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Nutrient content as well as uptake of organic guar gum as affected by land configuration and nutrient management under rainfed condition

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Abstract
The investigation entitled, "Nutrient content as well as uptake of organic guar gum as affected by land configuration and nutrient management under rainfed condition" was conducted during *kharif* season of 2013-14 at Agronomy farm, Dr. PDKV, Akola to study the production potential of guar gum under various land configuration and integrated nutrient management system. Seed and straw yields as well as N, P and K uptake by guar gum (seed and straw) were maximum under the treatment of Opening of furrow in each row and alternate rows compared to flatbed configuration. Nutrient content (N, P and K) in seed and straw was not influenced significantly due to land configuration. Significantly higher grain yield (270.17 kg ha^{-1}) and straw yield (588.35 kg ha^{-1}) was observed under the treatment of Opening of furrow in each row which was at par with Opening of furrow in alternate rows. Highest seed yield (281.71 kg ha^{-1}) and straw yield (598.07 kg ha^{-1}) was recorded with Vermicompost-2.0 t ha^{-1} than FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and control treatments. Nutrient content (N, P and K) in seed and straw was significantly higher in Vermicompost-2.0 t ha^{-1} compared to rest of the treatments. N, P and K uptake by seed and straw was recorded maximum in application of Vermicompost-2.0 t ha^{-1}. FYM-2.5 t ha^{-1} and Soybeancompost-2.0 t ha^{-1} were at par in terms of N, P and K uptake by seed and straw but were significantly superior to control treatments.

Keywords: FYM, guar gum, organic, soybean compost, vermicompost

Introduction
Guar or cluster bean [*Cyamopsis tetragonoloba* (L.) Taub], is a hardy and drought tolerant crop suitable for dry land farming. It is a multi-purpose legume crop cultivated mainly in the *kharif* season in arid environments. Guar seeds are a rich source of mucilage or gum, a natural hydrocolloid, which forms a viscous gel in cold water and used as an emulsifier, thickener, stabilizer in a wide range of food and industrial application (Marina *et al*., 2007) [4]. In India, Rajasthan is the leading state (70%) in the production followed by Gujarat, Haryana and Punjab. In India, guar occupies an area of 2.20 million hectares with a production of 6.0 Lakhs (Singh *et al*., 2009) [11]. As guar is a drought resistant crop and therefore, it can be grown successfully in areas where average rainfall is 30-40 centimeter. It is a crop preferring warm climate and grows well in the subtropics during summer. It cannot stand water logging conditions at all. Guar suits well under the marginal and sub marginal land and hence an experiment was conducted to see the suitability of guar gum under limited resources of Vidarbha region of Maharashtra.

Materials and Methods
The field experiment was conducted during *kharif* season of 2013-2014 at the farm of Agronomy Department, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The soil was clayey with pH-7.8 having organic carbon 0.43%, available N 174.30 kg/ha, $P_2O_5$14.40 kg/ha and K_2O 374.33 kg/ha. The experiment consisted of twelve treatment combinations with three levels of land configuration (Flat bed, Opening furrow in each row @ 30-40 DAS and Opening furrow in alternate rows @ 30-40 DAS) and four levels of nutrient management (Control, FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and Vermicompost-2.0 t ha^{-1}). The experiment was laid out in split plot design, allocating land configuration in main plots and nutrient management in sub plots and was replicated four times. Land configuration was done after 30 DAS while the organic sources of nutrient were applied before sowing of the seeds. Seeds of guar were dibbled all along the ridges according to recommended spacing of 45 cm.

Observations were recorded on vegetative parameters, seed yield, crude protein and gum content. Moisture retention in the soil after rains due to different treatments at the interval of thirty days period was worked out.

