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# Productivity, Grain Protein and Economics of Moth bean Genotypes as Influenced by Spacing and Organics under Dry land Areas

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## ABSTRACT

*A field experiment was conducted to study the productivity, grain protein and economics of moth bean [Vigna aconitifolia (Jacq.) Marechel] genotypes as influenced by spacing and organics under dry land areas during kharif 2013 in Northern dry zone of Karnataka. The moth bean local variety at spacing of 45 cm x 10 cm with application of 2.5 t FYM per ha produced significantly higher pods per plant (78.73), total dry matter at harvest (95.74 g plant$^{-1}$), branches per plant (8.73), higher seed yield (983 kg ha$^{-1}$), haulm yield (4886 kg ha$^{-1}$), net returns (Rs.42425 ha$^{-1}$) and benefit cost ratio (4.01) compared to other interactions. Higher nitrogen and protein content (3.90 and 24.41 %, respectively) was obtained with genotype MBS-27 at 45 cm x 10 cm spacing with application of 2.5 t FYM per ha. It can be concluded from the study that for dry land areas, moth bean local variety can be recommended at the spacing of 45 cm x 10 cm with 2.5 t FYM per ha application for higher yield, productivity and economic returns.*

***Key words:*** *Moth bean, organics, spacing, productivity, grain protein and economics*

## INTRODUCTION

Moth bean [*Vigna aconitifolia* (Jacq.) Marechel] is an important pulse crop of arid and semi-arid regions of India. It has multi-uses and adapts to extremes or uncongenial ecological niches particularly, in areas receiving fewer rains with erratic distribution. In India, crop is extensively grown in Rajasthan mainly as a mixed crop with cotton, sorghum and other pulses. It is generally consumed as a rich source of protein and is mostly consumed by low-income consumers in rural areas. In India, it is grown on an area of 13.19 lakh ha, mostly confined to Rajasthan, Uttar Pradesh, Haryana, Punjab, Madhya Pradesh, Gujarat, Maharashtra and Karnataka with a production of 1,753 lakh t and productivity of 133 kg per ha[14]. It is a hot weather, drought resistant legume.

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The densely matted branches, which grow horizontally and have deeply notched leaflets on long leaf branches. It thus helps greatly in the conservation of soil, water and serve as a very efficient and suitable cover crop for checking soil erosion. The lower productivity of this crop is attributed to several factors *viz.*, growing the crop under moisture stress, marginal lands with very low inputs and without pest and disease management, non-availability of high yielding varieties and late sowing. Choosing the proper genotypes, optimum plant population and organic source are the major factors for better yield. Hence, there is a scope for improving the production potential of this crop by adopting the improved varieties, optimum plant population and use of organic manures *viz.*, farm yard manure, vermi compost and poultry manure. Keeping these points in view, the study was conducted with the following objectives.

1. To study the interaction effect of moth bean genotypes, spacing and organics for productivity and grain quality.
2. To study the economics of the system.

## MATERIALS AND METHODS

The field experiment was conducted at College of Agriculture, Vijayapura in Northern dry zone of Karnataka (at latitude $16^0$ $49^1$ N, longitude $75^0$ $43^1$ E and altitude of 593 m above MSL) during *kharif* 2013. It was laid out in Randomised Complete Block Design with factorial concept and replicated thrice. There were 14 treatments including 12 treatment combinations involving three moth bean genotypes (MBS-27, BJMB-1 and local), two spacing (30 cm x 10 cm and 45 cm x 10 cm) and two organics (2.5 t $ha^{-1}$ FYM and 1 t $ha^{-1}$ vermi compost) along with two controls (local variety at 30 cm x 10 cm spacing with 10:20 kg $N:P_2O_5$ $ha^{-1}$ and local variety at 30 cm x 10 cm spacing with 10:20:10 kg $N:P_2O_5:K_2O$ $ha^{-1}$). The soil of the experimental site was medium black clay loam having normal pH of 8.45 recorded by using Buckman's pH meter[13] and EC of 0.18 $dSm^{-1}$ estimated by using conductivity bridge[8] and was low in available nitrogen (166 kg $ha^{-1}$) as analysed by using Alkaline permanganate method[16], medium in available phosphorus with 30 kg $ha^{-1}$ assessed through Olsen's method[15] and was high in available potassium (364 kg $ha^{-1}$) estimated by flame photometer[15]. The seed rate of 15 kg per ha was used for sowing. Organic and inorganic fertilizers were applied as per treatments at the time of sowing. The necessary after care operations were attended to keep the field free from weeds as and when required. The crude protein was estimated by multiplying the nitrogen content of seeds with factor 6.25[5]. Five plants were randomly selected from each net plot and tagged for recording growth, yield and quality parameters at regular intervals and data were subjected to the statistical analysis as described by Gomez and Gomez[6] using Dry soft ICRISAT software.

