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Impact of different land configuration and cultivars on growth and yield of green gram during summer season in the coastal plain of Odisha

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ABSTRACT

A field study on impact of land configuration, cultivar and nutrient management practices on green gram was carried out on sandy loam soil of Agronomy Main Research farm, Odisha University of Agriculture and Technology during summer 2016. The result revealed that on an average sowing of green gram on flatbed land configuration was superior over raised bed with respect to all the characters except plant height, and sowing of variety PDM 139 on flat beds was significantly superior with respect to number of pod plant^{-1} (35) and seed yield (423.75 kg ha^{-1}). Nutrient management practice based on STCR equations significantly yielded more (455.29 kg ha^{-1}) than the other treatments. It was also associated with higher yield attributing characters

Keywords: Green gram, land configuration, variety, nutrient management, growth, yield

Pulses, popularly called as the "Poor man's meat" contribute significantly to the country's nutritional security as a whole, owing to their higher content of proteins, vitamins and minerals (Singh *et al*., 2015). Green gram, a high protein legume, has a share of 5.02 and 8.2 per cent in the total area and productivity of India's total pulse production, respectively, with an average national yield of 481 kg ha^{-1} (https:// agriodisha.nic.in). In Odisha, it is usually grown as a third crop in summer, under irrigated condition. Though, it's productivity in Odisha has increased steadily still it is too low (477 kg ha^{-1}) as compared to national average mean (497 kg ha^{-1}) (https://agriodisha.nic.in). Sowing of green gram on flat beds is common method of establishment which often provides surface compaction and excess soil moisture conditions at times affecting the plant growth. Land configuration, by way of altering the soil physical environment can play a vital row towards increased population by unhindered and uniform germination. Akbar in 2007 reported that the raised bed method of land configuration reduces the salt injury and temporary water logging in plants. The rising cost of fertilizers, and the sustainability issues due to overuse of chemical fertilizers in an indiscrete manner, has necessitated for balanced and appropriate use of nutrients Odisha soils are predominantly acidic in nature (Mishra, 2005). It reduces the availability of phosphorus due to its fixation as aluminium and iron phosphate. PSB/PSM can solubilize fixed phosphorus (He *et al.*, 2002). Thus, it was worthwhile to plan a study on effect of these variables on growth and yield of summer green gram under coastal plains of Odisha.

MATERIALS AND METHODS

The experimental site is geographically located at 20°15'N latitude and 85°52'E longitude with an altitude of 25.9 m above Mean Sea level. The experiment was conducted under irrigated lowland during summer where the ground water table fluctuates between 40-60 cm below the ground level during the crop growing period.

The soil samples were collected before and after the experiment by using Z method from a depth of 0-15 1nd 15- 30 cm depth. Samples were air dried, grinded and passed through a 2 mm sieve for study of various physico-chemical characteristics (Table 1, 2).

The design of the experiment was split-plot design, having three replications with four main plot treatments having a combination as of two land configuration (M1- flatbed method and M2- raised bed method) and two varieties (V1- Nayagarh local and V2- PDM-139). Sub plots were allotted with six nutrient management practices like F_1= Farmer's Practice (100 kg DAP ha^{-1} + need based plant protection), F_2= F1+ seed inoculation with *Rhizobium* + PSB soil application, F_3= F2 + lime @ 5q ha^{-1}, F_4= F2 + NPK as RDF *i.e*. 20-40-20 kg N-P_2O_5-K2O ha^{-1} (no flat application of DAP), F_5= F2 + Soil test based NPK application, 25-40-25 kgN-P_2O_5-K_2O ha^{-1}, F_6= F2 + STCR based NPK application. Under STCR (F_6) variety wise doses were arrived using following equations keeping a target yield of 6 and 8 q ha^{-1} for the variety Nayagarh local and PDM-139, respectively.

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FN= 11.48 T – 0.51 SN

FP205 = 8.76 T – 0.76 SP2O5

FK20 = 12.21 T – O.51 SK20,

Where, T- target yield, SN- soil nitrogen value

Accordingly, the dose for the variety V1- Nayagarh local and V_2 - PDM-139, the dose was worked as 5:22:7.5kg N-P_2O_5-K_2O ha^{-1} and the seeds were treated with fungicide, carbendazim @ 1.5g kg^{-1} of seed at 7 days before sowing followed by treatment wise inoculation with *Rhizobium* and PSB @ 20g/kg of seeds. To reduce the crop weed competition and to provide better crop growth one hand weeding was done at 21 DAS in all the treatments. Plant protection measure was taken by spraying imidachloprid @ 100ml ha^{-1}or 0.2 ml l^{-1} of water to get rid of the white flies and jassids.

RESULTS AND DISCUSSION

Data related to the growth parameters *viz*., plant height (cm), number of branches per plant and leaf area index at harvest were significantly affected by land configuration and nutrient management practices (Table 3). Except plant height, the growth parameters increased significantly under the flat bed method of sowing with PDM 139 as compared to the other treatments. Raised bed method provides loose and porous soil that favoured root growth than the shoot. The plants were significantly the tallest (36.9cm) under flat-bed method with Nayagarh Local closely followed by flat-bed method with PDM-139 variety (35.4cm). Similar results have also been reported by Singh and Sekhon (2002) and Dodwadiya and Sharma (2012). The maximum number of branches per plant was observed from the flat bed with PDM 139 (5.23). The leaf area at harvest was significantly highest in the treatment consisting of raised bed with Nayagarh Local (4.05). Morphological variations in varieties also influence the LAI (Singh *et al*., 2014). Among the nutrient management treatments, it can be enunciated that there was no significant difference in the plant height due to the difference in the treatments. However, the highest number of branches (5.84) and the highest LAI were found in nutrient treatment F_6.

