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Yield potential of soybean as influenced by planting techniques under heavy soil of Jabalpur, Madhya Pradesh

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Abstract

A field experiment consisted of four planting techniques (i.e. Farmers practice, sowing by seed cum fertilizer drill machine, ridge and furrow method, sowing on broad bed furrow system 3 rows and sowing on broad bed furrow system 5 rows) under heavy soil of Jabalpur was conducted during kharif season of 2014 & 2015. These treatments were replicated 5 times under randomised block design. Soybean crop variety JS 9752 was sown on 28th and 30th June 2014 and 2015, respectively as per the sowing treatments. Results of the study recoded significantly highest germination (66.5%) followed by 63.3% under broad bed furrow sowing of crop with 5 rows and 3 rows, respectively. Plant population (42 plants/m²) and height (56.0 cm) of plants was recoded higher under farmers practice in which crop was sown on plat bed with help of seed cum fertilizer drill machine. Whereas, broad bed furrow recorded more number of field pods (31 per plant), seed per pod (2.2) as well as 100 grain weight of 9.05g. Further, it was noted that broad bed furrow with 5 rows recorded the highest seed and straw yields of 22.3 and 54.2 q ha⁻¹ and proved superior over ridge and furrow, and farmers practice but found at par to broad bed furrow with 3 rows crop. The top ranking BBF 5 rows also fetched maximum net monetary returns of Rs.89750/- per ha with B:C ratio of 3.72.

Keywords: Soybean, sowing techniques, broad bed furrow, ridge and furrow, seed and straw yields

Introduction

Soybean (*Glycine max* L. Mirril) ranks first among oil seed crops in Madhya Pradesh. Its cultivation in Madhya Pradesh has brought perceptible change with economy of farmers. (Naik *et al.*, 2018) [1] however, the average productivity of soybean in the state is still low. The major factor responsible for lowering down the yield potential of soybean is stagnation of rainwater due to poor drainage in heavy black soils of Jabalpur region. Excess soil moisture hampered root growth, nodulation as well as aeration in soil. It restrict the nutrient uptake, which affect the physiology and biochemistry of plant and ultimately reduced productivity (Gangwar *et al.*, 2012; Gangwar *et al.*, 2013; Sarvade *et al.*, 2014) [8, 9, 10]. JICA Project emphasized that sowing of soybean on raised bed furrow are suitable for soybean cultivation in heavy soils as this technique have numerous advantages *viz.* drainage of excess water from the crop field, improve aeration, root and nodule development as well as minimize the effect of drought (MP-JICA project 2016 & 2017) [2 & 4]. Keeping the above facts in view the planting techniques of soybean were evaluated under heavy soils of Jabalpur.

Materials and Methods

An assessment trial was carried out at KVK Farm Jabalpur, Madhya Pradesh for two consecutive kharif seasons of 2014 and 2015. The soil of experimental field was Vertisol (Deep five textured montmorillonite family of typic chromusterts) commonly known as black cotton soil. (Tomar 1989) [3]. Four planting techniques consisted of S₁: sowing by seed cum fertilizer drill machine (Farmer practice), S₂: Ridge and furrow S₃: Raised bed sowing (3 rows of crops on broad bed furrow), S₄: sowing of 5 rows on broad bed furrow system. These treatments were replicated five times under randomized block design. Soybean crop variety JS-9752 was sown on 28th and 30th June in 2014 and 2015 during kharif season, respectively, as per sowing technique treatments. Other agronomic practices were followed as per the recommended practices of JNKVV, Jabalpur (MP). Based on soil test values, fertilizer doses of 25:60:25 kg NPK ha⁻¹ in the form of urea, single super phosphate and murate of potash, respectively were applied as basal. Ridges were made at 90 and 150 cm distance leaving 30 cm wide furrows for the drainage of excess rain water. Three and five rows of crop as per treatments were planted on 90 and 150 cm wide ridges, respectively. Crop was harvested manually on 24th and 28th October during 2014 and 2015, respectively.

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Data pertaining of germination percentage, plant population, plant height, pods plant⁻¹, seeds pod⁻¹, test weight, seed and straw yields were recorded during both the years of study. Recorded data were compiled and statistically analysed under randomized block design to interpret the results.

Results and Discussions

Effect on Growth of crop

Growth with respect to germination, plant population and plant height were recorded at vegetative phase of crop. Data presented in Table 1 reveal significant variations among the treatments and the highest germination (66.5%) followed by 63.3 percentage were recorded under broad bed furrow sowing either 3 rows or 5 rows sown on the bed, respectively. However, ridge and furrow proved equally good to broad bed furrow planting but found significantly superior to farmers practice.

