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RESEARCH PAPER

Yield optimization in mungbean through improved seed and crop management practices in arid Rajasthan

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Abstract : Three separate experiments on selection of high yielding varieties, fertilizer management and effect of row spacing and agro-chemicals on crop yield were conducted in Transitional Plain of Luni Basin of Rajasthan. Average seed yield of mungbean varieties varied between 11.67 q/ha and 14.44 q/ha with the average of 12.80 q/ha. The maximum seed yield was recorded in RMG-492 followed by GM-4 with 14.00 q/ha. However, productivity of all other varieties was almost at par and relatively poor. A fertilizer dose comprising seed treatment with bio-fertilizers (*Azotobacter* and PSB culture), basal application of N 11.25 kg/ha and P 30 kg/ha; and foliar spray of 1% soluble NPK (19:19:19) @ 600 litre/ha at flowering stage provided maximum yield of 9.57 q/ha, which was 25.29 per cent higher yield over farmer's practice. The crop sown at row spacing of 30 cm gave 7.04% higher seed yield over 60 cm row spacing. Foliar spray of agro-chemicals (0.2% K_2SO_4 + thiourea 1000 ppm or 0.2% K_2SO_4 + 100 ppm ascorbic acid) during heat and moisture stress provided about 9% yield increase over control.

Key Words : Agro-chemicals, Fertilizer management, Mungbean, Row spacing, Seed yield, Varieties

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INTRODUCTION

Mungbean (*Vigna radiata* L.) is an important grain legume of arid and semi-arid regions. Rapid growth and early maturing characteristics; and ability to restore the soil fertility makes it valuable crop in various cropping systems. It is grown under wide range of soil conditions including marginal lands but performs best on fertile, medium-textured and sandy loam well drained soils. It is grown as sole crop or mixed/intercrop with cereals like pearl millet and sorghum, etc. and also intercropped with woody perennials under agro-forestry system. Its seed yield decreases when it is intercropped, but the total productivity of the system and land use efficiency markedly increases by intercropping (Ali, 1992). On an average, it fixes atmospheric nitrogen @ 300 kg/ha annually (Sharar *et al*., 2001). It is usually grown as rainfed crop, therefore, its production varies year after year with the amount and distribution of rainfall as well as infestation of pest and diseases.

Mungbean is primarily used for food purpose. It is a rich source of proteins and amino acids especially lysine and thus can supplement cereal-based human diets. Its seed contains 24.3% protein and 0.67% fats (Lee *et al*., 1997). It is used in the form of *Dal* and sprouts; and also in several confectionary items of day to day snacks. In Rajasthan, mungbean has occupied an area of 863129 ha (average of 2004-05 to 2008-09) with annual production of 280581 tonnes and productivity of 325 kg/ha (Anonymous, 2009-10). District Nagaur, Jodhpur, Jalore, Ajmer, Pali, Jaipur, Tonk and Barmer are major mungbean growing areas of the state.

Among many other crop production constraints, appropriate varieties and inter-row spacing are the most important, which contribute substantially to the seed yield of mungbean (Ismail and Hall, 2000; Khan *et al.*, 2001). Present studies were conducted to find out high yielding varieties, appropriate crop management practices like inter-row spacing, fertilizers and agro-chemicals for yield optimization of mungbean in arid Rajasthan.

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MATERIAL AND METHODS

Three separate experiments on selection of high yielding varieties, fertilizer management and effect of row spacing and agro-chemicals on crop yield were conducted in Transitional Plain of Luni Basin (Zone IIb) of Rajasthan [districts Jalore, pali, Jodhpur and Sirohi]. The performance of eight released and notified varieties of mungbean was tested for four years at experimental farm of Agricultural Research Station, Keshwana, Jalore [Latitude 25°23.115'N, longitude 72° 30.726'E, elevation 149.9 msl]. The site has a tropical arid climate with mean annual rainfall of 421 mm. Soil at the site was clay loam slightly saline in reaction (pH 8.7) and low in organic carbon (0.23 %). The experiment was laid out in a randomised block design with 3 replications. Sowing was done on 17.07.2007, 07.07.2008, 15.07.2011 and 20.07.2012, respectively. Plot size was kept as 2.5m x 4.0m accommodating 8 rows at 30 cm spacing with seed rate of 15 kg/ha. A fertilizer dose of N 15 kg/ha and P 40 kg/ha was applied to the crop. Additional foliar spray of 1% soluble NPK (19:19:19) at flowering and grain development stage was also applied for harvesting the higher yield. One hoeing was carried out at about 25 days after sowing and one hand weeding at 15 days thereafter to keep crop free from weeds. The experiment has been conducted during rainy season but under moisture stress situation irrigation was also applied as per requirement of the crop. Data collected on seed yield were analysed using standard analysis of variance (ANOVA) through Excel software of Microsoft Office.

