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EFFECT OF SPACING AND FERTILIZER LEVELS ON GROWTH, FODDER YIELD AND SEED YIELD OF VELVET BEAN

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SUMMARY

A field experiment was conducted at vegetables and tuber farm, Dharwad in the year 2017 using factorial RBD to evaluate the influence of three different spacings *i.e.,* 60 cm × 45 cm, 75 cm × 45 cm and 90 cm × 45 cm and three fertilizer levels (100:80:40, 125:100:50 and 150:120:60 kg NPK/ha) on growth, fodder yield and seed yield attributes of velvet bean. The results revealed that, except yield, all the parameters including growth components were non-significantly (P>0.05) influenced from interactions of various levels of spacings and fertilizer levels. However, significantly more pods per plant (29) and seed yield per plant (130.87 g) were recorded at a spacing of 90 cm × 45 cm with 150:120:60 kg NPK per ha. Similarly, significantly higher seed yield (39.66 q/ha), green fodder yield (35.32 t/ha) and dry fodder yield (11.77 t/ha) were recorded in 60 cm × 45 cm spacing with 150:120:60 kg NPK per ha.

Key words : Spacing, fertilizer, Velvet bean, growth, Seed yield

The genus *Mucuna*, belongs to the family leguminosae, sub family Papilionaceae, includes approximately 150 species of annual and perennial legumes. Among the various under-utilized wild legumes, Velvet bean (*Mucuna pruriens)* is widespread in tropical and sub-tropical regions of the world. The cultivated *Mucuna* spp. found in the tropics probably result from fragmentation deriving from the Asian cultigen. *Mucuna* spp. has been reported to contain the toxic compounds L-dopa and hallucinogenic tryptamines and anti-nutritional factors such as phenols and tannins. Due to the high concentrations of L-dopa (4–7 %), velvet bean is a commercial source of this substance, used in the treatment of Parkinson's disease.

For obtaining higher seed yield and quality, suitable planting distance is necessary for enhancing metabolic activities of the plant which intern influence the plant growth. The effect of plant density on growth and seed yield could vary due to varietal characters and growing seasons in the same geographical area. Thus the relationship of seed yield with different growth parameters and yield components under variable planting density is very important to understand the basic mechanism of yield with plant density relationship and this would also help in optimizing plant density per unit area for improving seed yield of velvet bean. The growth, yield and quality of the seed crop are largely influenced by the nutrient fertility status of soil apart from genetic potential of the crop. Plant nutrition play an important role in increasing the seed yield. Balanced and optimum use of nitrogen, phosphorus and potassium fertilizers play a vital role in increasing the yields of legumes. Though the yield potential of present varieties is high enough, but it has not been explored fully due to some production constraints. Among the limiting factors; proper level and ratio of nitrogen, phosphorus and potassium are of prime importance. Hence, an experiment was conducted to know the effect of spacing and fertilizer levels on growth, fodder yield and seed yield of velvet bean.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* season 2017 at Vegetables and Tuber Farm, Dharwad to find out the effect of spacings and fertilizer levels on crop growth, fodder yield and seed yield of velvet bean and it was laid out in RBD with factorial concept with three replications. There were nine treatment combinations consisting of three spacings *viz.,* 60 cm × 45 cm (S_1), 75 cm × 45 cm (S_2) and 90 cm × 45 cm (S_3) and three fertilizer levels *viz.,* F_1-

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100:80:40, F_2-125:100:50 and F_3-150:120:60 kg NPK per ha, respectively. The required quantities of seeds for each treatments were sown. During sowing, the pre calculated quantities of fertilizer dose in the form of Urea, Diammonium phosphate and Muriate of potash were applied to each of the experimental plots. All the recommended package of practices were followed timely during crop growth period. Five healthy and normal plants were selected randomly and tagged with a label in each plots as per treatment schedule for recording various observations on growth and seed yield parameters like plant height, number of branches per plant at harvest, days to flower initiation, days to 50 per cent flowering, pod length, number of pods per plant, seed yield, green fodder yield and dry fodder yield and data were statistically analysed (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