## RESULTS AND DISCUSSION

The moth bean local variety at spacing of 45 cm X 10 cm with application of 2.5 t $ha^{-1}$ FYM recorded significantly higher number of branches at harvest ($T_{11,}$ 8.73 $plant^{-1}$ , Table 1) over other interactions and control treatments but was on par with MBS-27 with 45 cm x10 cm + 1 t $ha^{-1}$ vermi compost ($T_4$ , 8.50 $plant^{-1}$). At 70 DAS, the interaction effect of leaf area index due to genotypes, spacing and organics did not differ significantly. Many studies also revealed that closer spacing may cause mutual shading, lodging and insect pest infestation due to more intra-specific competition[4,18]. Optimum plant density ensures the plant to grow properly with their aerial and underground parts by utilizing more solar radiation and soil nutrients[12]. The local variety at spacing of 45 cm X 10 cm with application of 2.5 t $ha^{-1}$ FYM recorded significantly higher number of nodules ($T_{11,}$ 10.26 $plant^{-1}$) and it was on par with $T_4$(10.06 $plant^{-1}$) and $T_2$ (9.73 $plant^{-1}$) compared to other interactions and control treatments. Control-1 (7.76 plant$^{-1}$) and Control-2 (8.20 plant$^{-1}$) treatments were on par with each other. This might be because, under higher plant population, the roots were having lesser number of nodules with smaller size having less fresh weight. Increase in the plant population might have created the competitive conditions and the plant roots couldn't proliferate in the soil profile[3]. At harvest, significantly higher total dry matter accumulation in plant was recorded with local variety at 45 cm X10 cm with 2.5 t ha$^{-1}$ FYM ($T_{11}$, 95.74 g plant$^{-1}$) and it was on par with $T_4$ (89.62 g plant$^{-1}$) and $T_3$ (87.12 g plant$^{-1}$) compared to other interactions and control treatments. However, the interaction $T_7$ recorded significantly lower total dry matter accumulation (52.34 g plant$^{-1}$). Among the control treatments, control-1 (76.36 g plant$^{-1}$) and control-2 (78.91 g plant$^{-1}$) were on par with each other. It was observed that higher dry matter accumulation under adequate plant spacing and optimum plant population per unit area resulted in good yield with more interception of solar radiation. Significantly higher number of pods was recorded with $T_{11}$ (78.73 plant$^{-1}$) and it was on par with $T_4$ (76.70 plant$^{-1}$) compared to other interactions and control treatments. Significantly lower number of pods was noticed with control-1 (71.66 plant$^{-1}$). The local variety at 45 cm X 10 cm with 2.5 t ha$^{-1}$ FYM recorded significantly higher seed yield ($T_{11}$ , 983 kg ha$^{-1}$) and it was on par with $T_4$ (946 kg ha$^{-1}$) and $T_{10}$ (846 kg ha$^{-1}$) compared to other interactions and control treatments. The interaction $T_6$ recorded significantly lower seed yield (386 kg ha$^{-1}$). The local variety at 45 cm X 10 cm with 2.5 t ha$^{-1}$ FYM recorded significantly higher haulm yield ($T_{11}$ , 4886 kg ha$^{-1}$) and it was on par with $T_4$ (4372 kg ha$^{-1}$) compared to other interactions and control treatments. Numerically higher harvest index was found with genotype MBS-27 at 30 cm X 10 cm with 1 t ha$^{-1}$ vermi compost ($T_2$, 21.76 %,) compared to other interactions and control treatments. This increase in seed yield was due to significantly higher performance of growth and yield parameters *viz.*, branches per plant (8.73), leaf area index at 70 DAS (7.17), nodules per plant (10.26), total dry matter production at harvest (95.74 g plant$^{-1}$) and pods per plant (78.73). These results are in conformity with the findings of Mohan Lal and Dhirendra Singh[11] in mung bean, Kumar[10] in moth bean, Taipodia and Nabam[17], Helmy *et al*[7]., in cowpea and Yadav *et al*[20]., in moth bean, Arun kumar and Uppar[2] and Yadav[19] in moth bean.

