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RESEARCH PAPER

Performance of different modules on yield, nutrient uptake and physico-chemical properties of soil after harvest of greengram (*Vigna radiata* L.)

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Abstract : A field experiment was conducted at Regional Research Station, SDAU, Bhachau, Kachchh to study the performance of different modules on yield, uptake and physico- chemical properties of soil after harvest in greengram (*Vigna radiata* L.) Experiment consisted of five different modules among three were organic modules, one was chemical module and control, under Randomized Block Design. The results of the experiments differed significantly. The significant improvement in yield attributes and yield was recorded with the chemical moduleT_4. In organic modules T_2 and T_3 recorded the highest growth improvement and yield as compared to control. Modules T_2 and T_3 also recorded the good nutrient content and uptake. Available nutrients in the soil after harvest were best in the organic modules (T_2 and T_3) maintained the soil physico-chemical properties by reducing the soil bulk density.

Key Words : Greengram, Organic module, Chemical module, Yield, Nutrient uptake, Physico-chemical property

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INTRODUCTION

The conventional agriculture is heavily dependent on non-renewable resources *viz*., chemical fertilizers and pesticides. The excessive and imbalanced use of agro-chemicals on soil and plant is not only damaging the soil biodiversity *i.e*. bacteria, fungi, actinomycetes etc., but also reduces the productivity potential of the farmland. Conventional intensive agriculture causes several problems as depletion of soil organic matter and plant nutrients besides occurrences of pest and diseases. Pulses are known to increase soil fertility and consequently the productivity of succeeding crop, fixes atmospheric nitrogen through symbiotic nitrogen fixation with the help of bacterium called *Rhizobia* (Pareek, 1978). Among the pulses, greengram (*Vigna radiata* L.) is one of the most important and extensively cultivated crops in India, which is cultivated in arid and semi arid regions. Greengram is locally known as "*Moong*". It contains about 25 per cent protein, 1.3 per cent fat, 3.5 per cent mineral, 4.1 per cent fibre and 56.7 per cent

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carbohydrate. Further, sprouted seeds synthesize vitamin C in them. It is also a good source of riboflavin and thiamin. The pulses are the chief sources of protein in a balanced diet in Indian conditions and contribute about 15 per cent of diet (Kumar and Ali, 2001).

Kachchh is the largest district and covers one third part of the Gujarat. Pulses are becoming major crops growing under Kachchh region. Among the pulses greengram (*Vigna radiata* L.) is one of the most important and extensively cultivated pulse crops, whose nutrient requirement is very low. Compared to other parts of Gujarat, Kachchh contains highest amount of degraded lands. Main cause for the degradation of land are the arid and semi-arid climatic condition, salinization, alkalinization, light texture soil with low organic carbon content and poor water holding capacity. The soils of arid and semi-arid regions have very low inherent productivity potential due to physical and nutritional constraints and are highly vulnerable to various degradation processes.

Adequate supply of organic manure and other nutrients is essential for proper growth and development as well as nutritional quality of greengram. Composting of agricultural waste materials in conjunction with bio-fertilizers play an important role in improving the organic matter content of the soil and thereby improving soil productivity and yield along with partial replacement of mineral fertilizers (Sutaria *et al.*, 2010). FYM is known to play an important role in improving the fertility and productivity of soils through its positive effects on soil physical, chemical and biological properties and balanced plant nutrition (Kumar *et al.*, 2011). It improves the structure and water holding capacity of soil. PROM is phosphate rich organic manure, produced by composting various organic wastes with high grade rock phosphate in fine size. It contains 10.4 per cent phosphorus, 7.9 per cent organic carbon and 0.4 per cent nitrogen, acts as alternative to DAP and makes soil soft and enriched with nutrients for long time, which plays an important role in maintaining soil fertility and productivity, with the