The present investigation has revealed the consistent and significant variations for growth parameters like plant height, number of branches at harvest due to spacings over fertilizer levels (Table 1). At harvest, plant height was significantly maximum (208.44 cm) in narrow spacing of 60 cm × 45 cm (S_1) than in medium S_2 (75 cm × 45 cm) (202.42 cm) and wider spacing of 90 cm × 45 cm (S_3) (197.33 cm). The increase in plant height was due to inter-plant competition which resulted in taller plants and were sparsely branched. Mureithi *et al*. (2012) opined that when the plants are sown closely together, their stems are shaded from light resulting in accumulation of auxin which is a major growth hormone that stimulates cell division and enlargement. In sparsely spaced plants, auxin destruction by light occurs resulting in plants being shorter. On the other hand, number of branches per plant at harvest were significantly more (6.04) in the wider spacing (S_3) than in medium (S_2) (5.89) and closer spacing (S_1) (5.58). Lower plant population of 24,691 plants per ha had the highest number of branches per plant than

TABLE 1

Effect of spacings, fertilizer levels and their interactions on plant height, number of branches, days to flower initiation, days to 50% flowering and pod length of velvet bean

Treatments	Plant height (cm)	Number of branches	Days to flower initiation	Days to 50% flowering	Pod length (cm)
Spacings (cm)					
S_1 : 60 cm x 45 cm	208.44	5.58	46.36	56.96	8.53
S_2 : 75 cm x 45 cm	202.42	5.89	46.33	57.28	8.94
S_3: 90 cm x 45 cm	197.33	6.04	46.64	57.42	9.41
S.Em. ±	1.05	0.05	0.15	0.20	0.21
C.D. @ 5 %	3.15	0.16	NS*	NS	0.62
Fertilizer (kg NPK/ha)					
F_1: 100:80:40 kg	197.83	5.67	45.02	55.61	8.51
F_2: 125:100:50 kg	202.22	5.71	46.38	57.03	8.91
F_3:150:120:60 kg	208.14	6.13	47.93	59.01	9.47
S.Em. ±	1.05	0.05	0.15	0.20	0.21
C.D. @ 5 %	3.15	0.16	0.44	0.59	0.62
Interaction (S × F)					
S_1F_1	205.83	5.40	45.00	55.57	8.00
S_1F_2	206.50	5.47	46.33	56.83	8.73
S_1F_3	213.00	5.87	47.73	58.47	8.87
S_2F_1	197.00	5.67	44.60	55.30	8.47
S_2F_2	203.43	5.73	46.33	56.97	8.67
S_2F_3	206.83	6.27	48.07	59.57	9.70
S_3F_1	190.67	5.93	45.47	55.97	9.07
S_3F_2	196.73	5.93	46.47	57.30	9.33
S_3F_3	204.60	6.27	48.00	59.00	9.83
S.Em. ±	1.82	0.09	0.25	0.34	0.36
C.D. @ 5 %	NS	NS	NS	NS	NS

*NS- Non significant.

higher population density of 37,037 plants per ha. At lower density, the interplant competition seemed to be little, thus plants utilized the available resources with little competition (Bakry *et al.*, 2011). Dhanjal *et al.* (2001) and Mozumder *et al.* (2003) in french bean reported increased growth rate in sparsely populated plants to less competition for space, nutrients, moisture and light due to better growth of plants in broader spacing which lead to more vegetative growth.

The effect of spacings was found to be non-significant for reproductive parameters like days to flower initiation and 50 per cent flowering. In general, wider spacing (S_3) recorded consistently higher values for reproductive parameters (46.64 and 57.42 days, respectively) over medium (S_2) and narrow spacing (S_1) irrespective of fertilizer levels used and it might be related to better vegetative growth, plant canopy area and efficient photosynthetic activities which might have enhanced the reproductive phase in the wider spacing unlike narrow spacing. These results are in agreement with the findings of Mazumder *et al.* (2007) in hyacinth bean.