Crude protein and nitrogen content in seeds did not show significant difference due to genotypes, spacing and organics. However, numerically higher crude protein content was recorded in MBS-27 at 45 cm x10 cm with 2.5 t ha$^{-1}$ FYM (24.41 %, Table 2) compared to other interactions and control treatments. This increase was due to higher nitrogen content in seeds (3.90 %). These findings are in line with the results of Alam Mondal *et al*[1]., in lentil, Yadav *et al*[20]., in moth bean and Arun kumar and Uppar[2] in moth bean. Significantly higher gross returns, net returns and benefit cost ratio was obtained with the interaction of local variety at spacing of 45 cm x 10 cm with application of 2.5 t ha$^{-1}$ FYM ($T_{11}$, Rs.56495 ha$^{-1}$, Rs.42425 ha$^{-1}$ and 4.01, respectively) and it was on par with $T_4$ (Rs.53891 ha$^{-1}$, Rs.37696 ha$^{-1}$ and 3.32, respectively) compared to other interactions and control treatments. This was mainly due to significantly higher seed yield and haulm yield recorded with local variety, wider row spacing and FYM. These results are in conformity with the findings of Krishna D.K[9]. The interaction of genotype BJMB-1 at spacing of 30 cm x10 cm with application of 1 t ha$^{-1}$ vermi compost recorded significantly lower gross returns, net returns and benefit cost ratio ($T_6$, Rs. 22804 ha$^{-1}$, Rs. 07089 ha$^{-1}$ and 1.44, respectively).

**Table 1: Productivity of moth bean genotypes as influenced by spacing and organics under dry land areas**

| Treatment | Branches $plant^{-1}$ at harvest | Leaf Area Index at 70 DAS | Nodules $plant^{-1}$ at 40 DAS | Total dry matter at harvest (g $plant^{-1}$) | Pods $plant^{-1}$ | Seed yield (kg $ha^{-1}$) | Haulm yield (kg $ha^{-1}$) | Harvest Index (%) |
|---|---|---|---|---|---|---|---|---|
| $T_1$: MBS-27 with 30 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 7.96 | 6.55 | 8.96 | 47.58 | 73.90 | 530 | 3214 | 14.17 |
| $T_2$: MBS-27 with 30 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 7.80 | 7.13 | 9.73 | 63.14 | 74.56 | 823 | 2957 | 21.76 |
| $T_3$: MBS-27 with 45 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 7.50 | 6.41 | 8.33 | 87.12 | 73.60 | 426 | 2442 | 14.92 |
| $T_4$: MBS-27 with 45 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 8.50 | 7.43 | 10.06 | 89.62 | 76.70 | 946 | 4372 | 17.91 |
| $T_5$: BJMB-1 with 30 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 7.76 | 6.16 | 8.50 | 81.80 | 73.86 | 510 | 3343 | 13.23 |
| $T_6$: BJMB-1 with 30 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 7.30 | 6.50 | 8.40 | 75.64 | 73.76 | 386 | 2314 | 17.37 |
| $T_7$: BJMB-1 with 45 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 7.56 | 6.53 | 7.76 | 52.34 | 74.30 | 656 | 2186 | 17.40 |
| $T_8$: BJMB-1 with 45 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 7.93 | 6.42 | 8.40 | 77.08 | 74.00 | 600 | 3086 | 18.44 |
| $T_9$: Local variety with 30 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 7.83 | 6.80 | 8.83 | 76.90 | 74.70 | 673 | 3857 | 11.73 |
| $T_{10}$: Local variety with 30 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 7.86 | 6.99 | 9.06 | 79.68 | 74.46 | 846 | 3986 | 16.07 |
| $T_{11}$: Local variety with 45 cm x10 cm + 2.5 t $ha^{-1}$ FYM | 8.73 | 7.17 | 10.26 | 95.74 | 78.73 | 983 | 4886 | 16.73 |
| $T_{12}$: Local variety with 45 cm x10 cm + 1 t $ha^{-1}$ vermi compost | 7.40 | 6.73 | 8.00 | 82.68 | 72.76 | 683 | 2957 | 18.79 |
| $T_{13}$: Control-1 | 7.16 | 6.48 | 7.76 | 76.36 | 71.66 | 526 | 2571 | 17.08 |
| $T_{14}$: Control-2 | 7.46 | 6.90 | 8.20 | 78.91 | 73.33 | 503 | 2957 | 09.27 |
| SEm ± | 0.19 | 0.21 | 0.30 | 3.46 | 0.88 | 46 | 205 | 1.67 |
| CD (P=0.05) | 0.56 | NS | 0.88 | 10.15 | 2.59 | 135 | 602 | NS |

