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Effect of Sowing Dates, Plant Density, Seed Treatment and Fertilizers on Performance and Quality Seed Production in Mungbean [*Vigna Radiata* (L.) Wilczek]

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Abstract

Variation in agro-ecological conditions due to climate change encourages modern research approaches to optimise the time for sowing, plant density and use of seed treatment and fertilizers to maximise the seed yield of Mungbean. It may vary from variety to variety and season to season. Therefore, an experiment was conducted in mungbean (var. SML 668) comprising three dates of sowing (July 15, August 1 and 16), two plant geometry (25 x 10 cm) and (30 x 10 cm) and six combinations of seed treatments and fertilizers, control (No fertilizer application), recommended dose of fertilizer (RDF) as basal dose (12.5 kg/ha N and 40 kg/ha P_2O_5), seed inoculation with *Rhizobium* and phosphate solubilizing bacteria (PSB), seed inoculation with *Rhizobium* and PSB + RDF as basal dose, seed inoculation with *Rhizobium* and PSB + 50 % more RDF as basal dose and seed inoculation with *Rhizobium* and PSB + RDF as basal dose + Borax spray (100 ppm) at flower initiation during *Kharif* 2013 and 2014 at CAZRI, Jodhpur. Studies revealed that delayed sowing in August reduced seed yield and affected yield attributes (plant height, pods/plant, seeds/pod, seed yield/plant and 1000-seed weight). Early sowing (15th July), wider spacing (30 x 10 cm) and recommended dose of fertilizer + seed treatment with *Rhizobium* and PSB + Borax spray (100 ppm) at flower initiation enhanced the seed yield and yield attributes in mungbean.

Keywords

Mungbean; Plant density; Seed production; Seed treatment; Seed quality

Introduction

Among the *kharif* pulses, mung bean is an important pulse crop grown in most of the tropical and sub-tropical parts of the world. It is also grown extensively in India under varying soil types and climatic conditions. It is a short duration crop that can be grown over a range of environments. In Rajasthan, it is mostly grown under rain fed condition in 7.59 lakh ha area with total production of 2.71 lakh tones. The average productivity of mungbean is 357 kg/ha which is very much low as compared to other mungbean growing states in the country (2006-07). Traditional method of cultivation practices adopted by most of the farmers is one of the reasons for low productivity in these areas. Moreover, yield barriers due to different genetic, physiological, biochemical constitutions and lack of required packages of practices required during the critical stages of crop growth posed a big challenge before suppliers to provide good quality seed of improved variety at reasonable price to the farmers. The development of high yielding varieties and better management practices recommended during recent years anticipated much scope for further increase in seed yield. Available technologies indicated that timely sowing at the proper plant densities along with application of recommended doses of fertilizer; microbial seed inoculants and foliar spray with micronutrients have been found to overcome such bottlenecks to a considerable extent in pulses. However, changing climatic conditions and untimely rains varying from July to August or its further delay in the area encourages adoption of different technological approaches for harnessing the true potential of the crops. Such studies are meagre in mung bean and particularly in arid zone of Rajasthan. The present study was therefore undertaken to study the effect of different sowing time, plant geometry, recommended dose of fertilizer, seed treated with *Rhizobium* and Phosphate Solubilizing Bacteria (PSB) alone or in combination and boron spray prior to flowering for optimising improvement of seed yield and seed quality parameters in mung bean.

