Indian Journal of Agronomy **63** (4): 472–476 (December 2018)

Research Paper

Effect of land configuration and nutrient management on greengram (*Vigna radiata*)

T.U. PATEL[1], A.J. PATEL[2], J.D. THANKI[3] AND M.K. ARVADIYA[4]

N.M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat 396 450

Received : August 2017; Revised accepted : October 2018

ABSTRACT

A field experiment was conducted from 2010–11 to 2012–13 during the post-rainy seasons at Navsari, Gujarat to evaluate the effects of land configuration and nutrient management on productivity, quality, nutrient uptake and economics of greengram [*Vigna radiata* (L.) Wilezek] cultivation. Growth attributes, viz. plant height, branches/plant and dry-matter accumulation, and yield attributes, viz. pods/plant, seeds/pod and seed index and seed and stover yield of greengram exhibited significantly higher values under raised bed method of planting compared to flat bed. Application of recommended dose of fertilizers (RDF 20 : 40 N:P kg/ha) resulted in markedly higher growth and yield attributes, grain yield, stover yield, N and P uptake, and net returns over the application of 75% RDF. Similarly, an application of FYM at 5 t/ha resulted in higher growth and yield attributes, grain yield and stover yield over no FYM application. Among treatment combinations, raised bed planting + RDF found superior to the other treatments.

Key words **:** Farmyard manure, Greengram, Nitrogen, Phosphorus, Protein content, Raised bed planting

Greengram is an important pulse crop grown throughout Gujarat. It is generally grown in rainy (*kharif*) and summer seasons. Now-a-days, winter (*rabi*) cultivation of summer greengram is becoming popular in south Gujarat owing to favourable agro-climatic conditions and availability of short duration varieties. Moreover, the cultivation of greengram during the post-rainy season gives higher yield owing to favourable soil-moisture regime, less attack of insect-pests and diseases, and enhanced photosynthetic activity because of clear skies under irrigation. Therefore, it is necessary to standardize management practices for cultivation of greengram in the post-rainy season. Poor soil condition (black cotton soil) is one of the major factors responsible for low productivity of crops in Gujarat. Besides, heavy black soils of this region are subjected to temporary water-logging after irrigation due to low infiltration rate particularly in the fields used for growing lowland paddy in the preceding rainy season. Waterlogging even for a short period proves detrimental to greengram growth and development. Moreover, under unavailability of water farmers use saline groundwater for irrigation. Greengram being a legume, is particularly sensitive to salinity hazard (Jat *et al.,* 2012). Land-management system plays a major important role in minimizing water-logging cause through irrigation and improving water-use efficiency of field crops. Easy and uniform germination as well as growth and development of plant are provided by manipulation of sowing method. Further, land configuration increases water-use efficiency (Chiroma *et al.,* 2008) and also increases availability of nutrients to crops. It is particularly useful in areas having saline irrigation water because it helps to avoid direct contact of young plants with saline irrigation water. The superiority of raised bed method of sowing could be ascribed to proper drainage of excess water coupled with adequate aeration at the time of irrigation. Pramanik and Singh (2006) reported that, crop planted on raised bed recorded significantly better growth than that planted on flat beds. They further concluded that raised bed planting significantly increased branching, nodulation and root growth. Hence raised bed method of sowing has been found suitable in alleviating the problems caused by temporary waterlogging, besides improving growth and yield of crop.

Further, fertilizer is one of the costly but important inputs in crop productivity. Nitrogen requirement of pulses is very low than other crops because nitrogen is needed only for establishment of plant, later on plants have their own potentiality to fulfil their requirement through symbi-

[1]**Corresponding author's Email:** tushagri.ank@nau.in
[1,2]Assistant Professor (Agronomy), [3]Head and Professor (Agronomy), [4]Principal, N.M. College of Agriculture

otic nitrogen fixation. Its proper management not only improves the efficiency of applied nutrients but also reduces the gap between addition and removal of nutrients. Current trends in agriculture are centered on reducing the use of inorganic fertilizers by organic manure. Farmyard manure is beneficial in nitrogen fixation in legume and has been found beneficial in maintaining the proper health of the crop. Fertilizer alone cannot sustain productivity of land in modern farming. Similarly, nutrient supply through organic manures can hardly fulfil the need of the crop and also reduces the cost of cultivation. (Gadi *et al.,* 2017). The use of farmyard manure (FYM) along with inorganic fertilizer increases the nutrient-use efficiency. Keeping in view these above consideration, the present investigation is undertaken to study the response of land configuration and nutrient management on greengram in *rabi* season.