**Note:** Control 1- local variety with RDF (10:20:00 kg $N:P_2O_5:K_2O$ $ha^{-1}$) at 30 cm x 10cm spacing
Control 2- local variety with 10:20:10 kg $N:P_2O_5:K_2O$ $ha^{-1}$ at 30 cm x 10cm spacing
FYM- Farm yard manure, DAS – Days after sowing, NS – Non significant

**Table 2: Grain protein and economics of cultivation of moth bean genotypes as influenced by spacing and organics under dry land areas**

| Treatment | Nitrogen (%) | Protein content (%) | Gross returns (Rs.ha$^{-1}$) | Net returns (Rs.ha$^{-1}$) | Benefit cost ratio (B:C) |
|---|---|---|---|---|---|
| $T_1$: MBS-27 with 30 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.88 | 24.28 | 31322 | 17347 | 2.23 |
| $T_2$: MBS-27 with 30 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.89 | 24.33 | 45602 | 29487 | 2.82 |
| $T_3$: MBS-27 with 45 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.90 | 24.41 | 24997 | 11102 | 1.79 |
| $T_4$: MBS-27 with 45 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.85 | 24.08 | 53891 | 37696 | 3.32 |
| $T_5$: BJMB-1 with 30 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.68 | 23.01 | 30515 | 16620 | 2.19 |
| $T_6$: BJMB-1 with 30 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.74 | 23.37 | 22804 | 07089 | 1.44 |
| $T_7$: BJMB-1 with 45 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.72 | 23.26 | 36112 | 22057 | 2.56 |
| $T_8$: BJMB-1 with 45 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.82 | 23.91 | 34629 | 18754 | 2.17 |
| $T_9$: Local variety with 30 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.74 | 23.37 | 39453 | 25623 | 2.84 |
| $T_{10}$: Local variety with 30 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.74 | 23.41 | 48312 | 32422 | 3.03 |
| $T_{11}$: Local variety with 45 cm x10 cm + 2.5 t ha$^{-1}$ FYM | 3.81 | 23.81 | 56495 | 42425 | 4.01 |
| $T_{12}$: Local variety with 45 cm x10 cm + 1 t ha$^{-1}$ vermi compost | 3.71 | 23.42 | 38602 | 22872 | 2.44 |
| $T_{13}$: Control-1 | 3.83 | 23.97 | 30190 | 12273 | 1.68 |
| $T_{14}$: Control-2 | 3.51 | 21.89 | 39602 | 21457 | 2.17 |
| SEm ± | 0.09 | 0.58 | 2407 | 2407 | 0.16 |
| CD (P=0.05) | NS | NS | 7059 | 7059 | 0.48 |

**Note:** Control 1- local variety with RDF (10:20:00 kg $N:P_2O_5:K_2O$ ha$^{-1}$) at 30 cm x 10cm spacing
Control 2- local variety with 10:20:10 kg $N:P_2O_5:K_2O$ ha$^{-1}$ at 30 cm x 10cm spacing
FYM- Farm yard manure, DAS – Days after sowing, NS – Non significant

## CONCLUSION

It can be concluded that moth bean local variety at spacing of 45 cm X 10 cm with 2.5 t FYM ha$^{-1}$ produced significantly higher seed yield (983 kg ha$^{-1}$), crude protein content (24.41 %), net returns (Rs.42425 ha$^{-1}$) and benefit cost ratio (4.01) under Northern dry zone of Karnataka.

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