Table A: Details of the module

Treatments	Module details
T_1 (Module1)	**Organic module-I (OFM-I)**
	Soil application of 20 kg N/ha through FYM + *Trichoderma viride* @ 1.5kg/ha
	Soil application of phosphorus through enriched compost through PROM @ 40kg/ha
	Seed treatment with *Rhizobium* @ 30 g/kg seed
	Install 50 bird perches /ha
	Application of bio pesticides as per need
T_2 (Module 2)	**Organic module-II (OFM-II)**
	Soil application of 20 kg N/ha through Vermicompost + *Trichoderma viride* @ 1.5kg/ha
	Soil application of phosphorus through enriched compost through PROM @ 40kg/ha
	Seed treatment with *Rhizobium* @ 30 g/kg seed
	Install 50 bird perches /ha
	Application of bio pesticides as per need
T_3 (Module 3)	**Organic module-III (OFM-III)**
	Soil application of 20 kg N/ha through FYM + *Trichoderma viride* @ 1.5kg/ha
	Soil application of phosphorus through enriched compost through PROM + VAM @ 40kg/ha
	Seed treatment with *Rhizobium* @ 30 g/kg seed
	Install 50 bird perches /ha
	Application of bio pesticides as per need
T_4 (Module 4)	**Chemical module-IV (CM-IV)**
	Seed treatment with carbendazim + thiram @ 3 g/kg seed
	Apply 20 kg N and 40 kg P_2O_5/ha in the form of chemical fertilizer
	Apply prophenophos 50% EC @ 0.05% when *Helicoverpa* population exceeds 5 larvae/meter row length
	Spray mancozeb 0.2% if incidence of Aschochyta leaf blight is observed
T_5 (Module 5)	Absolute control

Table B: Methods used for estimation of physico-chemical properties of the soil

Soil pH (1:2.5)	Potentiometric method	Jackson (1967)
EC (dSm^{-1})(1:2.5) at 25 ^{0}C	Conductometric method	Jackson (1967)
Bulk density(Mg/m^3)	Core method	Piper (1950)
Available N (kg ha^{-1})	Alkaline potassium permanganate	Subbiah and Asija (1956)
Available P_2O_5 (kg ha^{-1})	Extraction with 0.5 M $NaHCO_3$ (pH 8.5) colorimetric method	Olsen *et al*. (1954)
Available K_2O(kg ha^{-1})	Flame photometeric method	Richards (1954)
Available sulphur (mg kg^{-1})	1% NaCl extraction method	Williams and Steinberg (1959)

presence of FYM or vermicompost along with PSB.

Organic farming has special importance in Kachchh district in response to less awareness regarding the crop residue and animal waste management and drastic soil and climatic condition. Since greengram is low nutrient demanding crop, organic manuring and biofertilizers are feasible for cultivation of this crop. Hence, the present study on effect of different modules on yield, nutrients content and uptake after harvest in greengram (*Vigna radiata* L.) grown on light textured soil of Kachchh region was under taken.

MATERIAL AND METHODS

The experiment was conducted at Regional Research Station, SDAU, Bhachau, Kachchh, Gujarat, during the *Kharif* season from 2009-10 to 2014-15. The soil was sandy loam and low in organic matter. The soil pH was 8.03 and having organic carbon (0.27 %), available nitrogen (172.48kg ha^{-1}) and available phosphorus (36.60kg ha^{-1}) and medium in potassium (308.40kg ha^{-1}). The treatments comprised of three organic modules, one chemical module and control, the details of the module are presented in the following Table A.

The experiment was laid out in Randomized Block Design with five quadrates in each module (2m×2m). Manures and fertilizers were applied as per the treatment. Greengram variety GM-4 was sown at the seed rate of 15-20 kg/ha with the spacing of 45cm x 10cm. Gross plot size was 14.5m x 20.5m. Further observations were recorded and statistical analysis was done.