The raised bed system of land configuration with variety PDM-139 gave significantly the highest pod numbers per plant (36.7), pod length (5.23 cm), pod dry weight (7.66g) and the mean 100 seed weight (3.91g) (Table 4). This is due to the fact that in the aforesaid method better root growth is favoured which in turn facilitates better source to sink movement thus providing more nutrition to the plant, which is displayed in form of superior yield attributing features. Among the nutrient management practices, the treatments F_6 gave the highest value in terms of the aforesaid yield attributing characters, but it was not significant in case of 100 seed weight. The raised bed method of sowing along with variety PDM 139 significantly increased the seed and haulm yields over flatbed sowing (Table 4). Higher growth, superior yield attributes in the modified land configuration might have contributed for the higher yields in this treatment. Similar results were also reported by Lawand *et al*. (1993).

The seed and haulm yield of green gram was significantly affected by the nutrient management. The treatment F_6 produced significantly higher seed (455.69 kg ha^{-1}) and haulm yield (1461.3 kg ha^{-1}) over the other

Table 1: Mechanical composition of soil

Mechanical constituents	Depth (cm)		Method adopted
	0-15	15-30	
Sand (%)	73.35	75.52	Bouyoucous hydrometer method (Piper, 1950)
Silt (%)	16.20	12.46	
Clay (%)	10.45	12.12	
Soil textural class	Sandy loam	Sandy loam	

Table 2: Physio- chemical properties of the soil

Parameter	Initial value	Method employed
Bulk density (mg m^{-3})	1.64 mg m^{-3}	Core sampler (Logsdon *et al*., 2008)
Organic carbon (%)	0.75%	Walkley and Black's wet digestion method
Available N (kg ha^{-1})	225.5 kg ha^{-1} (low)	Alkaline $KMnO_4$ method (Subbiah and Asija, 1956)
Available P (kg ha^{-1})	45.6 kg ha^{-1} (high)	Bray's-1 'P' method (Jackson, 1973)
Available K (kg ha^{-1})	129 kg ha^{-1} (medium)	Ammonium acetate extraction by flame photometer (Jackson,1973)
pH	5.5	Glass electrode Beckman's pH meter (Jackson, 1973)

Table 3: Growth attributes of green gram as influenced by land configuration, variety and nutrient management practices

Treatments	Plant height (cm)	Number of branches plant^{-1}	Leaf area index (at harvest)
Land configuration and variety			
M1V1	36.9	4.80	2.69
M1V2	35.4	5.23	3.24
M2V1	33.1	4.49	4.05
M2V2	32.7	4.97	3.43
SEm (±)	**0.02**	**0.16**	**0.04**
LSD (0.05)	**0.07**	**0.56**	**0.13**
Nutrient management			
F1	34.1	3.75	2.61
F2	33.8	4.18	3.20
F3	34.6	4.70	3.38
F4	34.6	5.21	3.45
F5	34.9	5.56	3.60
F6	35.05	5.84	3.87
SEm (±)	**0.02**	**0.24**	**0.04**
LSD (0.05)	**0.05**	**0.68**	**0.12**

Table 4: Yield attributes, seed and haulm yield of green gram as affected by land configuration variety and nutrient management practices

Treatments	Pod number	Pod length (cm)	Pod dry weight (g)	100 seed weight (g)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})
Land configuration and variety						
Flat bed with Nayagarh Local	33.4	4.80	5.34	2.49	378.65	988.21
Flat bed with PDM 139	34.9	4.97	7.11	2.98	423.75	1316.14
Raised Bed with Nayagarh Local	35.1	4.49	6.55	2.44	339.62	1213.27
Raised bed with PDM 139	36.7	5.23	7.66	3.91	522.84	1418.09
LSD (0.05)	0.07	0.56	0.13	0.19	26.64	25.60
Nutrient management						
F1. Farmer's Practice(100 kg DAP ha^{-1} + need based plant protection)	34.1	3.75	5.34	2.86	341.90	988.47
F2. F1+ seed inoculation with *Rhizobium* + PSB soil application	33.8	4.18	5.85	2.93	410.64	1083.33
F3. F2 + lime @ 5q ha^{-1}	34.6	4.70	6.38	2.96	433.65	1181.34
F4. F2 + NPK as RDF i.e. 20-40-20 kg N-P_2O5-K_2O ha^{-1} (no flat application of DAP)	34.6	5.21	7.02	2.96	452.27	1299.81
F5. F2 + soil test based NPK application i.e. 25-40-25 kg N-P_2O_5-K_2O ha^{-1}	34.9	5.56	7.50	2.97	402.82	1389.26
F6. F2 + STCR based NPK application	35.05	5.84	7.89	3.05	455.29	1461.34
LSD (0.05)	**0.05**	**0.68**	**0.12**	**0.18**	**76.13**	**22.19**

treatments (Table 4). Increase in was associated with higher growth and yield attributing characters. Besides, the STCR based nutrient management translocated more photosynthetic products to seeds, thereby helped to realize more yield. STCR approach showed encouraging results in more than 80% of the experiments conducted under different STCR centres (Subba Rao and Srivastava, 2000).

It can be enunciated that the flat bed method along with PDM 139 variety could yield better if the nutrients are managed using STCR based equations in the coastal plains of Odisha. Study also encourages developing more STCR- based equations for diverse crops grown under eastern tropical regions of the country.

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