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EFFECT OF SPACING AND NUTREINT LEVELS ON THE QUALITY AND YIELD OF FODDER RICE BEAN- [*VIGNA UMBELLATA* (THUNB.)].

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SUMMARY

A field experiment was conducted at College of Agriculture, Vellayani, Trivandrum to standardize the spacing and nutrient levels of fodder rice bean [*Vigna umbellata* (Thunb.)]. The treatments consisted of three spacings (S_1 - 30 cm x 10 cm, S_2 - 30 cm x 20 cm and S_3 - 30 cm x 30 cm), three levels of nitrogen (N_0 - 0 kg/ha, N_1 - 20 kg/ha and N_2 - 30 kg/ha) and three levels of phosphorous (P_0 - 0 kg P_2O_5/ha, P_1 - 20 kg P_2O_5/ha and P_2 - 40 kg P_2O_5/ha). The highest protein content was observed when the lowest spacing 30 cm x 10 cm (S_1) when the highest dose nitrogen was applied 30 kg/ha (N_2). The lowest CF (16.43 %) was observed at $S_2 N_0 P_1$. Spacing and N levels had significant impact on green fodder yield (GFY) and dry fodder yield (DFY). The highest GFY and DFY were produced at spacing of 30 cm x 10 cm (s_1) and at N_2 (30 kg N/ha) (while remaining at par with N_1). The treatment $S_1 N_2 P_1$ (30 cm x 10 cm spacing + 30 kg N/ha+20 kg P_2O_5/ha) recorded the highest GFY (17.29 t/ha) and DFY (3.46 t/ha).

Key words : Fodder rice bean, Spacing, Nutrient levels, Crude protein, Crude Fibre, Green fodder yield Dry fodder yield

Rice bean [*Vigna umbellata* (Thunb.)] is a legume crop which belongs to the family Fabaceae. It is a neglected crop and is used for different purposes such as food, fodder, animal feed, green manure, cover crop and to maintain the soil fertility. Rice bean was found best adapted to drought prone sloppy areas, preferably in marginal lands and red soil, which is moderate in fertility status (Khadka and Acharya, 2009). The approximate bio-chemical analysis of fodder at flowering stage reveals 24% dry matter, 15% crude protein, 32% crude fibre, 1 per cent fat, 42% N-free extract, 11% ash, 1.2% calcium and 0.4% phosphorus. It has been observed that fodder rice bean has all the nutritive values similar to fodder cowpea which is the most common fodder legume of Kerala.

Spacing levels are found to affect the growth and yield attributes of several fodder crops. Patidar (2003) reported that crude protein contents in seeds and straw of fodder cowpea were not affected due to different row spacings but crude protein yields were higher with 60 cm row spacing.

The spreading and non-spreading types of fodder cowpea yield less grain and more fodder when planted in closer spaced rows and more grain and less fodder when grown in wider spacing. The increasing trend in green forage yield of fodder cowpea in response to increasing level of nitrogen fertilization was observed by Sultana *et al*. (2005). Balai *et al*. (2017) concluded that increase in phosphorus level caused significant increase in green and dry forage yields of cowpea upto 40 kg P_2O_5/ha. In India rice bean is one of the most popular fodder legumes and can be raised as a pure crop or as intercrop with cereals and grass fodder. Since the growth and yield of this crop is found to be good under Kerala conditions, this crop may be recommended as a fodder legume for cultivation in the state and thus this study was proposed with an objective to standardise the spacing and nutrient levels for fodder rice bean.

MATERIALS AND METHODS

The experiment was conducted at College of Agriculture, Vellayani, Kerala during *Kharif*, 2017 in Randomised Block Design with three replications. The soil of the experimental site was red sandy loam, acidic in nature and soil EC in safe range. The soil had high organic carbon content, low available N, high available P and medium K content. The treatments consisted of three spacings (S_1 : 30 cm x 10 cm, S_2 : 30 cm x 20 cm and S_3 : 30 cm x 30 cm), three levels of nitrogen (N_0 - 0 kg/ha, N_1 - 20 kg/ha and N_2 - 30 kg/ha) and three levels of phosphorous (P_0 - 0 kg P_2O_5/ha, P_1 - 20 kg P_2O_5/ha and P_2 - 40 kg P_2O_5/ha) . FYM @ 5 t/ha and

K_2O @ 30 kg/ha were applied uniformly to all treatments as basal. There were 27 treatment combinations. The observation were recorded on green fodder yield (t/ha), dry fodder yield (t/ha) crude protein (%) and crude fibre (%).