For estimation of nitrogen, phosphorus and potassium content and uptake in greengram, composite samples of whole plant were taken after harvest and ground to powder which was used for the chemical analysis. Nitrogen was estimated by Kjeldahl's method (Jackson, 1967), phosphorus was estimated by Vanadomolydo phosphoric acid yellow colour method (di-acid extract), potassium was estimated by using the flame photometer (Jackson, 1967) and sulphur was estimated by turbidimetric method (Chaudhary and Cornfield, 1966). The total uptake of nitrogen, phosphorus, potassium and sulphur were calculated by using given formula :

$$\text{Nutrient uptake (kg ha}^{-1}) = \frac{\text{Nutrient content (\%) x Yield (kg ha}^{-1})}{100}$$

The soil samples were randomly drawn from different spots of experimental site upto 30 cm depth composite sample was prepared after proper mixing, drying and sieving. Soil physico-chemical properties were analyzed by using the following methods.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussions have been summarized under following headings:

Effect of different modules on yield:

Results from the Table 1 showed that there was significant difference among the different treatments for seed and straw yield. The maximum seed and straw yield were recorded in module T_4 in (pooled data) as compared to organic module and control. In case of organic modules T_2 followed by T_3 were found best for seed and straw yield, due to improvement of soil physical, chemical and biological properties cumulatively benefited the greengram crop. Similar results were also recorded by the Suman *et al.* (2006).

Effect of different modules on content and nutrients uptake :

Results from the Table 1 (pooled data) indicate that nitrogen, phosphorus, potassium and sulphur content significantly differed with the treatments. The highest nitrogen content in both seed and straw was recorded in the modules T_4 and T_2, both were at par with each other, followed by module T_3 and control (module T_5) had recorded the least nitrogen content in both seeds and straw. Same trend has been observed for phosphorus, potassium and sulphur content. Both the chemical module (T_4) and organic module (T_2) recorded the highest nutrients content. The higher level nutrients content in the plant analysis in T_4 module is due to readily available nutrients which were applied through fertilizers. In organic module T_2 recorded the maximum nutrients content with the application of vermicompost and PROM this due to well-developed root system which helps in increased nitrogen fixation and its availability to plant along with other nutrients and PROM has provided the phosphorus to the plant. Similar results have also been reported by Kumar (2000) and Dadheech (2001). Results from the Table 2 (pooled data) indicate that highest nitrogen uptake in module T_4 in seed (32.270 kg/ha) and straw (22.822 kg/ha) was recorded which was at par with the module T_2, which recorded the 30.087 kg/ha nitrogen uptake in seed and 20.865 kg/ha nitrogen in straw. Module T_4 (5.419 kg/ha in seed and 4.331 kg/ha in straw) and T_2 (5.024 kg/ha in seed and 3.928kg/ha in straw) recorded the highest phosphorus uptake in both

Table 1: Effect of different modules on yield and nutrient content of greengram **(Pooled data)**

Treatments	Yield (kg/ha)		N content (%)		P content (%)		K content (%)		S content (%)	
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw
Module-1	648	823	3.294	1.845	0.536	0.341	1.227	1.354	0.230	0.169
Module-2	886	1083	3.394	1.879	0.568	0.354	1.253	1.371	0.237	0.179
Module-3	723	918	3.323	1.851	0.552	0.346	1.240	1.361	0.235	0.174
Module-4	995	1248	3.410	1.885	0.573	0.358	1.258	1.389	0.239	0.182
Module-5	486	687	3.213	1.820	0.514	0.330	1.205	1.333	0.221	0.157
S.E.±	22.50	27.45	0.020	0.007	0.006	0.003	0.005	0.005	0.004	0.005
C.D. (P=0.05)	62.37	76.09	0.06	0.02	0.02	0.01	0.01	0.02	0.01	0.01
CV%	14.25	13.68	3.14	1.82	5.54	3.90	2.22	2.06	4.11	7.06

Table 2 : Effect of different modules on nutrient uptake of greengram **(Pooled data)**