MATERIALS AND METHODS

A field experiment was conducted during 2010–11, 2011–12 and 2012–13 at the Research Farm of N.M. College of Agriculture, Navsari Agricultural University, Navsari, (20° 57' N, 72° 54' E) Gujarat. The soil was clay in texture, having 0.59 % organic C, medium in available nitrogen (224 kg/ha) and phosphorus (40 kg/ha), fairly rich in available potassium (362 kg/ha) and slightly alkaline in reaction (*p*H 7.6) with normal electrical conductivity. The experiment was laid out in factorial randomized block design, having 8 treatments combinations with 4 replications. The treatments comprised 2 levels each of land configuration (L_1, flat bed; and L_2, raised bed), inorganic fertilizer [F_1, 75% recommended dose of fertilizer (RDF); F_2, RDF and FYM (M_1, no FYM or control; and M_2, FYM 5 t/ha)]. After harvesting of preceding paddy, field was irrigated and prepared for sowing of greengram using 2 cross-cultivation and harrowing, followed by planking. The flat bed was the smooth plain surface of natural field, which is surrounded by its boundaries in the shape of a simple plot. Raised beds were formed with a bed former. The size of the raised bed (RB) was 120 cm at base, 90 cm at top width and 20 cm height from the natural terrain. Greengram variety 'Co 4' was sown on 25, 18 and 28 November in 2010, 2011 and 2012 cropping season, respectively, by *kera* method with seed rate of 15 kg/ha. Row-to-row spacing was maintained at 30 cm, whereas plant-to-plant spacing was 10 cm. The required quantities of well-decomposed FYM 5 t/ha was calculated for gross plot area and manually incorporated into upper 15 cm soil depth as per the treatments. Recommended rate of fertilizers (20:40:0 kg N:P:K/ha) was used in lines as per the treatment just before sowing of the crop at the depth of 5 cm and covered with soil. The required quantities of urea, single super phosphate for gross plot area were worked out as per treatment. The full quantity of single superphosphate and urea was applied basal. In addition to 1 pre-sowing irrigation for field preparation, the crop was given 5 irrigations during the growing season using borewell water (EC 2.80 dS/m). All the agronomic management practices were followed as per the standard recommendations.

Biometric observations of greengram crop, viz. plant height, branches/plant at 60 days after sowing (DAS), dry-matter accumulation, pod/plant, seeds/pod, seed index, seed and stover yield, and uptake of N and P were recorded at harvesting. The nutrient uptake was determined by multiplying the concentration with their dry-matter accumulation. Treatment effects in all the 3 years were same so pooled analysis of data was made. To calculate the cost of cultivation, the cost of each treatment was determined and then compared with each other according to the prevailing market prices of greengram. Treatment-wise economics was calculated by considering prevailing market price as: labour, ₹120/day; nitrogen (urea), ₹13.91/kg; Phosphorus (SSP), ₹46.3/kg; grain, ₹65/kg and stover, ₹2/kg. The data collected were subjected to Fisher's analysis of variance technique using 'MSTATC' statistical software at $p \leq 0.05$ probabilities was applied to compare the differences among treatments' means.

RESULTS AND DISCUSSION

Growth attributes

Across the season, land configuration had significant effect on growth attributes, viz. plant height, branches/plant and dry-matter accumulation, of greengram crop. Raised bed method of sowing resulted in significantly taller plant with higher number of branches/plant and dry-matter accumulation compared to the flat bed method of sowing (Table 1). The improvement in growth attributes of greengram could be attributed to fact that ridge and furrow method of sowing helps in maintaining favourable condition for relatively longer duration resulting in good supply of available nutrients, soil aeration, soil environment, better physical condition of soil, and N fixation by nodule bacteria resulted better growth and development of crop. Higher number of branches coupled with plant height might have resulted in higher dry weight/plant. Sowing on raised bed was particularly helpful as the experimental soil with high clay (66.3%) as was observed by Shete *et al.* (2010), who reported that land configuration plays important role and shows higher growth parameters in raised bed over flat bed method.

