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Fresh and Dry Weight of Seed Guar Cultivars Influenced By Spacing and Nutrition under Mahanandi Conditions

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ABSTRACT

The effect of planting geometry and nutrition on growth and flowering of seed guar cultivars viz., HG 365 and HG 563 was analysed under Mahanandi conditions. The fresh and dry weights of different plant parts were significantly the highest in the variety HG 365 planted at a spacing of 30 cm x 10 cm. Dry weight of whole plant was found superior at 30 cm x 20 cm spacing with fertilizer dose of 45N: 60P: 60K: 30S kg per ha. The fresh and dry weight of pod per plant also exhibited significant superiority in this treatment combination. The per plant seed yield was highest at the spacing of 30 cm x 20 cm whereas per plot yield was highest at 30 cm x 10 cm.

Key words: *Dry weight, Fresh weight nutrition, Spacing, Seed guar.*

INTRODUCTION

Cluster bean is botanically called as *Cyamopsis tetragonoloba* (L.) Taub. It belongs to the family Leguminaceae. The crop is popularly known as guar referring to its seed. India is considered as native place for guar or cluster bean. It has been used as vegetable in our country from hundreds of years. The crop is renowned as drought hardy, being deep rooted and having a low water requirement. It requires a low annual rainfall of about 400 mm to 500 mm. Guar tolerates high temperature and dry conditions, thus gaining popularity in arid and semi-arid climates[9].

MATERIAL AND METHODS

The experiment was conducted in factorial randomized design with three factors *viz.*, varieties (2), planting geometry levels (3) and nutritional levels (3) replicated thrice. The plot was laid out at Horticultural Research Station, Mahanadi, and Kurnool district of Andhra Pradesh during both *kharif* and *rabi* seasons of the years 2014-15 and 2015-16. The data obtained from both the years was pooled and presented in the tables.

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RESULTS AND DISCUSSION

Fresh weight of whole plant (g)

The fresh weight of whole plant exhibited significant variations due to variety, planting geometry, nutritional combinations as well as their interactions (Table 1).

The varieties HG 365 recorded the highest fresh weight of whole plant both in *kharif* (68.64 g) and *rabi* seasons (61.09 g) at 90 DAS. Planting geometry of 30 cm x 20 cm (S_2) recorded significantly highest fresh weight of whole plant (*kharif* 63.96 g; *rabi*56.92 g) followed by 40 cm x 10 cm (S_3) (*kharif*63.24 g; *rabi*56.29 g). The lowest fresh weight of whole plant was recorded by the planting geometry at 30 cm x 10 cm (S_1) (*kharif*63.00 g; *rabi*56.07 g). Application of 45N: 60P: 60K: 30S kg per ha (F_3) recorded the highest fresh weight of whole plant (*kharif*69.50 g; *rabi*61.86 g) followed by 30N: 40P: 40K: 20S kg per ha (F_2) (*kharif*64.41 g; *rabi*57.32 g). The lowest fresh weight of whole plant (*kharif*56.29 g; *rabi*50.10 g) was recorded by the application of 15N: 20P: 20K: 10S kg per ha (F_1). Among the interaction effects, the fresh weight of whole plant and its components was significantly influenced by the interaction between planting geometry and nutrional level. The widest planting geometry 30 cm x 20 cm (S_2) with the highest nutritional level 45N: 60P: 60K: 30S kg per ha (F_3) recorded the highest fresh weight of whole plant (70.60 g) which was on par with the same planting geometry + medium fertilizer dose of 30N: 40P: 40K: 20S kg per ha (F_2) (64.62 g), moderately denser planting geometry 40 cm x 10 cm (S_3) at both the highest, and medium nutritional levels (64.59 g respectively).