Irrespective of fertilizer levels, a marked and consistent variation due to spacings was observed for seed yield and its components. On an average, higher pod length (9.41 cm), number of pods (27), seed yield (125.69 g) per plant were seen in the plants at wider spacing (90 cm × 45 cm) (S_3) than those at medium (75 cm × 45 cm) (S_2) and closer spacing (60 cm × 45 cm) (S_1). This might be due to optimum vegetative and reproductive growth of plants at 90 cm × 45 cm spacing which was reflected in terms of more number of inflorescence per plant, flowers per inflorescence, weight of seeds and pods per plant. Lesser plant population utilizing broader space led to more number of branches per plant and subsequently more pods and seed. Significantly higher seed yield and its components noticed in the wider spacing may be attributed to the less plant population density resulting into better growth of plants which has enhanced the source to sink relationship compared to narrow spacing. On the contrary, significantly more seed yield (38.28 q) per ha, green fodder yield (33.31 t/ha) and dry fodder yield (11.1 t/ha) were obtained in the closer spacing (S_1) over wider spacing (S_3). It was due to more plant population density (37,037 plants/ha) in closer spacing as against 75 cm × 45 cm (29,629 plants/ha) and 90 cm × 45 cm (24,691 plants/ha) spacings. Shrikanth *et al.* (2008) obtained similar results in lablab bean. He reported that higher plant population gives more seed yield per hectare.

In the present study, all the growth and reproductive parameters varied markedly due to the fertilizer levels irrespective of spacings. Higher plant height (208.14), number of branches (6.13) at harvest, days to flower initiation (47.93) and 50 per cent flowering (59.01) were significantly maximum in a fertilizer level of 150:120:60 kg NPK per ha (F_3) followed by F_2 and F_1. This might be due to high fertilizer level resulted in greater availability and greater uptake of nutrients which might have enhanced the growth by more cell division, cell elongation and synthesis of proteins. Therefore, the plant height and number of branches might have increased. These results are in agreement with Shrikanth (2008) in lablab bean. Flowering parameters also varied significantly due to the fertilizer levels as against spacings. Days to flower initiation and days to 50 per cent flowering were significantly more (47.93 and 59.01) in higher fertilizer dose *i.e.* 150:120:60 kg NPK per ha as compared to medium and low fertilizer doses. Increase in days to flower initiation and 50 per cent flowering might be due to increased nitrogen levels which might inturn resulted in more vegetative growth and delayed the reproductive phase. Less number of days for flower initiation and 50 per cent flowering (45.02 and 55.61 days) were recorded in F_1 (100:80:40 kg NPK per ha) was might be due to less nitrogen level lead to less vegetative growth and early flowering. Similar results were also obtained by Kadre and Kalalbandi (2014) in peas.

The yield attributing characters like higher pod length (9.47 cm), pods per plant (25.59), seed yield per plant (121.08 g), seed yield per ha (36.59 q) and green fodder yield (30.5 t/ha) and dry fodder yield (10.17 t/ha) were significantly highest in 150:120:60 kg NPK per ha. Lowest value of all the yield parameters were found with 100:80:40 kg NPK per ha. Higher dose of fertilizer might have improved the nutrient availability and uptake of nutrients to the crop resulting in better source to sink relation. These results are also in agreement with findings of Kumar *et al.* (2013) in mung bean. Similarly the green fodder yield and dry fodder yield was maximum (35.5 and 11.33 t/ha) in 150:120:60 kg NPK per ha. Grewal *et al* (2000) and Naagar and Meena (2004) reported that significant increase in fodder yield was observed at higher fertilizer dose in cluster bean.