Material and Methods

A field experiment comprising three dates of sowing, 15th of July, 1st of August and 16th of August; two crop geometry, (25 × 10 cm) and (30 × 10 cm) and six combinations of seed treatments and fertilizers, Control (No Fertilizer Application) (F_1), Recommended dose of Fertilizer (RDF) as basal dose (12.5 kg/ha N and 40 kg/ha P_2O_5) (F_2), Seed inoculation with Rhizobium and Phosphate Solubilizing Bacteria (PSB) (F_3), Seed inoculation with Rhizobium and PSB + RDF as basal dose (F_4), Seed inoculation with Rhizobium and PSB + 50 % more RDF as basal dose (F_5) and Seed inoculation with Rhizobium and PSB + RDF as basal dose + Borax spray (100 ppm) at flower initiation (F_6) was conducted in Factorial Randomized Block Design with three replications during *Kharif* 2013 and 2014. The mungbean variety SML 668 was sown in flat bed of plot size 2.5 x 5 m on sandy soil of the institute farm at CAZRI, Jodhpur. Weeding management was done by spraying Stomp 30 EC @ 2.5 lit/ha as pre-emergence using 500 lit/ha water followed by two hand weeding. The experiment was conducted in rain-fed conditions but irrigation with sprinkler was provided whenever the shortage of rains observed and required for the crop growth.

The seeds were inoculated with Rhizobium and Phosphate Solubilizing Bacteria @ 4 g/kg seed, dried for 30 minutes in shade followed by sowing in the field. The required quantity of fertilizers in the form of Urea and DAP for the plot size was applied and mixed in the soil before sowing. The data was recorded for plant height at 30 and 60 days after sowing, flowering days, pods per plant, pod length, seeds per pod, seed yield per plant, seed yield per square meter, 1000-seed weight and harvest index. The seed quality attributes were recorded in the laboratory for seed germination as per standard procedure and vigour indices were calculated by multiplying normal

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seedling percentages with seedling length and seedling dry weight. Data were evaluated by split-plot analysis of variance (ANOVA) by using the SPSS program.

Results and Discussion

The data revealed that dates of sowing, crop geometry and fertilizers and seed treatments had significant influence on plant growth characteristics, seed yield and seed quality (Table 1 and 2).

The early sowing (15th July) recorded maximum plant height at 30 DAS & 60 DAS during both the years. Days to flowering were earlier in 16th Aug sowing during 2013, but it was 15th July during 2014. No. of pods per plant was maximum for 16th Aug. sowing in 2013 whereas, during 2014 early sowing recorded maximum No. of pods per plant (Table 1). Khairnar et al. [1] evaluated 22 genotypes of mungbean under condition of the kharif season; they found wide variability in most of yield components and grain yield per ha. The characters viz., pod length; seeds per pod, seed yield per unit area and harvest index were significantly higher in early sowing during both the years (Table 1). Over all the early sowing, 15th July found to be better sowing date for better seed yield. Boe et al. [2] recorded that delayed mungbean planting date from May to July produced forage higher with 2.2 ton/ha Under Egyptian condition. Similarly, Ashour et al. [3] and El-Kramany [4], recorded that some genotypes of mungbean gave a suitable vegetative growth and yields when sown lately around mid of July.

Effect of crop geometry was found non-significant for most of the characters studied except, No. of pods per plant (Table 1) [5]. Over all wider spacing (30 x 10 cm) recorded higher values for the most of the seed yield attributing characters and yield compare to narrow spacing (25 x10 cm) during both the years.

Fertilizer treatments had significant effect on no. of pods and seed yield during 2013 and 2014. Seed treated with PSB + RDF as basal dose + Borax spray (100 ppm) at flower initiation (F_6) recorded maximum no. of pods (20.1), pod length (8.8 cm) during 2014. Similarly, seeds per pod (8.9 & 8.7) and seed yield (71.9 & 227.6 g/m^2) during both the years [6,7]. The characters, no. of pods per plant were shown significant during 2013 and 2014 with F_5 and F_6 treatments respectively. Plant height at 30 DAS & 60 DAS was recorded maximum for the treatment F5 during both the years (Table 1). Seed treatment with rhizobium + Phosphate Solubilizing Bacteria (PSB)

Table 1: Effect of dates of sowing, crop geometry and fertilizers on plant characters, seed yield and its components in mungbean.