Dry weight of pods per plant (g)

The dry weight of pods exhibited significant variations due to variety, planting geometry, nutritional combinations as well as their interactions (Table 2). Among the varieties HG 365 recorded the highest dry weight of pods both in *kharif* (21.37 g) and *rabi* seasons (16.51 g) at 90 DAS. Planting geometry of 30 cm x 20 cm (S_2) recorded significantly the highest dry weight of pods (*kharif* 20.45 g; *rabi*15.84 g) followed by 30 cm x 10 cm (S_1) (*kharif*20.29 g; *rabi*15.68 g). The lowest dry weight of pods was recorded by the planting geometry at 40 cm x 10 cm (S_3) (*kharif*19.99 g; *rabi*15.44 g). Application of 45N: 60P: 60K: 30S kg per ha (F_3) recorded the highest dry weight of pods (*kharif*21.71 g; *rabi*16.81 g) which was on par with 30N: 40P: 40K: 20S kg per ha (F_2) (*kharif*21.12 g; *rabi*16.33 g). The lowest dry weight of pods (*kharif*17.90 g; *rabi*13.82 g) was recorded by the application of 15N: 20P: 20K: 10S kg per ha (F_1).

Dry weight of whole plant (g)

Data on dry weight of whole plant showed non-significant differences at 30 DAS. However, the dry weight of whole plant exhibited significant variations due to variety, planting geometry, nutritional combinations as well as their interactions (Table 3 and 4) at 60 and 90 DAS. Among the varieties HG 365 recorded the highest dry weight of whole plant both in *kharif* (31.43 g) and *rabi* seasons (25.46 g) at 90 DAS. Planting geometry of 30 cm x 10 cm (S_1) recorded significantly the highest dry weight of whole plant (*kharif* 39.95 g; *rabi*24.10 g) followed by 40 cm x 10 cm (S_3) (*kharif*29.45 g; *rabi*23.86 g). The lowest dry weight of whole plant was recorded by the planting geometry at 30 cm x 20 cm (S_2) (*kharif*29.42 g; *rabi*23.83 g). Application of 45N: 60P: 60K: 30S kg per ha (F_3) recorded the highest dry weight of whole plant (*kharif*31.40 g; *rabi*25.43 g) which was on par with 30N: 40P: 40K: 20S kg per ha (F_2) (*kharif*30.85 g; *rabi*24.99 g). The lowest dry weight of whole plant (*kharif*26.38 g; *rabi*21.37 g) was recorded by the application of 15N: 20P: 20K: 10S kg per ha (F_1). The interaction effects exhibited the similar trend as that observed in case of fresh weights.

As evident from the data on dry weights of different plant parts, the photosynthetic capacity of the plant was significantly influenced by the variety, planting geometry and nutritional combinations. The fresh weight of whole plant as well as its components like leaf, stem, and pod was nothing but the carbon assimilates, synthesized by the green leaves through

photosynthesis. Some of these assimilates would have been lost through respiration and the differences could be observed as the net photosynthetic product. Among the varieties, the highest values of fresh weight and dry weights at 90 DAS for whole plant as well as its components were observed in HG 365. Among the planting densities the whole plant fresh and dry weights were maximum at the widest spacing of 30 cm x 20 cm (16.7 plants per m^2) followed by relatively closer spacing 40 cm x 10 cm (25 plants per m^2).

In respect of fertilizer doses the fresh and dry weight of whole plant as well as its components increased with every increase in the nutritional dose. However the increase in these weights above F_2 level was not significant with respect to leaves, indicating that additional doses above F_2 level could not be productively utilized by the plant and eventually produced less leaf area and therefore could have not assimilated and diverted the assimilates in to photosynthetic organs. These results are in conformity with Naik[4, 5] who noticed that the whole plant dry weight was significantly superior with lower plant densities or widely spaced plants, and attributed the same due to lack of competition for growth resources during all stages of crop growth. Increase in the fresh and dry weight with higher fertiliser level was also reported by Kumavath and Khangarot and Sharma and Nehara[7].

Prabhavathi[6] studied dry matter accumulation among different genotypes and stated that those genotypes that had initiated bearing after 60 days from planting putforth, minimum dry matter and hence translocation of assimilates towards reproductive parts was less. Further it was noted that with increased fertiliser doses, the dry matter accumulation was found to be significantly more. It was thus inferred that, the earlier dose of nutrients had profound influence on the production of dry matter and its partitioning between the various organs of the plant, because the dry matter accumulated in the earlier stages would be directly influenced by such doses. Proper doses in the early stage of the crop can thus make the plant to push greater amount of assimilates to reproductive organs.

