Influence of spacing and organics on growth, yield and quality of arid legume moth bean [Vigna aconitifolia (Jacq.) Marechal]

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Abstract: A field experiment was conducted to study the effect of spacing and organics on growth, yield and quality of moth bean genotypes during kharif 2013. The experiment 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 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:O₃⁻⁻⁻ K, O ha⁻¹ and local variety at 30 cm x 10 cm spacing with 10:20:10 kg N:P:O₃⁻⁻⁻ K, O ha⁻¹). The local moth bean genotype gave significantly higher seed yield (796 kg ha⁻¹) at wider row spacing of 45 cm x 10 cm compared to 30 cm x 10 cm. Application of 1 t vermi compost per ha recorded significantly higher seed yield (714 kg ha⁻¹) compared to 2.5 t FYM per ha. The interaction of moth bean local variety at spacing of 45 cm x 10 cm with application of 2.5 t FYM per ha produced significantly higher seed yield (983 kg ha⁻¹), effective nodule number per plant (10.26), node weight (5 mg plant⁻¹), total dry matter at harvest (95.74 g plant⁻¹), seed yield (17.60 kg plant⁻¹) and crude protein yield (234 kg ha⁻¹) compared to other interactions. It can be concluded that for dry land situation, interaction of local moth bean genotype can be recommended at a spacing of 45 cm x 10 cm with 2.5 t FYM per ha application.

Key words: Moth bean, Spacing, Organics, Growth, Yield, Seed quality parameters

Introduction

Arid legumes viz., moth bean, horse gram, lentil etc. are grown on poor and eroded soils under low rainfall, dry land condition and with lack of irrigation facility. Cereals and other remunerative crops fail or perform very badly under these marginal conditions. Hence, arid legumes stand better chance under such circumstances. Farmers sometimes leave such fields fallow particularly due to paucity of soil water or the land being exhausted of plant nutrients. The practice of keeping land fallow allows the soil to recuperate under natural conditions. However, instead of keeping them fallow, farmers prefer to grow some arid legumes that would give them some grain yields in addition to making the soil fertile. Moth bean [Vigna aconitifolia (Jacq.) Marechal] is an important pulse crop of the desert region and is remarkably well suited to arid and semi-arid areas of India and some countries of Asia. In India, it is grown on an area of 13.19 lakh ha, mostly confined to Rajasthan, Gujarat, Maharashtra, Karnataka, Uttar Pradesh and Haryana with a production of 1,75 lakh t and productivity of 133 kg per ha (Rajendra Prasad, 2013). It can very well stand drought conditions and is probably the most drought resistant crop among the grain legumes. The crop has spreading growth habit forming a mat like covering on the soil surface. 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 (Yadav, 1992). Moreover, the yield of local cultivars of moth bean is much lower compared to other pulse crops. This clearly shows that it is necessary to overcome these constraints to get higher yields. Yield is a complex character resulting from the interplay of genotypes with the environmental variables and various metabolic processes. Proper screening of genotypes under variable environmental conditions gives an idea of their suitability for different regions as well as for wider adaptability. Plant population per unit area is one of the main factors determining the grain yield of moth bean. The genotypes of moth bean can express their full potential only when grown under the optimum plant density, which ensures the efficient utilization of inputs. Indiscriminate use of chemicals in agriculture has weakened the ecological base in addition to degrading the soil, water resources and quality of food. 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 objectives i.e. 1). To study the response of moth bean genotypes to spacing and organics for growth, yield and quality, 2). To study the effect of organics on seed yield and quality of moth bean, 3). To study the interaction effect of moth bean genotypes, spacing and organics.

Materials and Methods

The field experiment was conducted at College of Agriculture, Vijayapura in Northern dry zone of Karnataka during
**Results and Discussion**

The leaf area index (LAI) at 50 days after sowing (DAS) was significantly influenced by genotypes. The local variety recorded significantly higher leaf area index (5.51) and was on par with MBS-27 (5.46). Spacing and organics did not influence LAI significantly. The interaction of local variety at spacing of 45 cm X 10 cm with application of 2.5 t FYM ha\(^{-1}\) recorded significantly higher leaf area index (G\(_{S_0}S_0\), 6.63) and was on par with G\(_{S_0}S_0\) (5.99) and G\(_{S_0}S_0\) (5.84). The interaction G\(_{S_0}S_0\) recorded significantly lower leaf area index (4.63) compared to rest of the interactions and control treatments. At 70 DAS, the local variety recorded significantly higher leaf area index (6.92) and was on par with MBS-27 (6.89). Spacing and organic treatments did not influence LAI significantly. The interaction effect 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 (Bond et al., 2005 and Tan et al., 2000). Optimum plant density ensures the plant to grow properly with their aerial and underground parts by utilizing more solar radiation and soil nutrients (Mondal et al., 2013). Higher interception of solar radiation under higher seed rates might be the result of less plant population with high LAI. This increased LAI is responsible for higher PAR interception (Bilal Ahmad Lone et al., 2009).