As regards to plant populations, on an average the highest counts of 42 plants followed by 41.2/m² were recorded under farmers practice and ridge and furrow planting. Moreover, broad bed furrow noted the almost equal number of plants (37.0 and 36.2/m²) under 3 and 5 rows, respectively. The taller plants (56.0 cm height) were observed under farmers practice followed by ridge and furrow, whereas, broad bed furrow planting technique produced shorten plants of 47.0 and 50.5 cm long under 3 and 5 rows on broad bed, respectively. The taller plants under farmers practice might be due to higher seed rate that had more competition for sun light and space (Motwani and Ashish, 2018) [5].

Amongst the planting techniques, broad bed furrow recorded more number of filled pods (31/ plant) seeds/pod (2.2/pod) as well as 100 seed weight of 9.05 g closely followed by 2.20 and 9.03g under broad bed furrow 3 rows and BBF 5 rows, respectively and proved superior over farmers practice and ridge furrow techniques of planting. The lowest values of filled pods/plant, seeds/pod and 100 seeds weight of 14, 1.6

and 8.57 were recorded under farmers practice. Availability of the machinery helps to improve the growth of crop in broad bed furrow 3 rows and BBF 5 rows (Madanzi *et al.*, 2010 [6]; Matsuo *et al.*, 2019) [7].

Crop Yield

Data in relation to seed and straw yields were recorded and presented in Table 2. Data reveal significant variations amongst the planting techniques. Significantly the highest average seed (22.3 q/ha⁻¹) and straw (54.2 qha⁻¹) yields were recorded under broad bed furrow with five rows of crop followed by broad bed furrow with three rows of soybean, crop (20.4 and 50.90 qha⁻¹), respectively showed superior and over farmers practice as well as ridge and furrow method. The broad bed furrows registered 95.6 and 78.9% higher seed yield as well as 77.1 and 66.4 percentage of straw yields under 5 and 3 rows, respectively, over farmers practice. Moreover, ridge and furrow gave 43.0 and 37.3% higher seed and straw yields over farmers practice but found statistically inferior over broad bed furrow. Similar results has been reported MP-JICA project (2016) [2]. The Furrow Irrigated Raised Bed System (FIRBS) and Broad bed and furrow (BBF) method give 23.3 and 15.2 per cent higher yield over sweep blade type seed drill (Madanzi *et al.*, 2010 [6]; Matsuo *et al.*, 2019) [7].

Economics

Economics of the various sowing treatments (Table 3) of soybean on Broad Bed in 5 rows earned maximum gross return (Rs. 122650/- per ha) and net monetary return of Rs. 89750/- per ha with B:C ratio of 3.72 followed by BBF 3 rows which gave Rs. 79150/- per ha net return with B:C ratio of 3.39. Whereas, farmers practice fetched only Rs. 24950/- per ha with B:C ratio of 1.66. Using machinery for the sowing and preparing bed and furrow will save the time and increase economic returns (Matsuo *et al.*, 2019) [7].

Table 1: Growth and yield attributes of soybean under various planting techniques

Treatments	Germination (%)	Plant Population (m ²)	Plant height (cm)	Pods/plant		Seeds /pod	100 seeds weight (g)
				Filled	Unfilled		
Farmers practices	61.2	42	56	14	29	1.6	8.57
RF method	65.5	41.2	52.2	23	17	2.0	8.85
BBF (3 rows)	66.3	37.0	47.0	28	14	2.2	9.03
BBF (5 rows)	66.5	36.2	50.05	31	16	2.2	9.05

Table 2: Seed and straw yields of soybean under different planting techniques

Treatments	Seed yield (q/ha)	Change in Seed Yield (%)	Straw yield (q/ha)	Change in straw yield (%)	Harvest Index
Farmers practices	11.40	-	30.6	-	37.40
RF method	16.30	43.0	42.0	37.20	38.85
BBF (3 rows)	20.40	78.9	50.9	66.00	40.09
BBF (5 rows)	22.30	95.6	54.2	77.25	41.15
SEm(±)	1.18		5.60		
CD (5%)	3.55		16.70		

Table 3: Economics of different sowing techniques of soybean

Treatments	Cost of fixed inputs (Rs/ha)	Cost of operation (Rs/ha)	Cost of Seed (Rs/ha)	Total Cost (Rs/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C Ratio
Farmers practices	15500	8750	12500	37750	62700	24950	1.66
RF method	15500	12050	7500	35050	89650	54600	2.55
BBF (3 rows)	15500	11550	6000	33050	112200	79150	3.39
BBF (5 rows)	15500	11400	6000	32900	122650	89750	3.72

Conclusion

Based on two years findings, it is concluded that broad bed furrow planting is superior over ridge and furrow as well as

flatbed planting by seed cum fertilizer drill machine and gave better germination of seed, plant stands, which further

contributes to filling of grains and number of grains/pod hence ultimately increased the grain yield per hectare.

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