The amount of total dry matter (TDM) produced was stated as an indication of the overall efficiency of utilization of resources and better light interception. The data pertaining to total dry weight per plant in the present study indicated that, it increased continuously from 30 DAS to harvest. At later stages of crop growth, the dry matter accumulation followed decreasing trend, which was attributed to reduced source activity leading to lesser dry matter accumulation in leaf and stem. The results of the present study are in conformity with those revealed by Prabhavathi[6].

Meena *et al.*, [3] also noticed significant differences among the varieties in respect of dry matter accumulation at all the growth stages. This was attributed to be due to the fast growth habit of those varieties showing high dry matter accumulation taking less time to mature. The cultivars with high dry matter accumulation took less time to mature indicating that the assimilates were compounded over time to effect maturity period and *vice versa.*

Ayub *et al.*,[1] quoted that the seeding density influenced the plant growth due to its direct relation with plant population. The higher plant population increased competition among plants for nutrients, light and space, thus reducing dry weight per plant; while lower population density caused inefficient use of natural resources and inputs[2] . The dry matter yield was increased significantly with increase in nitrogen levels[1]. The highest dry matter yield was recorded with the application of top most dose of nitrogen. The increase in dry matter yield was attributed to the production of more dry matter as a result of improved photosynthetic activity at higher levels of nitrogen. Dry matter per unit area was significantly increased with increase in seeding rates or density of population. The highest dry matter yield was obtained with the highest seeding rates of 50 kg ha^{-1}. However, these results are contradictory to those of Sheikh[8] and

Modaihsh *et al*., [4] who reported that nitrogen application did not affect the dry matter accumulation. These contradictory results can be attributed to differences in climate and soil fertility.

Table 1: Fresh weight of whole plant (g) at 90 DAS as influenced by variety, planting geometry and nutritional combination during *kharif & rabi* (pooled data of 2014-15 & 2015-16)

Planting Geometry (B)	Nutritional Combination (C)	Variety (A)					
		Kharif			Rabi		
		HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**
S_1 (30 cm x 10 cm) (33.3 plants per m^2)	F_1 (15N:20P:20K:10S)	59.54	51.87	**55.70**	52.99	46.17	**49.58**
	F_2 (30N:40P:40K:20S)	68.50	59.52	**64.01**	60.96	52.97	**56.97**
	F_3 (45N:60P:60K:30S)	74.12	64.45	**69.29**	65.97	57.36	**61.66**
	Mean	**67.38**	**58.62**	**63.00**	**59.97**	**52.17**	**56.07**
S_2 (30 cm x 20 cm) (16.7 plants per m^2)	F_1 (15N:20P:20K:10S)	62.01	51.31	**56.66**	55.18	45.66	**50.42**
	F_2 (30N:40P:40K:20S)	70.45	58.79	**64.62**	62.70	52.32	**57.51**
	F_3 (45N:60P:60K:30S)	78.01	63.19	**70.60**	69.43	56.24	**62.83**
	Mean	**70.15**	**57.76**	**63.96**	**62.44**	**51.41**	**56.92**
S_3 (40 cm x 10 cm) (25 plants per m^2)	F_1 (15N:20P:20K:10S)	61.09	51.93	**56.51**	54.37	46.22	**50.29**
	F_2 (30N:40P:40K:20S)	69.83	59.35	**64.59**	62.14	52.82	**57.48**
	F_3 (45N:60P:60K:30S)	74.19	63.06	**68.63**	66.03	56.13	**61.08**
	Mean	**68.37**	**58.11**	**63.24**	**60.85**	**51.72**	**56.29**
For Comparing varieties (A) and Nutritional combinations (C)							
F_1 (15N:20P:20K:10S)		60.88	51.70	**56.29**	54.18	46.02	**50.10**
F_2 (30N:40P:40K:20S)		69.59	59.22	**64.41**	61.94	52.71	**57.32**
F_3 (45N:60P:60K:30S)		75.44	63.57	**69.50**	67.14	56.58	**61.86**
Mean		**68.64**	**58.16**	**63.40**	**61.09**	**51.77**	**56.43**