All the growth and reproductive parameters under the study did not differ significantly due to the interaction between spacing and fertilizer (S × F) levels. However, plant height at harvest was

TABLE 2
Effect of spacings, fertilizer levels and their interactions on pods/plant, seed yield/plant, seed yield /ha, green fodder yield (t/ha) and dry fodder yield (t/ha) of velvet bean

Treatments	No. of pods/plant	Seed yield (g/plant)	Seed yield/ (q/ha)	Green fodder yield (t/ha)	Dry fodder yield (t/ha)
Spacings (cm)					
S_1 : 60 cm x 45 cm	20.45	102.83	38.28	33.31	11.10
S_2 : 75 cm x 45 cm	25.67	116.42	34.77	28.14	9.38
S_3 : 90 cm x 45 cm	27.00	125.69	31.25	24.73	8.24
S.Em. ±	0.26	0.84	0.27	0.26	0.09
C.D. @ 5 %	0.79	2.51	0.80	0.79	0.26
Fertilizer (kg NPK/ha)					
F_1 : 100:80:40 kg	22.98	109.71	32.98	26.78	8.93
F_2 : 125:100:50 kg	24.54	114.15	34.73	28.91	9.64
F_3 :150:120:60 kg	25.59	121.08	36.59	30.50	10.17
S.Em. ±	0.26	0.84	0.27	0.26	0.09
C.D. @ 5 %	0.79	2.51	0.80	0.79	0.26
Interaction (S × F)					
S_1F_1	19.95	98.03	36.50	31.27	10.42
S_1F_2	20.30	103.39	38.69	33.32	11.11
S_1F_3	21.10	107.08	39.66	35.32	11.77
S_2F_1	24.00	109.13	32.33	27.06	9.02
S_2F_2	26.33	114.83	34.40	28.33	9.44
S_2F_3	26.67	125.29	37.57	29.03	9.68
S_3F_1	25.00	121.97	30.12	22.00	7.33
S_3F_2	27.00	124.22	31.09	25.06	8.35
S_3F_3	29.00	130.87	32.54	27.13	9.04
S.Em. ±	0.46	1.45	0.46	0.45	0.15
C.D. @ 5 %	1.37	4.34	1.38	31.27	0.45

numerically more in treatment combination of 60 cm × 45 cm spacing and 150:120:60 kg NPK per ha level ($S_1 \times F_3$). Whereas, numerically higher number of branches per plant, days to flower initiation, days to 50 per cent flowering, were noticed in $S_3 \times F_3$ treatment combination.

Significantly higher number of pods per plant (29), seed yield per plant (130.87 g), seed yield per ha (39.66 q/ha) were maximum in S_3F_3 treatment combination. This was due to better growth of plants in the broader spacing which lead to more branches and flowers and there was less competition between the plants for nutrients, moisture and light, resulting in more number of branches, pods and bolder seeds. Seed yield per ha (39.66 t/ha), green fodder yield (35.32 t/ha) and dry fodder yield (11.77 t/ha) was maximum in S_1F_3 treatment. This was mainly due to more plant population density (37037 plants/ha) and greater supply of nutrients (150:120:60 kg NPK per ha) as against medium and low fertilizer levels. These results are in conformity with Shrikanth *et al.* (2008) in lablab bean and Harsha *et al.* (2017) in long bean.

CONCLUSIONS

The interaction of spacing and fertilizer levels (S × F) on plant height, number of branches, days to flower initiation and 50 per cent flowering were found to be non significant. With increase in spacing and fertilizer doses, S_3F_3 (90 cm × 45 cm and 150:120:60 kg NPK per ha) treatment combination recorded significant increase in number of pods (29) and seed yield per plant (130.87 g) whereas seed yield (39.6 q/ha), green fodder yield (35.32 t/ha) and dry fodder yield (11.77 t/ha) were maximum at 60 cm × 45 cm spacing with a fertilizer dose of 150:120:60 kg NPK per ha.

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