Application of 100% RDF resulted in significantly taller plant height, dry-matter accumulation, and branches/plant than the application of 75% RDF treatment. This was owing to adequate supply of N and P to the plants

with the application of 100% RDF. External supply of N in adequate amount at planting is crucial for the establishment and initial growth of plants when plants do not receive biologically fixed nitrogen. Similarly, P plays an important role in root development and proliferation, thus influencing overall nutrient and water uptake by plants. Besides, P also has pivotal role in the biosynthesis of proteins, phospholipids, nucleic acids, and membrane transport and cytoplasm streaming. Phosphorus increases nitrogenase activity of root nodules, which results in improved biological N fixation. Ambhore (2004) also noticed improvement in growth parameter with 100% application of N and P in greengram.

Significant increase in plant height, branches/plant, dry-matter accumulation were recorded with the application of FYM 5 t/ha as compared to without application of FYM treatment. This might be owing to balanced supply of nutrients to crop plants through FYM. Besides, FYM has favourable effects on physical, chemical and biological properties of soil (Singh *et al*., 2009).

Yield attributes and yield

Land configuration had significant effects on yield attributes of greengram. Pods/plant, seeds/pod and seed index were significantly higher under raised bed method of sowing than flat bed sowing (Table 1). This can be attributed to better growth of plants in terms of dry-matter accumulation, branches/plant under raised bed method, which in turn improved the photosynthesis and N utilization for development of sink. Further, it is a fact that increase in number of leaves leads to increased photosynthesis, thereby more food was prepared by plants leading to more number of clusters and pods/plant. Sowing on raised beds improved the seed (924 kg/ha) and stover (2,410 kg/ha) yield of greengram by 9.08 and 8.04% respectively, as compared to flat bed sowing. This might be owing to the cumulative effect exerted by better soil environment, aeration, root development, N fixation by nodule bacteria, optimum moisture-air equilibrium throughout the crop growth besides supply of available nutrients to the crop resulting in better growth and development and ultimately reflected in better seed yield. The present findings are in accordance with those Dhindwal *et al.,* (2006) in greengram with respect to seed yield.

Application of 100% RDF significantly improved yield attributes such as pods/plant, seeds/pod, seed index over the application of 75% RDF. The higher value of yield attributes with the application of 100% RDF were largely attributed to better growth of plant in terms of plant height, number of branches/plant and dry-matter accumulation which resulted in higher production of photosynthates which were utilized by the plant for development of sink under adequate supply of nutrients through recommended dose of fertilizers and gave higher number of pods/plant and seeds/pod, as reported by Das *et al.* (2011). At the end, result was reflected on grain (941 kg/ha) and stover (2396 kg/ha) yield of greengram and raised by 13.24 and 7.05% respectively. This might be owing to application of 100% RDF that probably ensured sufficient supply of N and P to plant for remarkable improvement in the yield attributes, better development of various growth parameters which ultimately resulted in higher grain and stover yields. Similar results were reported by Yakadri *et al*. (2004). Similarly, the application of FYM at 5 t/ha significantly in-

Table 1. Growth and yield attributes as influenced by land configuration and nutrient management on greengram (pooled data of 3 years)

Treatment	Plant height (cm)	Branches/plant at 60 DAS	DMA (g/plant)	Pods/plant	Seeds/pod	Seed index (g)
Land configuration						
Flat bed	42.3	4.0	17.6	26.2	7.1	4.5
Raised bed	46.1	4.4	18.5	28.4	7.8	4.9
SEm±	0.39	0.06	0.16	0.23	0.08	0.04
CD (P=0.05)	1.10	0.17	0.44	0.64	0.22	0.12
Inorganic fertilizer						
75% RDF	41.5	3.9	17.3	25.7	7.0	4.4
100% RDF	47.0	4.5	18.8	28.9	7.9	5.0
SEm±	0.39	0.06	0.16	0.22	0.08	0.04
CD (P=0.05)	1.10	0.17	0.44	0.64	0.22	0.12
FYM level						
No FYM	42.6	4.0	17.8	26.4	7.2	4.6
FYM 5 t/ha	45.8	4.4	18.3	28.2	7.7	4.8
SEm±	0.39	0 .06	0.16	0.22	0.07	0.04
CD (P=0.05)	1.10	0.17	0.44	0.65	0.22	0.12

DAS, Days after sowing; DMA, dry-matter accumulation; RDF, recommended dose of fertilizer; FYM, farmyard manure

creased yield attributes over the no application of FYM treatment. Similar trend was also noted for grain (917 kg/ha) and stover (2,498 kg/ha) yields, showing an increase of 7.25 and 16.95% respectively, over no use of FYM. This perhaps was caused by favourable effect of FYM application on growth attributes, which contributed higher photosynthates for the reproductive parts of the plants. These results confirm the findings of Jat *et al.* (2012). However, harvest index was remained unaltered with different land configuration, inorganic fertilizer and FYM levels treatments.