At 40 DAS, significantly higher number of nodules (9.27 plant\(^{-1}\)) was noticed with MBS-27 compared to local variety (9.04 plant\(^{-1}\)) and BJMB-1 (8.26 plant\(^{-1}\)). However, the spacing and organics did not influence significantly. The interaction of local variety at spacing of 45 cm X 10 cm with application of 2.5 t FYM ha\(^{-1}\) recorded significantly higher number of nodules (G\(_{S_0}S_0\), 10.26 plant\(^{-1}\)) and it was on par with G\(_{S_0}S_0\) (10.06 plant\(^{-1}\)) and G\(_{S_0}S_0\) (9.73 plant\(^{-1}\)) compared to other interactions and control treatments. At 40 DAS, genotypes and spacing did not show significant difference on nodule weight. However, higher nodule weight was recorded with local variety and MBS-27 (3 mg plant\(^{-1}\)) compared to BJMB-1 (2 mg plant\(^{-1}\)). The spacing of 45 cm X 10 cm recorded significantly higher nodule weight (3 mg plant\(^{-1}\)) compared to 30 cm X 10 cm (2 mg plant\(^{-1}\)). Application of 2.5 t FYM ha\(^{-1}\) or 1 t vermi compost ha\(^{-1}\) were on par for nodule weight (3 mg plant\(^{-1}\)). The interaction of local variety at spacing of 45 cm X 10 cm with application of 2.5 t FYM ha\(^{-1}\) recorded significantly higher nodule weight (G\(_{S_0}S_0\), 5 mg plant\(^{-1}\)) compared to other interactions and control treatments. This might be because, under high plant population, the roots were having lesser number of nodule with smaller size having less fresh weight. Increase in the plant population might have created competitive conditions and the plant roots couldn't proliferate in the soil profile (Bilal Ahmad Lone et al., 2009).

Genotypes differed significantly for days taken to 50% flowering. The local variety flowered significantly earlier (94.08 days) compared to BJMB-1 (97.33 days) and MBS-27 (99.33 days). Spacing and organics did not influence significantly on the days taken to 50 per cent flowering. The interaction effect of genotype, spacing, and organics also did not show significant influence. The local variety matured significantly earlier (132.91 days) compared to BJMB-1 (136.66 days) and MBS-27 (138.66 days). Organics and spacing did not show significant difference. The interaction effect due to genotype, spacing and organics did not show significant difference. Seed yield per plant differed significantly with genotypes and spacing. Significantly higher seed yield was recorded with local variety (14.76 g plant\(^{-1}\)) compared to MBS-27 (14.34 g plant\(^{-1}\)) and BJMB-1 (13.30 g plant\(^{-1}\)). Spacing of 45 cm X 10 cm recorded significantly higher seed yield (14.52 g plant\(^{-1}\)) over 30 cm X 10 cm (13.74 g plant\(^{-1}\)). Organic treatments did not influence significantly. Significantly higher seed yield was noticed with interaction G\(_{S_0}S_0\) (17.60 g plant\(^{-1}\)) and it was on par with G\(_{S_0}S_0\) (16.83 g plant\(^{-1}\)) compared to other interactions and control treatments. At harvest, local variety recorded significantly higher total dry matter accumulation (83.75 g plant\(^{-1}\)) compared to MBS-27 (71.87 g plant\(^{-1}\)) and BJMB-1 (71.71 g plant\(^{-1}\)). Among the spacing, 45 cm X 10 cm recorded significantly higher total dry matter accumulation (80.76 g plant\(^{-1}\)) over 30 cm X 10 cm spacing (70.79 g plant\(^{-1}\)). Organic treatments did not influence significantly. The significantly higher total dry matter accumulation was recorded with local variety at 45 cm X 10 cm with 2.5 t FYM ha\(^{-1}\) (G\(_{S_0}S_0\), 95.74 g plant\(^{-1}\)) and it was on par with G\(_{S_0}S_0\) (89.62 g plant\(^{-1}\)) and G\(_{S_0}S_0\) (87.12 g plant\(^{-1}\)) compared to other interactions and control treatments. 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.