Treatments	Plant height at 30 DAS (cm)		Plant height at 60 DAS (cm)		Days to flowering		No. of Pods/ plant		Pod Length (cm)		Seeds/pod (Nos.)		Seed Yield/Sq. m (g)		Harvest Index	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Date of Sowing (D)																
15th July	31.1	27.8	40.1	51.2	27.8	31.7	11.9	20.1	9.1	8.8	9.3	9.2	78.8	223.4	0.44	0.56
1st August	16.1	20.3	25.1	46.3	28.9	35.6	8.8	16.4	8.6	8.5	9.3	8.5	52.8	189.8	0.35	0.51
16th August	25.3	22.1	27.5	48.2	27.4	34.5	13.7	16.0	7.9	8.1	7.8	7.9	45.8	219.5	0.31	0.51
S.Em±	0.40	0.81	0.60	1.36	0.20	0.14	0.4	0.57	0.1	0.06	0.1	0.09	2.7	6.51	0.01	0.01
CD at 5%	1.30	2.27	1.70	3.83	0.50	0.40	1.1	1.60	0.3	0.16	0.4	0.27	7.7	18.37	0.03	0.02
Crop Geometry (G)																
25 × 10 cm	24.0	23.4	30.4	46.8	28.3	33.9	10.3	15.8	8.5	8.4	8.7	8.3	57.4	203.8	0.37	0.52
30 × 10 cm	24.3	23.3	31.5	50.4	27.8	34.0	12.7	19.1	8.6	8.6	8.8	8.7	60.8	218.1	0.36	0.54
S.Em ±	0.40	0.66	0.50	1.11	0.20	0.11	0.3	0.46	0.1	0.05	0.1	0.08	2.2	5.32	0.01	0.01
CD at 5%	NS	NS	NS	3.13	NS	NS	0.9	1.31	NS	0.13	NS	0.22	NS	NS	NS	0.02
Fertilizers (F)																
F1	22.4	21.8	28.0	46.2	28.8	34.2	10.9	14.9	8.4	8.2	8.7	8.3	49.0	188.7	0.38	0.50
F2	23.6	23.5	30.5	48.0	28.1	34.1	11.4	17.5	8.3	8.4	8.7	8.4	54.3	211.8	0.35	0.54
F3	23.2	23.1	29.8	47.1	28.3	34.1	12.0	15.7	8.4	8.5	8.8	8.6	50.9	200.5	0.34	0.52
F4	25.1	23.8	31.7	48.7	27.8	33.8	11.4	18.1	8.6	8.5	8.8	8.6	65.2	214.4	0.37	0.51
F5	25.6	24.4	33.2	51.1	27.3	33.9	12.8	18.7	8.7	8.5	8.7	8.7	63.2	222.6	0.38	0.56
F6	25.2	23.6	32.4	50.4	27.9	33.4	10.5	20.1	8.7	8.8	8.9	8.7	71.9	227.6	0.38	0.55
S.Em±	0.60	1.14	0.80	1.92	0.30	0.20	0.56	0.80	0.2	0.08	0.2	0.13	3.9	9.21	0.02	0.01
CD at 5%	NS	3.22	2.3	NS	0.80	NS	1.59	2.27	NS	0.23	NS	NS	10.9	28.38	NS	0.03
Interactions																
D x G	NS	3.22	NS	NS	NS	NS	NS	2.27	NS	NS	NS	NS	NS	NS	NS	NS
D x F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
G X F	NS	NS	3.3	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.06	NS
D X G X F	NS	NS	NS	NS	NS	NS	3.89	NS	NS	NS	NS	NS	NS	NS	NS	NS

F1 - Control (No Fertilizer Application); F2 - Recommended dose of Fertilizer (RDF) as basal dose (12.5 kg/ha N and 40 kg/ha P2O5); F3 – Seed treated with Rhizobium and Phosphate Solubilizing Bacteria (PSB); F4 - Seed treated with PSB + RDF as basal dose; F5 - Seed treated with PSB + 50 % more RDF as basal dose; F6 - Seed treated with PSB + RDF as basal dose + Borax spray (100 ppm) at flower initiation

Table 2: Effect of dates of sowing, crop geometry and fertilizers on seed quality attributes in mungbean.