Factor	**S Em±**	**CD**	**S Em±**	**CD**
Variety (A)	**1.48**	**4.29**	**1.32**	**3.82**
Ptg. Geom. (B)	**0.10**	**0.29**	**0.09**	**0.26**
Nutril. Combn.(C)	**1.67**	**4.83**	**1.19**	**3.44**
A x B	**-**	**NS**	**-**	**NS**
B x C	**1.68**	**4.86**	**1.21**	**3.51**
A x C	**-**	**NS**	**-**	**NS**
A x B x C	**-**	**NS**	**-**	**NS**

CD: CD at 5% level of significance DAS: Days after sowing

Table 2: Dry Weight (g) of plant parts at 90 DAS as influenced by variety, planting geometry and nutritional combination during kharif (pooled data of 2014-15 & 2015-16)

Planting Geometry (B)	Nutritional Combination (C)	Variety (A)								
		Leaf			Stem			Pod		
		HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**
S_1 (30 cm x 10 cm) (33.3 plants per m^2)	F_1 (15N:20P:20K:10S)	3.02	2.57	**2.80**	6.35	5.40	**5.87**	20.01	17.89	**18.95**
	F_2 (30N:40P:40K:20S)	3.46	2.94	**3.20**	7.27	6.18	**6.72**	21.61	19.34	**20.47**
	F_3 (45N:60P:60K:30S)	3.47	2.95	**3.21**	7.12	6.05	**6.58**	22.64	20.24	**21.44**
	Mean	**3.32**	**2.82**	**3.07**	**6.91**	**5.88**	**6.39**	**21.42**	**19.16**	**20.29**
S_2 (30 cm x 20 cm) (16.7 plants per m^2)	F_1 (15N:20P:20K:10S)	2.85	2.42	**2.63**	5.98	5.08	**5.53**	18.74	16.76	**17.75**
	F_2 (30N:40P:40K:20S)	3.29	2.80	**3.04**	6.91	5.87	**6.39**	22.73	20.31	**21.52**
	F_3 (45N:60P:60K:30S)	3.30	2.80	**3.05**	6.76	5.75	**6.26**	23.32	20.82	**22.07**
	Mean	**3.15**	**2.67**	**2.91**	**6.55**	**5.57**	**6.06**	**21.60**	**19.30**	**20.45**
S_3 (40 cm x 10 cm) (25 plants per m^2)	F_1 (15N:20P:20K:10S)	2.96	2.52	**2.74**	6.34	5.39	**5.86**	17.93	16.06	**17.00**
	F_2 (30N:40P:40K:20S)	3.39	2.88	**3.13**	7.24	6.16	**6.70**	22.55	20.16	**21.35**
	F_3 (45N:60P:60K:30S)	3.46	2.94	**3.20**	7.31	6.21	**6.76**	22.83	20.41	**21.62**
	Mean	**3.27**	**2.78**	**3.02**	**6.96**	**5.92**	**6.44**	**21.10**	**18.88**	**19.99**
For Comparing varieties (A) and Nutritional combinations (C)										
F_1 (15N:20P:20K:10S)		2.94	2.50	**2.72**	6.22	5.29	**5.76**	18.90	16.90	**17.90**
F_2 (30N:40P:40K:20S)		3.38	2.87	**3.13**	7.14	6.07	**6.60**	22.30	19.94	**21.12**
F_3 (45N:60P:60K:30S)		3.41	2.90	**3.15**	7.06	6.00	**6.53**	22.93	20.49	**21.71**
Mean		**3.24**	**2.76**	**3.00**	**6.81**	**5.79**	**6.30**	**21.37**	**19.11**	**20.24**