RESULTS AND DISCUSSION

Crude protein content

Spacing levels could not significantly influence the crude protein content in fodder rice bean while nitrogen and phosphorus levels had significant impact on crude protein content. Among the various spacing levels, the lowest spacing 30 cm x 10 cm (S_1) resulted in higher crude protein content, though it was non-insignificant. When the nitrogen levels alone were considered, the highest protein content (18.15%) was observed when the nitrogen was applied @ 30 kg/ha. Iqbal *et al.* (1998) found that protein contents increased with successive increase in N fertilizer application in fodder rice bean. In case of phosphorus levels, the highest crude protein (17.69 %) was observed at 40 kg P_2O_5/ha and was on par with 20 kg P_2O_5/ha. Kumar *et al.* (2016) and Iqbal *et al.* (1998) reported similar results in fodder rice bean. Among the two factor interactions, the highest crude protein (19.44%) was found in S_1 N_2 and was on par with S_2 N_2 (18.28%) and S_3N_1 (18.28%). This can be accounted to the fact that nitrogen enhanced the protein synthesis in plants. With respect to spacing × phosphorus interaction, the highest crude protein (19.25%) was observed in S_3P_0 and was on par with S_1 P_2 (18.86 %). The S x N x P interactions were not having significant influence on crude protein content. This might be due to the sufficient availability of nutrients in the plots even though the inter plant competition was severe.

TABLE 1
Effect of spacing, nitrogen and phosphorus levels on crude protein (CP), crude fibre (CF), green fodder yield (GFY) and dry fodder yield (DFY)

Treatments	CP (%)	CF (%)	GFY (t/ha)	DFY (t/ha)
S_1-30 cm x 10 cm	17.69	21.18	12.95	2.59
S_2-30 cm x 20 cm	16.72	24.85	12.26	2.45
S_3-30 cm x 30 cm	17.56	26.09	11.35	2.27
S. Em±	0.43	0.57	0.63	0.13
C. D. (P=0.05)	NS	1.15	1.27	0.26
N_0-0 kg/ha	16.79	19.61	11.37	2.27
N_1-20 kg/ha	17.05	25.33	12.52	2.50
N_2-30 kg/ha	18.15	27.18	13.66	2.73
S. Em±	0.43	0.57	0.63	0.13
C. D. (P=0.05)	0.87	1.15	1.27	0.25
P_0-0 kg/ha	16.66	22.73	12.32	2.46
P_1-20 kg/ha	17.63	23.55	12.75	2.55
P_2-40 kg/ha	17.69	25.85	12.49	2.50
S. Em±	0.43	0.57	0.63	0.13
C. D. (P=0.05)	0.87	1.15	NS	NS

TABLE 2
Effect of SxN, SxP and NxP interaction on crude protein (CP), crude fibre (CF), green fodder yield (GFY) and dry fodder yield (DFY).

Treatments	CP (%)	CF (%)	GFY (t/ha)	DFY (t/ha)
Spacing × Nitrogen				
S_1 N_0	16.72	19.53	10.80	2.16
S_1 N_1	16.92	22.64	13.46	2.69
S_1 N_2	19.44	21.38	14.57	2.91
S_2 N_0	15.94	18.31	10.55	2.11
S_2 N_1	15.94	25.60	11.83	2.37
S_2 N_2	18.28	28.50	14.40	2.88
S_3 N_0	17.69	20.99	12.77	2.55
S_3 N_1	18.28	27.76	12.26	2.45
S_3 N_2	16.72	28.20	12.00	2.40
S. Em±	0.75	0.99	1.10	0.22
CD	1.52	1.98	2.21	0.44
Spacing × Phosphorus				
S_1 P_0	17.50	20.22	12.43	2.49
S_1 P_1	16.72	20.69	13.63	2.73
S_1 P_2	18.86	22.64	12.77	2.55
S_2 P_0	15.75	23.38	11.75	2.35
S_2 P_1	16.92	23.89	13.03	2.61
S_2 P_2	17.50	27.29	12.00	2.40
S_3 P_0	16.72	24.58	12.77	2.55
S_3 P_1	19.25	26.06	11.57	2.31
S_3 P_2	16.72	27.63	12.69	2.54
S. Em±	0.75	0.99	1.10	0.22
CD	1.52	NS	NS	NS
Nitrogen × Phosphorus				
N_0 P_0	16.14	18.49	12.86	2.57
N_0 P_1	17.69	18.43	14.83	2.97
N_0 P_2	16.53	21.91	13.29	2.66
N_1 P_0	16.33	24.87	12.43	2.49
N_1 P_1	17.11	25.29	13.20	2.64
N_1 P_2	17.69	25.84	11.92	2.38
N_2 P_0	17.50	24.82	11.66	2.33
N_2 P_1	18.08	26.93	10.20	2.04
N_2 P_2	18.86	28.81	12.26	2.45
S. Em±	0.75	0.99	1.10	0.22
CD	NS	1.98	NS	NS

Crude fibre content

Among the spacing levels, the lowest crude fibre of 21.18 % was observed at S_1 30 cm x 10 cm spacing. As the spacing increased, the crude fibre content also increased. With respect to the nitrogen levels, crude fibre was significantly influenced with increment in nitrogen application. Within the nitrogen levels, the lowest crude fibre content was at N_0 0 kg N/ha). Katoch (2010) reported that crude fibre increased significantly in the fodder rice bean genotypes with increasing rates of N. Among the different phosphorus levels, the lowest crude fibre content was observed at P_0 0 kg P_2O_5/ha) and was on par with P_1 (23.55%). Similar results were also reported by Jha *et al.* (2014) and Bhavya *et al.* (2014) in fodder cowpea.