Protein content

Land configuration and inorganic fertilizer application fail to exert their significant effect on protein content, as also reported by Abedi *et al.* (2010), who reported that quality of albumins-globulins is scarcely influenced by N nutrition. However, application of FYM 5 t/ha significantly improved the protein content in greengram grain. It is a well-known fact that application of organics improved the overall physicochemical and biological properties of soil, ultimately enhanced root growth that increased water and nutrients uptake resulting in improved protein in greengram (Abedi *et al.,* 2010).

Nutrient uptake

The uptake of N by greengram was not influenced significantly due to land configuration. Contrary to this, P uptake was influenced by raised bed method of sowing. This might be owing to better root growth and conse-

Table 2. Effect of land configuration and nutrient management on seed and stover yield, harvest index, protein content, nutrient uptake and economics of greengram (pooled data of 3 years)

Treatment	Seed yield (kg/ha)	Stover yield (kg/ha)	Harvest index (%)	Protein content in seeds (%)	Uptake (kg/ha) N	Uptake (kg/ha) P	Net returns (× 10^3 ₹/ha)	Benefit : cost ratio
Land configuration								
Flat bed	847	2225	27.6	19.7	28.7	8.2	43.2	3.7
Raised bed	924	2410	27.8	20.4	30.7	8.8	46.4	3.5
SEm±	7.7	24.2	0.30	0.32	0.77	0.13	–	–
CD (P=0.05)	21.9	68.5	NS	NS	NS	0.36	–	–
Inorganic fertilizer								
75% RDF	831	2238	27.2	19.9	26.8		42.2	3.6
100% RDF	941	2396	28.3	20.5	32.6	9.3	49.1	3.9
SEm±	7.7	24.2	0.53	0.32	0.44	0.13	–	–
CD (P=0.05)	21.9	68.5	NS	NS	1.24	0.36	–	–
FYM level								
No FYM	855	2136	28.6	19.2	7.7	7.9	43.6	3.7
FYM 5 t/ha	917	2498	26.9	20.6	31.7	9.1	42.7	3.0
SEm±	7.7	24.2	0.30	0.32	0.43	0.13	–	–
CD (P=0.05)	21.9	68.5	NS	0.81	1.24	0.36	–	–

RDF, Recommended dose of fertilizer; FYM, farmyard manure

Table 3. Interaction effect of land configuration and nutrient management on economics of greengram (pooled data of 3 years)

Treatment	Grain yield (kg/ha)	Stover yield (kg/ha)	Gross returns (× 10^3 ₹/ha)	Net returns (× 10^3 ₹/ha)	Benefit: cost ratio
Interaction					
$L_1F_1M_1$	720	1,937	39.9	23.6	2.45
$L_1F_1M_2$	875	2,337	48.4	26.5	2.21
$L_1F_2M_1$	875	2,138	48.1	31.2	2.85
$L_1F_2M_2$	919	2,486	50.9	28.5	2.27
$L_2F_1M_1$	850	2,133	46.8	28.3	2.53
$L_2F_1M_2$	878	2,546	49.1	26.5	2.18
$L_2F_2M_1$	974	2,336	53.4	35.9	3.06
$L_2F_2M_2$	995	2,624	55.0	31.9	2.38
SEm±	15.5	42.3	1.42	0.98	0.06
CD (P=0.05)	43.7	NS	3.95	2.56	0.16

Details of treatments are given under Materials and Methods

quently higher yield of both grain and stover under raised bed sowing, resulting in higher P uptake. The application of 100% RDF also led to significant increase in nutrient uptake by greengram over application of 75% RDF. This may be attributed to improved availability of N and P owing to application of 100% RDF. Application of FYM 5 t/ha significantly improved N and P uptake over no application which was probably owing to balanced and sustained supply of nutrients to plant due to FYM application.

