	18.99	1.39
S.E m. +	10.87	1.30	5.78	3.54	0.19	0.023	0.59	0.05
C.D. (p=0.05)	32.31	3.87	17.18	10.52	0.57	0.068	1.76	NS

(20:40, N:P_2O_5 kg ha^{-1}) + 20kg K_2O ha^{-1} + 20 kg S ha^{-1} + FYM at 5t ha^{-1} + *Rhizobium* at 20 g kg^{-1} seed + PSB 20g kg^{-1} seed + 1% $FeSO_4$ at 30 and 45 DAS + $ZnSO_4$ at 1% foliar spray at 30 and 45 DAS + *Trichoderma harzianum* at 2.5 kg ha^{-1}at the time of sowing significantly increased the highest availability of N, P_2O_5, K_2O, S and micronutrient in post harvest soil (Table 3and 4) as Bellaki and Bandanur (1995) reported that available N, P and K and micronutrients increased significantly with organic sources of nutrient either alone or in combination with inorganic fertilizers. All INM treatment had more available N, P_2O_5, K_2O, S and micronutrient(Fe, Mn, Zn and Cu) in post harvest soil than absolute control and RDF. Similarly, these results were confirmed with those of Jat *et al.,* (2012), Mitra and Mandal (2012) and Quddus *et al.,* (2012) and this improved the chemical soil properties of calcareous as well as also increased the seed yield of green gram over RDF and absolute control.

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