Results and Discussion

Effect of land configuration

Highest seed yield (270 kg ha^{-1}) was recorded with opening of furrow in each row which was at par with opening of furrow in alternate rows and found significantly higher than flatbed sowing. The increased seed yield was mostly attributed to more pod bearing and dry matter accumulation in the treatments. The land configuration benefitted to drain out excess moisture and keep soil condition healthy. Similar effect of modified land configuration has also been reported by Jogdande *et al*. (2003) [3], Patil *et al*. (2011) [6] and Saha *et al.* (2017) [9]. Land configuration effect on N, P and K content in seed and straw does not reach to the level of significance. Opening of furrow in each row recorded maximum N, P and K content in seed and straw than other treatments. N, P and K uptake by seed and straw was significantly influenced by land configuration. Opening of furrow in each row recorded maximum N uptake (11.09 kg ha^{-1}), P uptake (1.14 kg ha^{-1}) and K uptake (9.59 kg ha^{-1}) in seed which as at par with opening of furrow in alternate rows but was significantly superior over flat bed. Similar trend was also observed in the N uptake (8.42 kg ha^{-1}), P uptake (0.47 kg ha^{-1}) and K uptake (9.74 kg ha^{-1}) by straw. Fairer availability of soil moisture might have promoted growth of root as well as their functional activity resulting in higher extraction of nutrients from soil environment to aerial parts.

Table 1: NPK uptake (kg ha^{-1}) by guar seed at harvest as influenced by land configuration and nutrient management

Treatments	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
A) Main plot (Land configuration)			
L_1(Flat bed)	9.61	1.06	8.35
L_2(Opening of furrow in each row)	11.09	1.14	9.59
L_3(Opening of furrow in alternate rows)	10.61	1.08	9.22
SE(m)$\pm$	0.25	0.012	0.26
CD at 5%	0.88	0.043	0.92
B) Sub-plot (Nutrient management)			
N_0(Control)	9.35	1.03	7.96
N_1(FYM-2.5 t ha^{-1})	10.62	1.11	9.28
N_2(Soybeancompost-2.0 t ha^{-1})	10.50	1.09	9.04
N_3(Vermicompost- 2.0 t ha^{-1})	11.28	1.16	9.93
SE(m)$\pm$	0.17	0.01	0.21
CD at 5%	0.50	0.03	0.63
C) Interaction (A x B)			
SE(m)$\pm$	0.3	0.019	0.37
CD at 5%	NS	NS	NS
GM	10.44	1.09	9.05

Table 2: NPK uptake (kg ha^{-1}) by guar Straw at harvest as influenced by land configuration and nutrient management

Treatments	Nitrogen uptake (kg ha^{-1})	Phosphorus uptake (kg ha^{-1})	Potassium uptake (kg ha^{-1})
A) Main plot (Land configuration)			
L_1(Flat bed)	6.23	0.37	7.63
L_2(Opening of furrow in each row)	8.42	0.47	9.74
L_3(Opening of furrow in alternate rows)	7.32	0.43	8.90
SE(m)$\pm$	0.29	0.011	0.23
CD at 5%	1.01	0.035	0.71
B)Sub-plot (Nutrient management)			
N_0(Control)	6.26	0.37	7.74
N_1(FYM-2.5 t ha^{-1})	7.30	0.43	8.76
N_2(Soybeancompost-2.0 t ha^{-1})	7.06	0.41	8.45
N_3(Vermicompost- 2.0 t ha^{-1})	8.68	0.51	10.08
SE(m)$\pm$	0.23	0.010	0.22
CD at 5%	0.67	0.032	0.65
C) Interaction (A x B)			
SE(m)$\pm$	0.40	0.019	0.39
CD at 5%	NS	NS	NS
GM	7.32	0.43	8.76

Table 3: Mean seed and straw yield of guar (kg ha^{-1}) and nutrient (NPK) content (%) of guar seed and straw at harvest as influenced by land configuration and nutrient management