Interaction effect

In case of interaction, adoption of raised bed method of sowing and nourished the crop with 20:40:00 kg N:P:K/ha with or without application of FYM was found equally effective by giving significantly higher yield of green gram. Significantly, lowest yield of greengram was noted under flat bed method of sowing + 75% RDF + no FYM treatment combination.

Economics

The raised bed method of sowing resulted in the maximum net returns and benefit: cost (B:C) ratio over the flat bed sowing method. Fertilized the crop with 100% RDF secured higher net returns and B:C ratio than 75% RDF treatment. Contrary to this, application of FYM 5 t/ha recorded lower value of net returns with B : C ratio, though the same treatment recorded the highest crop yield, because the cost of cultivation of FYM applied treatment was much higher the without application of FYM.

So far interaction effect is consider (Table 3), raised bed method of sowing and nourishing the crop with 100% RDF without FYM resulted in the maximum net returns of 35.9×10^3₹/ha and B : C ratio 3.06, which was followed by raised bed method of sowing + 100% RDF + 5 t/ha FYM by securing net returns of 31.9×10^3₹/ha with B : C ratio of 2.38. However, the lowest net returns of 23.6×10^3 ₹/ha were received under flat bed + 75% RDF + no FYM treatment.

On the basis of 3 year experiment, it can be concluded that raised bed system of sowing and fertilizing the crop as per recommended dose (20:40 N:P kg/ha) proved most promising for getting higher profitable yield of *rabi* greengram 'Co 4' under the subtropical agro-ecosystem of Gujarat.

REFERENCES

Abedi, T., Alemzadeh, A. and Kazemeini, S.A. 2010. Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. *Australian Journal of Crop Science* **4**(6): 384–389.

Ambhore, A.P. 2004. Response of summer greengram (*Vigna radiata* L.) to biofertilizers and inorganic fertilizers under south Gujarat conditions. M.Sc. (Agric.) Thesis, Navsari Agricultural University, Navsari, Gujarat.

Chiroma, A.M., Alhassan, A.B. and Khan, B. 2008. Yield and water use efficiency of millet as affected by land configuration treatments. *Journal of Sustainable Agriculture* **32**(2): 321–333.

Das, B., Wagh, A.P., Dod, V.N., Nagre, P.K. and Bawkar, S.O. 2011. Effect of integrated nutrient management on cowpea. *The Asian Journal of Horiculture* **6**(2): 402–405.

Dhindwal, A.S., Hooda, I.S., Malik, R.K. and Kumar, S. 2006. Water productivity of furrow-irrigated rainy season pulses planted on raised beds. *Indian Journal of Agronomy* **51**(1): 49–53.

Jat, R.A., Arvadia, M.K., Bhumika, Tandel, Patel, T.U. and Mehta, R.S. 2012. Response of saline water irrigated greengram (*Vigna radiata*) to land configuration, fertilizers and farm yard manure in Tapi command area of south Gujarat. *Indian Journal of Agronomy* **57**(3): 270–274.

Gadi, P., Joy, D. and Shankar, M. 2017. Effect of different organic manures, inorganic fertilizers and growth regulators on growth and yield of geengram (*Vigna radiata* L.). *Bulletin of Environment, Pharmacology and Life Sciences.* Special issue **6**(1): 67–75.

Pramanik, S.C. and Singh, N.B. 2006. Raised bed planting improves productivity of pulses. *Chickpea Newsletter*, January 2006.

Shete, P.G., Baviskar, V.S. and Adhav, S.L. 2010. Response of *rabi* greengram (*Vigna radiata* L.) to land configuration and inorganic fertilizer with and without FYM. *International Journal of Plant Science* **5**(2): 498–501.

Singh, G., Marwaha, T.S. and Kumar, D. 2009. Effect of resource-conserving techniques on soil microbiological parameters under long-term maize (*Zea mays*)–wheat (*Triticum aestivum*) crop rotation. *Indian Journal of Agricultural Sciences* **79**(2): 94–100.

Yakadri, M, Tahatikunta, R. and Latchanna, A. 2004. Dry-matter production and nutrient uptake of greengram (*Vigna radiata* L.) as influenced by nitrogen and phosphorus during wet season. *Legume Research* **27**(1): 58–61.