Among the two factor interactions, spacing × nitrogen and nitrogen × phosphorous interaction had significant effect on crude fibre content. The lowest value of crude fibre was obtained in the combination S_2N_0 (18.31%) followed by S_1N_0 (19.53 %) and might be due to closer spacing resulted taller and thinner stems with less fibrous nature. The lowest value of the crude fibre was in the treatment N_0 P_1 (18. 43%) and was on par with N_0 P_0 (18.49%). This might be due to that minimum nutrients applied in both cases. Among S x N x P interactions, lowest crude fibre was obtained in treatment S_2 N_0 P_1 (16. 43 %) and was on par with S_1 N_0 P_0. This can be attributed to the minimum quantity of fertilizers applied.

Green and dry fodder yield

Spacing of 30 cm x 10 cm (S_1) recorded the highest GFY (12. 95 t/ha) and was on par with S_2 (12.26 t/ha). These results are in agreement with the findings of Prasad *et al*. (1994) who reported that yield of rice bean decreased with increased spacing. Among the nitrogen levels, highest GFY (13.66 t/ha) and DFY (2.731 t/ha) was recorded at N_2 (30 kg N/ha) and was found to be on par with N_1 (20 kg N/ha) which produced GFY of 12.52 t/ha and DFY of 2.50 t/ha. The increase in yield with N fertilization might be due to the improved supply of photosynthates and also better uptake of nutrients. It was found that P levels had no significant impact on GFY and DFY. Among the two factor interactions, spacing × nitrogen interaction alone had significant impact on GFY and DFY. The highest GFY was recorded at S_1N_2 (14.57 t/ha) and was found to be on par with S_1N_1 (13.46 t/ha), S_2N_2 (14.40 t/ha) and S_3N_0 (12.77 t/ha).

TABLE 3

Effect of SxNxP interaction on crude protein (CP), crude fibre (CF), green fodder yield (GFY) and dry fodder yield (DFY).

Treatments	CP (%)	CF (%)	GFY (t/ha)	DFY (t/ha)
S_1 N_0 P_0	16.40	16.75	9.67	1.93
S_1 N_0 P_1	15.69	19.63	10.43	2.09
S_1 N_0 P_2	18.08	22.22	12.30	2.46
S_1 N_1 P_0	16.69	25.24	13.62	2.72
S_1 N_1 P_1	16.72	21.01	13.17	2.63
S_1 N_1 P_2	17.34	21.66	13.59	2.72
S_1 N_2 P_0	19.41	18.67	14.00	2.80
S_1 N_2 P_1	17.76	21.43	17.29	3.46
S_1 N_2 P_2	21.16	24.04	12.43	2.49
S_2 N_0 P_0	15.04	19.49	11.37	2.27
S_2 N_0 P_1	17.66	16.43	10.42	2.08
S_2 N_0 P_2	15.13	19.01	9.84	1.97
S_2 N_1 P_0	14.29	22.27	10.69	2.14
S_2 N_1 P_1	14.94	25.73	14.23	2.85
S_2 N_1 P_2	18.60	28.79	10.57	2.11
S_2 N_2 P_0	17.92	28.37	13.17	2.63
S_2 N_2 P_1	18.15	28.52	14.45	2.89
S_2 N_2 P_2	18.76	28.80	14.59	2.91
S_3 N_0 P_0	16.98	19.24	12.93	2.59
S_3 N_0 P_1	19.74	19.23	9.76	1.95
S_3 N_0 P_2	16.37	24.49	12.63	2.52
S_3 N_1 P_0	18.02	27.10	11.99	2.40
S_3 N_1 P_1	19.67	28.12	11.20	2.24
S_3 N_1 P_2	17.14	27.07	11.59	2.32
S_3 N_2 P_0	15.17	27.41	11.41	2.28
S_3 N_2 P_1	18.34	27.83	12.79	2.55
S_3 N_2 P_2	16.66	28.79	11.85	2.37
S/ Em±	1.30	1.71	1.25	0.21
CD	NS	3.44	2.5	0.42

Similarly, the highest DFY was recorded at S_1N_2 (2.91 t/ha) and was found to be on par with S_2N_2 (2.88 t/ha), S_1N_1 (2.69 t/ha) and S_3N_0 (2.55 t/ha). This might be because of the presence of more number of plants in the least spacing adopted and the increased vegetative growth due to higher N application. The S x N x P interaction, $s_1n_2p_1$ recorded higher GFY (17.29 t/ha) and DFY (3.46 t/ha) which might be due to the closer spacing adopted and higher N applied.

CONCLUSION

The crude protein content was found to be under the normal range though not influenced by the treatment combinations. Meanwhile, the lowest crude fibre was observed when spacing of 30 cm x 20 cm was adopted and nutrients were not applied to the crop.

Higher yields in fodder rice bean can be obtained when cultivated at a spacing of 30 cm x 10 cm with application of 30 kg N/ha in two splits at 15 and 30 DAS and basal application of 20 kg P_2O_5/ha, 5 t/ha of FYM and 30 kg K_2O/ha.

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