Treatments	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	NPK content in guar seed			NPK content in guar straw		
			N content (%)	P content (%)	K content (%)	N content (%)	P content (%)	K content (%)
A)Main plot (Land configuration)								
L_1(Flat bed)	238.25	487.05	4.03	0.412	3.50	1.27	0.077	1.56
L_2(Opening of furrow in each row)	270.17	588.35	4.10	0.423	3.54	1.42	0.079	1.65
L_3(Opening of furrow in alternate rows)	261.63	551.61	4.05	0.414	3.52	1.33	0.078	1.61
SE(m)±	5.87	10.47	0.04	0.004	0.065	0.04	0.002	0.03
CD at 5%	20.33	36.23	NS	NS	NS	NS	NS	NS
B)Sub-plot (Nutrient management)								
N_0(Control)	226.36	495.78	3.95	0.408	3.37	1.27	0.076	1.55
N_1(FYM-2.5 t ha^{-1})	260.71	544.10	4.07	0.418	3.55	1.34	0.079	1.60
N_2(Soybeancompost-2.0 t ha^{-1})	258.94	531.39	4.07	0.413	3.49	1.32	0.077	1.58
N_3(Vermicompost- 2.0 t ha^{-1})	281.71	598.07	4.16	0.425	3.66	1.44	0.080	1.68
SE(m)±	4.05	10.01	0.02	0.003	0.06	0.03	0.001	0.02
CD at 5%	11.76	29.05	0.06	0.01	0.17	0.10	0.002	0.08
C) Interaction (A x B)								
SE(m)±	7.02	17.34	0.04	0.006	0.10	0.06	0.002	0.05
CD at 5%	NS	NS	NS	NS	NS	NS	NS	NS
GM	256.68	542.34	4.06	0.416	3.52	1.34	0.078	1.61

Effect of nutrient management

Seed and straw yield was influenced significantly by various nutrient management practices. Highest seed yield (281.71 kg ha^{-1}) and straw yield (598.07 kg ha^{-1}) was recorded with Vermicompost-2.0 t ha^{-1} than FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and control treatments. The increased seed and straw yield with Vermicompost might be due the fact that increased absorption of nutrients and their assimilation. Supply of N in balanced quantity enabled the guar plants to assimilate sufficient photosynthetic products and thus increased the dry matter accumulation. These findings are in close agreement with the results obtained by Dadema and Dongale (2004) [2], Patel *et al*. (2010) [5] and Ramawtar *et al*. (2013) [8].

The present study revealed that N, P and K content in seed and straw was influenced significantly by various nutrient management practices. N, P and K content in seed and straw was maximum in Vermicompost-2.0 t ha^{-1} (4.16 and 1.44% N, 0.425 and 0.080% P and 3.66 and 1.68% K in seed and straw, respectively) compared to FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and control treatments. Increased N, P and K content in seed and straw was mostly due to higher nutrients content in Vermicompost compared to other sources. The findings are in accordance with those reported by Vasanthi and Subramanian (2004) [12], Singh *et al*. (2007) [10] and Chhipa *et al*. (2012) [1].

Nutrient management treatments were found to be significant in N, P and K uptake by both seed and straw. Vermicompost-2.0 t ha^{-1} recorded the maximum Nitrogen uptake (11.28 and 8.68 kg ha^{-1}), Phosphorus uptake (1.16 and 0.51 kg ha^{-1}) and Potassium uptake (9.93 and 10.08 kg ha^{-1}) by both seed and straw respectively, which was significantly superior over FYM-2.5 t ha^{-1}, Soybean compost-2.0 t ha^{-1} and control treatments. The nutrient uptake is a function of yield and nutrient concentration in plant. Thus, this might be due to in general, the trend of nutrient uptake was very well resembled with dry matter accumulation and per hectare yield data of various treatments. The enhanced uptake of these nutrients in the corresponding treatments could be due to the increased and sustained availability of nutrients through organic fertilizers. The increased uptake might be also due to improvement in soil physical, chemical and biological health through application of organic fertilizers under different nutrient management practices which increased adequate availability of NPK in soil solution with better root growth, thereby increasing uptake of nutrients. The results of present investigation are in close agreements with Rajkhowa *et al*. (2003) [7] and Vasanthi and Subramanian (2004) [12].

From this research work, it can be concluded that land configuration of opening of furrow in each or alternate rows nourished with Vermicompost-2.0 t ha^{-1} should be selected for getting maximum yield and also for improvement in nutrient content as well as uptake of organic guar gum under *rainfed* condition.

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