Factor	**S Em±**	**CD**	**S Em±**	**CD**	**S Em±**	**CD**
Variety (A)	**0.07**	**0.20**	**0.14**	**0.42**	**0.32**	**0.93**
Ptg. Geom. (B)	**0.02**	**0.05**	**0.04**	**0.12**	**0.05**	**0.13**
Nutril. Combn.(C)	**0.06**	**0.17**	**0.54**	**1.57**	**0.51**	**1.48**
A x B	-	**NS**	-	**NS**	-	**NS**
B x C	**0.07**	**0.21**	**0.55**	**1.61**	**0.53**	**1.54**
A x C	-	**NS**	-	**NS**	_	**NS**
A x B x C	-	**NS**	-	**NS**	**0.84**	**2.42**

CD at 5% level of significance DAS: Days after sowing

Table 3: Dry Weight (g) of whole plant as influenced by variety, planting geometry and nutritional combination during kharif (pooled data of 2014-15 & 2015-16)

Planting Geometry (B)	Nutritional Combination (C)	Variety (A)								
		30 DAS			60 DAS			90 DAS		
		HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**
S_1 (30 cm x 10 cm) (33.3 plants per m^2)	F_1 (15N:20P:20K:10S)	10.56	8.45	**9.51**	22.18	17.75	**19.97**	26.62	21.30	**23.96**
	F_2 (30N:40P:40K:20S)	10.78	9.17	**9.97**	22.64	19.25	**20.95**	27.17	23.10	**25.14**
	F_3 (45N:60P:60K:30S)	10.97	9.32	**10.15**	23.03	19.58	**21.30**	27.64	23.49	**25.57**
	Mean	**10.77**	**8.98**	**9.88**	**22.62**	**18.86**	**20.74**	**27.14**	**22.63**	**24.89**
S_2 (30 cm x 20 cm) (16.7 plants per m^2)	F_1 (15N:20P:20K:10S)	9.97	8.47	**9.22**	20.93	17.79	**19.36**	25.11	21.35	**23.23**
	F_2 (30N:40P:40K:20S)	11.28	9.59	**10.44**	23.70	20.14	**21.92**	28.44	24.17	**26.30**
	F_3 (45N:60P:60K:30S)	12.02	10.21	**11.11**	25.23	21.45	**23.34**	30.28	25.74	**28.01**
	Mean	**11.09**	**9.42**	**10.26**	**23.29**	**19.79**	**21.54**	**27.94**	**23.75**	**25.85**
S_3 (40 cm x 10 cm) (25 plants per m^2)	F_1 (15N:20P:20K:10S)	9.72	8.26	**8.99**	20.79	17.67	**19.23**	24.50	20.82	**22.66**
	F_2 (30N:40P:40K:20S)	11.11	9.44	**10.28**	23.77	20.20	**21.98**	28.00	23.80	**25.90**
	F_3 (45N:60P:60K:30S)	11.21	9.53	**10.37**	23.98	20.39	**22.18**	28.25	24.02	**26.14**
	Mean	**10.68**	**9.08**	**9.88**	**22.85**	**19.42**	**21.13**	**26.92**	**22.88**	**24.90**
For Comparing varieties (A) and Nutritional combinations (C)										
F_1 (15N:20P:20K:10S)		10.08	8.40	**9.24**	21.30	17.74	**19.52**	25.41	21.16	**23.28**
F_2 (30N:40P:40K:20S)		11.06	9.40	**10.23**	23.37	19.86	**21.62**	27.87	23.69	**25.78**
F_3 (45N:60P:60K:30S)		11.40	9.69	**10.54**	24.08	20.47	**22.28**	28.72	24.42	**26.57**
Mean		**10.85**	**9.16**	**10.00**	**22.92**	**19.36**	**21.14**	**27.33**	**23.09**	**25.21**

Factor	**S Em±**	**CD**	**S Em±**	**CD**	**S Em±**	**CD**
Variety (A)	**0.24**	**0.69**	**0.50**	**1.46**	**0.60**	**1.74**
Ptg. Geom. (B)	**0.04**	**0.13**	**0.08**	**0.23**	**0.11**	**0.32**
Nutril. Combn.(C)	**0.14**	**0.39**	**0.29**	**0.83**	**0.34**	**0.99**
A x B	-	**NS**	-	**NS**	-	**NS**
B x C	**0.17**	**0.49**	**0.35**	**1.01**	**0.43**	**1.25**
A x C	-	**NS**	-	**NS**	-	**NS**
A x B x C	-	**NS**	-	**NS**	**1.00**	**2.90**