A trial on fertilizer management with four treatment combinations was conducted in 2011 at 28 farmer's fields. Experiments were laid out uniformly in strips of 0.40 ha. Variety RMG-492 was used for experimentation. All experimental inputs like seed and fertilizers as per requirement of the treatments were provided to farmers. These trials were conducted under RKVY project with the objective of validation and transfer of technology at farmer's fields.

Another experiment to see the effect of row spacing and agro-chemicals on crop yield was conducted at experimental farm, Jalore. Seven treatment combinations were tested in a randomised block design with 3 replications for two years. Mungbean variety GM-4 was used for experimentation. Plot size was kept as 4.0 m x 5.0 m. Sowing was done on 16.07.2011 and 21.07.2012, respectively. A fertilizer dose of N-15 and P-40 kg/ha was applied to the crop. Sowing was done at two different row spacings (30 cm and 60 cm) and foliar spray of two agro-chemicals *viz*., 0.2% K_2SO_4 + thiourea 1000 ppm and 0.2% K_2SO_4 + 100 ppm ascorbic acid at grain development stage was applied in respective treatments.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Varietal evaluation:

Differences among varieties for seed yield were found statistically significant during all four years. Year wise average seed yield ranged between 9.69 q/ha and 17.11 q/ha. The experiment has been conducted during rainy season therefore; this wide range of fluctuation over the years is largely affected by climatic conditions like amount and distribution of rainfall, temperature and relative humidity, etc. Variety wise average seed yield of mungbean varied between 11.67 q/ha and 14.44 q/ha with the average of 12.80 q/ha. The maximum seed yield was recorded in RMG-492 followed by GM-4 with 14.00 q/ha. However, productivity of all other varieties was almost at par and relatively poor. One thousand seed weight of different varieties ranged between 34.40g and 49.37 g with the average of 40.10 g. The maximum test weight was observed in SML-668 followed by GM-4 and RMG-268 with 42.50 and 41.83g, respectively. Days to 50% flowering varied between 38 and 42 days after sowing. Varieties GM-4, RMG-268 and SML-668 were found earliest in flowering.

Results indicate that RMG-492 was a high potential variety but its seed size was relatively small and its flowering was also little late; and variety SML-668 had maximum test weight but its productivity was relatively poor. Therefore, considering the production potential, earliness and test weight in view, variety GM-4 seems to be the most appropriate for cultivation in arid Rajasthan. However, other two varieties RMG-492 and SML-668 may also be cultivated to maintain the varietal diversity for sustainable crop production.

Francisco and Maeda (1989), Rasul *et al.* (2012), Taj *et al.* (2003) and Yadav and Warsi (1988) also reported significant differences in seed yield of different mungbean varieties.

Fertilizer management:

Results revealed that a fertilizer dose comprising seed treatment with bio-fertilizers (*Azotobacter* and PSB culture), basal application of N 11.25 kg/ha and P 30 kg/ha and foliar spray of 1% soluble NPK (19:19:19) @ 600 litre/ha at flowering stage provided maximum yield of 9.57 q/ha, which was 25.29 per cent higher yield over farmer's practice. It was followed by 125% recommended dose of fertilizers and 100% RDF along with bio-fertilizers with the yield enhancement of 18.56 and 14.78 per cent, respectively (Table 2). It appears from the results that foliar spray of soluble NPK may have supplied optimum nutrition needed for higher production and the use of bio-fertilizers has also accelerated the production.

Therefore, conventional practices of mungbean

cultivation at farmer's fields need to be improved and seed treatment with bio-fertilizers, basal application of N 11.25 kg/ha and P 30 kg/ha; and foliar spray of 1% soluble NPK at flowering stage may be promoted for enhancing the productivity of mungbean.