Treatments	Test weight (gm)		Seed Germination (%)		Vigour Index I		Vigour Index II	
	2013	2014	2013	2014	2013	2014	2013	2014
Date of Sowing (D)								
15th July	59.5	71.1	74.9	88.1	2798	2844	2435	2760
1st August	52.5	63.1	80.3	92.6	2920	2655	2787	2679
16th August	45.7	66.0	74.5	96.3	2582	2545	1916	2963
S.Em±	0.57	0.43	1.2	0.91	77	61	166	48
CD at 5%	1.61	1.23	3.4	2.56	218	173	467	134
Crop Geometry (G)								
25 × 10 cm	52.4	65.7	75.8	90.9	2737	2569	2212	2642
30 × 10 cm	52.7	67.8	77.3	93.7	2796	2793	2547	2959
S.Em±	0.47	0.35	1.0	0.74	63	50	135	39
CD at 5%	NS	1.0	NS	2.09	NS	142	NS	109
Fertilizers (F)								
F1	50.7	65.1	73.7	87.9	2600	2315	2028	2405
F2	53.2	66.1	78.2	93.6	2877	2707	2420	2624
F3	51.2	66.2	74.9	91	2643	2672	2364	2678
F4	52.6	67.2	74.5	93	2689	2742	2141	3034
F5	53.3	67.8	79.7	94.4	2954	2843	2810	3090
F6	54.5	67.9	78.4	94	2836	2808	2512	2971
S.Em±	0.81	0.61	1.7	1.29	109	87	234	67
CD at 5%	2.28	1.73	NS	3.63	NS	245	NS	190
Interactions								
D x G	2.3	NS	NS	NS	NS	NS	NS	190
D x F	NS	NS	NS	NS	NS	NS	NS	NS
G X F	NS	NS	NS	NS	NS	NS	NS	NS
D X G X F	NS	NS	NS	NS	NS	NS	NS	NS

F_1 - Control (No Fertilizer Application); **F_2** - Recommended dose of Fertilizer (RDF) as basal dose (12.5 kg/ha N and 40 kg/ha P_2O_5); **F_3** – Seed treated with Rhizobium and Phosphate Solubilizing Bacteria (PSB); **F_4** - Seed treated with PSB + RDF as basal dose; **F_5** - Seed treated with PSB + 50 % more RDF as basal dose; **F_6** - Seed treated with PSB + RDF as basal dose + Borax spray (100 ppm) at flower initiation.

+ RDF as basal dose+ borax spray (100 ppm) at flower initiation had maximum seed yield produced highest yield (71.9 and 227.6 g/m^2) followed by Rhizobium and PSB + RDF as basal dose and seed treated with Rhizobium and PSB + 50% more of RDF (Table 1).

The seed quality parameters like test weight, germination % and vigour Index I & II were found significant for date of sowing. Early sowing recorded highest test weight for both the year [8]. Whereas late sowing (1st Aug & 16th Aug) recorded maximum germination % during 2013 and 2014 respectively and similar results were shown for vigour indices also (Table 2). Effect of crop geometry on seed quality traits shown that, the wider spacing (30 x 10) recorded maximum values for all the seed quality traits during both the years (Table 2).

Seed treated with PSB + 50 % more RDF as basal dose (F_5) recorded maximum values for seed germination (79.7 & 94.4) % and vigour index I (2954 & 2843) and vigour index II (2810 &3090) followed by Seed treatment with rhizobium + Phosphate Solubilizing Bacteria (PSB) + RDF as basal dose + borax spray (100 ppm) at flower initiation (Table 2) [9].

From the results, it can be concluded that early sowing (15th July), wider spacing (30 x 10 cm) and recommended dose of fertilizer + seed treatment with Rhizobium and PSB + Borax spray (100 ppm) at flower initiation were the better treatments for increased seed yield in mung bean.

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