CD: CD at 5% level of significance DAS: Days after sowing

Table 4: Dry Weight (g) of whole plant as influenced by variety, planting geometry and nutritional combination during *rabi* (pooled data of 2014-15 & 2015-16)

Planting Geometry(B)	Nutritional Combination (C)	Variety (A)								
		30 DAS			60 DAS			90 DAS		
		HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**	HG 365	HG 563	**Mean**
S_1 (30 cm x 10 cm) (33.3 plants per m^2)	F_1 (15N:20P:20K:10S)	10.02	8.02	**9.03**	21.05	16.85	**18.96**	23.80	20.95	**22.38**
	F_2 (30N:40P:40K:20S)	10.23	8.70	**9.46**	21.49	18.27	**19.89**	26.19	23.05	**24.62**
	F_3 (45N:60P:60K:30S)	10.41	8.85	**9.63**	21.86	18.59	**20.22**	26.92	23.69	**25.30**
	Mean	**10.22**	**8.52**	**9.38**	**21.47**	**17.90**	**19.69**	**25.64**	**22.56**	**24.10**
S_2 (30 cm x 20 cm) (16.7 plants per m^2)	F_1 (15N:20P:20K:10S)	9.46	8.04	**8.75**	19.87	16.89	**18.38**	22.33	19.65	**20.99**
	F_2 (30N:40P:40K:20S)	10.71	9.10	**9.91**	22.50	19.12	**20.81**	26.68	23.48	**25.08**
	F_3 (45N:60P:60K:30S)	11.41	9.69	**10.55**	23.95	20.36	**22.15**	27.04	23.79	**25.42**
	Mean	**10.53**	**8.94**	**9.74**	**22.11**	**18.79**	**20.45**	**25.35**	**22.31**	**23.83**
S_3 (40 cm x 10 cm) (25 plants per m^2)	F_1 (15N:20P:20K:10S)	9.23	7.84	**8.53**	19.73	16.77	**18.25**	22.06	19.41	**20.73**
	F_2 (30N:40P:40K:20S)	10.55	8.96	**9.76**	22.56	19.17	**20.86**	26.87	23.65	**25.26**
	F_3 (45N:60P:60K:30S)	10.64	9.05	**9.84**	22.76	19.35	**21.05**	27.22	23.95	**25.58**
	Mean	**10.14**	**8.62**	**9.38**	**21.69**	**18.43**	**20.06**	**25.38**	**22.34**	**23.86**
For Comparing varieties (A) and Nutritional combinations (C)										
F_1 (15N:20P:20K:10S)		9.57	7.97	**8.77**	20.22	16.84	**18.53**	22.73	20.00	**21.37**
F_2 (30N:40P:40K:20S)		10.50	8.92	**9.71**	22.18	18.85	**20.52**	26.58	23.39	**24.99**
F_3 (45N:60P:60K:30S)		10.82	9.20	**10.00**	22.86	19.43	**21.15**	27.06	23.81	**25.43**
Mean		**10.30**	**8.69**	**9.49**	**21.76**	**18.38**	**20.07**	**25.46**	**22.40**	**23.93**

Factor	**S Em±**	**CD**	**S Em±**	**CD**	**S Em±**	**CD**
Variety (A)	-	**NS**	**0.47**	**1.39**	**0.43**	**1.25**
Ptg. Geom. (B)	-	**NS**	**0.08**	**0.22**	**0.09**	**0.25**
Nutril. Combn.(C)	-	**NS**	**0.28**	**0.79**	**0.45**	**1.29**
A x B	-	**NS**	-	**NS**	-	**NS**
B x C	-	**NS**	**0.33**	**0.96**	**0.45**	**1.31**
A x C	-	**NS**	-	**NS**	**0.83**	**2.42**
A x B x C	-	**NS**	-	**NS**	**0.86**	**2.50**

CD: CD at 5% level of significance DAS: Days after sowing

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