Among the genotypes, local variety recorded significantly higher seed yield (796 kg ha\(^{-1}\)) compared to MBS-27 (681 kg ha\(^{-1}\))
and BJMB-1 (538 kg ha⁻¹). In local variety, there was an increase of 16.88 per cent over MBS-27 and 47.79 per cent over BJMB-1 in seed yield. This increase in seed yield with local variety was due to significantly higher performance of growth and yield parameters viz., leaf area index at 50 and 70 DAS (5.51 and 6.92, respectively), total dry matter at harvest (83.75 g plant⁻¹) and seed yield (14.76 g plant⁻¹). Similar increase in seed yield was also obtained with local variety with RDF (10:20 kg N:P:K ha⁻¹) compared to other interactions and control treatments. This increase in seed yield was due to significantly higher leaf area index at 50 and 70 DAS (5.24 and 6.87, respectively), effective nodules (8.94 plant⁻¹) and total dry matter at harvest (77.97 g plant⁻¹). These results are in conformity with the findings of Taipodia and Nabam (2013), Helmy et al. (2015) in cowpea and Yadav et al. (2009) in moth bean. The organic treatment of 1 t vermi compost ha⁻¹ recorded significantly higher seed yield (714 kg ha⁻¹) compared to 2.5 t FYM ha⁻¹ (630 kg ha⁻¹). There was an increase of 13.33 per cent in seed yield compared to 2.5 t ha⁻¹ FYM. This increase in seed yield was due to significantly higher leaf area index at 50 and 70 DAS (5.24 and 6.87, respectively), effective nodules (8.94 plant⁻¹), seed yield (14.16 g plant⁻¹) and total dry matter at harvest (77.97 g plant⁻¹). These findings are in accordance with results obtained by Arun Kumar and Uppar (2007) in moth bean, John De Britto and Sorma Girija (2006) in gram. The interaction of local variety at 45 cm X 10 cm spacing, Control-2 - local variety with 10:20:10 kg N:P:K ha⁻¹ and total dry matter at 30 cm X 10cm spacing.
higher performance of growth and yield parameters viz., leaf area index at 50 and 70 DAS (6.63 and 7.17, respectively), effective nodules per plant (10.26), nodule weight (5 mg plant\(^{-1}\)), total dry matter production at harvest (95.74 g plant\(^{-1}\)) and seed yield (17.60 g plant\(^{-1}\)). These results are in agreement with Yadav (1992) in moth bean.

Crude protein content in seeds did not show significant difference due to genotypes, spacing and organsics. However, higher crude protein content was recorded in MBS-27 (24.27%) compared to local variety (23.45%) and BJMB-1 (23.39%). This increase was due to higher content of nitrogen in seeds of MBS-27 (3.88%). These findings are in agreement with Vijayalaxmi (2012) in black gram and Alam Mondal et al. (2013) in lentil. Spacing of 45 cm X 10 cm recorded higher crude protein content (23.78%) compared to 30 cm X 10 cm (23.63%). This increase was due higher nitrogen content in seeds (3.80%).

These findings are in conformity with Arun kumar and Uppar (2007) in moth bean, Naiknaware et al. (2015) in ground nut and Prithi et al. (2015) in soybean. The interaction effect of genotype, spacing and organsics did not show significant difference.

Crude protein yield in seeds differed significantly due to genotypes, spacing and organsics. Significantly higher protein yield was recorded with MBS-27 (G. \(156\) kg ha\(^{-1}\)) compared to local variety (G. \(126\) kg ha\(^{-1}\)) and BJMB-1 (G. \(125\) kg ha\(^{-1}\)). Spacing of 45 cm X 10 cm recorded significantly higher protein yield (S. \(170\) kg ha\(^{-1}\)) over 30 cm X 10 cm (S. \(148\) kg ha\(^{-1}\)). Application of 1 t vermi compost ha\(^{-1}\) recorded higher crude protein content (23.72%) compared to 2.5 t FYM ha\(^{-1}\) (O. \(23.69\)). This increase was due to higher nitrogen content in seeds with vermi compost application (3.79%).

These results are in agreement with Vijaylaxmi (2012) in black gram and Alam Mondal et al. (2013) in lentil. Spacing of 45 cm X 10 cm recorded higher crude protein content (23.78%) compared to 30 cm X 10 cm (23.63%). This increase was due higher nitrogen content in seeds (3.80%).

These findings are in line with the results of Dahmardeh et al. (2010) in faba bean and Yadav et al. (2009) in moth bean. Application of 1 t vermi compost ha\(^{-1}\) recorded higher protein yield (O. \(2\)), 170 kg ha\(^{-1}\)) over 30 cm X 10 cm (S. \(2\)). Control-1 and control-2 treatments were on par with each other (126 kg ha\(^{-1}\) and 154 kg ha\(^{-1}\), respectively).

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\(^{-1}\)) and crude protein yield (234 kg ha\(^{-1}\)) under Northern dry zone of Karnataka.

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References