Effect of row spacing and agro-chemicals:

Differences among treatments for seed yield were not found statistically significant during both the years. Year wise average seed yield ranged between 10.07 q/ha and 11.96 q/ ha. The fluctuation in the seed yield over the years might have affected by climatic conditions like amount and distribution of rainfall, temperature and relative humidity, etc. However, treatment wise, seed yield varied between 10.23 q/ha and 12.00 q/ha with the average of 11.02 q/ha (Table 3). Therefore, results indicate that 30 cm row spacing was more appropriate and provided 7.04% higher seed yield over 60 cm row spacing. Rasul *et al.* (2012) also reported similar results. Foliar spray of agro-chemicals (0.2% K2SO4 + thiourea 1000 ppm or 0.2% K2SO4 + 100 ppm ascorbic acid) at seed development stage provided about 9% yield increase over control.

Conclusion:

From present studies, it can be concluded that varieties GM-4 and RMG-492 may be cultivated at 30 cm row spacing. Seed treatment with bio-fertilizers (*Azotobacter* and PSB culture), basal application of N 11.25 kg/ha and P 30 kg/ha

Table 1 : Seed yield of different varieties of mung bean

Varieties	Seed yield (q/ha)					1000 seed wt. (g)	Days to 50% flowering
	2009	2010	2011	2012	Mean		
MUM-2	-	-	11.44	12.17	11.81	36.50	40.00
IPM-02-03	-	-	11.57	11.77	11.67	40.17	39.00
GM-4	10.58	19.27	11.83	14.33	14.00	42.50	38.00
RMG-62	9.37	14.48	13.48	11.93	12.32	41.83	39.00
RMG-268	8.29	14.32	13.40	11.20	11.80	41.13	38.00
RMG-344	8.70	16.79	11.58	12.00	12.27	34.40	42.00
RMG-492	11.19	20.74	14.15	11.67	14.44	34.90	41.00
SML-668	9.98	17.05	11.55	11.00	12.40	49.37	38.00
Mean	9.69	17.11	12.38	12.01	12.80	40.10	39.38
C.D. (P=0.05)	1.84	3.45	1.50	1.85	-	2.93	-

Table 2 : Seed yield of mung bean as affected by fertilizer management at farmer's fields

Treatments	Grain yield (q/ha)	% Increase over FP
125% RDF (N 18.75 + P 50 kg/ha)	8.78	18.56
100% RDF (N 15 + P 40 kg/ha) + Bio-fertilizers (*Azotobacter* + PSB culture)	8.39	14.78
75% RDF (N 11.25 + P 30 kg/ha) + Bio-fertilizers + 1% foliar spray of soluble NPK (19:19:19) at flowering stage	9.57	25.29
Farmer practice (FP)	5.15	-

Table 3 : Seed yield of mung bean as affected by row spacing and agro-chemicals

Treatments	Seed yield (q/ha)		
	2011	2012	Mean
30 cm row spacing (control)	11.22	10.67	10.95
30 cm row spacing and foliar spray of 0.2% K_2SO_4 + thiourea 1000 ppm during heat and moisture stress	12.92	11.00	11.96
30 cm row spacing and foliar spray of 0.2% K_2SO_4 + 100 ppm ascorbic acid during heat and moisture stress	13.33	10.67	12.00
60 cm row spacing	11.13	9.33	10.23
60 cm row spacing with dust mulch at moisture stress condition	11.34	9.42	10.38
60 cm row spacing and foliar spray of 0.2% K_2SO_4 + thiourea 1000 ppm during heat and moisture stress	12.03	9.42	10.73
60 cm row spacing and foliar spray of 0.2% K_2SO_4 + 100 ppm ascorbic acid during heat and moisture stress	11.73	9.97	10.85
Mean	11.96	10.07	11.02
C.D. (P=0.05)	NS	NS	-

NS=Non-significant

and foliar spray of 1% soluble NPK (19:19:19) @ 600 litre/ha at flowering stage is an appropriate fertilizer management practice. Foliar spray of 0.2% K_2SO_4 + thiourea 1000 ppm or 0.2% K_2SO_4 + 100 ppm ascorbic acid at seed development stage is helpful in yield optimization of mungbean.

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