Treatments	N uptake (kg/ha)		P uptake (kg/ha)		K uptake (kg/ha)		S uptake (kg/ha)	
	Seed	Straw	Seed	Straw	Seed	Straw	Seed	Straw
Modules-1	23.419	16.787	3.781	3.104	8.67	12.30	1.626	1.528
Modules-2	30.087	20.865	5.024	3.928	11.09	15.22	2.090	1.983
Modules-3	25.185	17.918	4.178	3.351	9.38	13.17	1.769	1.685
Modules-4	32.270	22.822	5.419	4.331	11.90	16.82	2.253	2.193
Modules-5	16.175	12.862	2.580	2.321	6.05	9.41	1.112	1.108
S.E. ±	1.718	1.099	0.277	0.224	0.58	0.80	0.117	0.104
C.D. (P=0.05)	4.81	3.08	0.77	0.63	1.65	2.26	0.33	0.29
CV%	15.11	13.47	14.75	14.70	13.97	13.46	14.75	13.75

Table 3: Effect of different modules on available nutrients and physico-chemical properties of soil after harvest of greengram **(Pooled data)**

Treatments	Available N	Available P	Available K	Available S	EC	PH	Bulk density
Module-1	178.53	42.34	317.00	8.94	0.81	8.28	1.60
Module-2	177.48	41.46	316.52	8.86	0.82	8.29	1.61
Module-3	180.59	42.36	317.4	9.15	0.81	8.28	1.60
Module-4	175.06	40.82	315.04	8.74	0.82	8.37	1.64
Module-5	170.38	38.10	311.82	8.58	0.81	8.32	1.648
S.E.±	2.33	0.73	5.17	0.05	0.015	0.052	0.01
C.D. (P=0.05)	2.75	0.93	NS	0.15	NS	NS	0.03
CV%	2.95	3.99	3.66	3.00	4.14	3.42	3.63

NS= Non-significant

seed and straw. Similar trend has been observed for potassium (T_4-11.90 kg/ha in seed and 16.82 in straw kg/ha and T_2 – 11.09 kg/ha in seed and 15.22 kg/ha in straw) and sulphur uptake module T_4 and T_2 recorded the highest nutrients uptake followed by module T_3 and least nutrients uptake for all the nutrients were recorded in control treatment (module T_5). This might be due to higher level of nutrient contents and yield in both T_4 and T_2 modules resulted in higher uptake. Similar observations were reported by Patil *et al.* (2012) in chickpea.

Effect of different modules on physico-chemical properties of soil:

Results from the Table 3 (pooled data) indicate that treatments differed significantly for available nitrogen, phosphorus, sulphur and bulk density after harvest of greengram. There was no significance difference for available potassium, EC and pH between the treatments. Among the different modules, module T_3 (180.59 kg/ha) and module T_1 (178.53kg/ha) recorded the highest available nitrogen in the soil. Module T_3 recorded the 42.36 kg/ha and module T_1 recorded the 42.34 kg /ha available phosphorus in the soil after harvest and both were at par with each other. Module T_3 recorded the highest sulphur content (9.15 kg/ha) followed by module T_1. For the available nutrients in the soil after harvest, modules T_3 and T_1 were found best, followed by module T_2 and least was observed with the control (T_5) and chemical module (T_4). Module T_1 and T_3 contained FYM application, farm yard manure is known to maintain soil productivity longer than inorganic fertilizers. It conations all micro and macro nutrients, its effect will be retained in the soil for longer period of time. These results are in accordance with the findings of Prabhakar Reddy (2010) and Reddy *et al.* (2007). Least bulk density was recorded in the Modules T_1, T_2 and T_3 and maximum was recorded in modules T_4 and T_5. All the organic manures were significantly reduced the bulk density, this due to increase in the porosity and addition of organic carbon to the soil through manures. These results are in line with the findings of Patil *et al.* (2012).

Conclusion:

Among all the different modules, module T_4 was found best for growth characters and yield. Among all the organic modules T_2 followed by T_3 recorded the maximum yield and yield attributes and they also recorded the good nutrient uptake and maintenance of soil physico-chemical properties, reduced the bulk density of the soil. T_2 module can be recommended to farmers to insure the public health and a sustainable agriculture, maintains soil fertility and reduces pest and disease problems.

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