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Influence of different seed bed configurations on growth characters and yield of soybean (*Glycine max* L.) in Malwa Region of Madhya Pradesh

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ABSTRACT
The cultivation of soybean crop in flat bed to raised bed offers more effective control over irrigation and drainage as well as their impacts on rainwater management during the monsoon season. The field trials were conducted during the two consecutive years Kharif 2017 and Kharif 2018 at farmer's field in Gogarpura, and Guradia deda villages of Mandsaur district of Madhya Pradesh to assess the effect of different seed bed configurations on growth characters and yield of soybean. The experiment consists of three seed bed configurations i.e., flat bed sowing at 45 cm inter row spacing (T1), raised bed of 90 cm with 3 crop rows per bed (T2) and raised bed of 60 cm with 2 crop rows per bed (T3) with ten replications. The treatment T3 was found significantly superior in terms of plant height, number of root nodules per plant at flowering, number of pods per plant, grain yield, straw yield and harvest index as compared to treatments T1 and T2. The grain yield was found maximum in treatment T3 (16.73 q/ha) followed by treatment T2 (14.88 q/ha) and treatment T3 (14.71 q/ha). The treatment raised bed of 60 cm with 2 crop rows per bed (T3) recorded highest net return of 38455 Rs/ha with B:C ratio of 2.91 was found economically feasible as compared to other seed bed configurations in Malwa Region of Madhya Pradesh.
Keywords – *Raised bed, Soybean, Grain yield, Net return, B:C ratio*

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INTRODUCTION

Soybean (*Glycine max.* L.) is a major crop grown during the Kharif or monsoon season in the rainfed areas of central and peninsular India. Soybean is known as "Golden bean", "Miracle crop" etc., because of its several uses. In India, the soybean crop presently covers an area of about 12 million hectares with a total production of about 14 million tones [3]. The three largest soybean producing states are Madhya Pradesh, Maharashtra and Rajasthan. Soybean has emerged as a potential crop for changing the economic position of the farmers in India particularly in Madhya Pradesh. For improvement of agricultural productivity the package of improved implement, machines play important role, besides high yielding varieties, fertilizer, irrigation and plant protection practices. Mechanization of agriculture has assumed greater importance for increasing agricultural production and productivity by efficiently and effectively utilizing scarce resources and costly farm inputs improving timeliness factor, reducing labour cost and human drudgery etc. for soybean and wheat cropping system. Most of the farmers used seed drill for sowing of soybean on flat bed system, but due to improper drainage in the field, the yield of soybean reduced drastically.

Land treatments (raised sunken bed system, ridges and furrows, broad bed and furrows) increased in situ soil moisture conservation, minimized runoff, and soil erosion [11]. Change over from growing crops in flat bed to ridge-furrow system of planting crops on raised bed alters the crop geometry and land configuration, offers more effective control over irrigation and drainage as well as their impacts on transport and transformations of nutrients, and rainwater management during the monsoon season. In Central India, majority of the area under

soybean–wheat based cropping system is covered under vertisols and associated soils [2]. These soils are potentially productive, if managed properly in terms of overcoming soil, water and nutrient management constraints.

In recent years, raised bed system has proved to be one of the important components of low cost sustainable production system. This planting system facilitates mechanical weed control, increased water use efficiency, reduced crop lodging and has lower seed requirement [9]. Potential agronomic advantages of beds include improved soil structure due to reduced compaction through controlled trafficking, reduced water logging and timely machinery operations due to better surface drainage. Beds also create the opportunity for mechanical weed control and improved fertilizer placement [12]. Jat and Singh [5] reported higher biological yield and highest net and gross return from land configuration treatment as compared to conventional system. Presently, most of the farmers are being used seed drill for sowing of soybean on flat bed system, but the yield of soybean reduced drastically due to improper drainage in the field. Water logging adversely affects the growth of crop, primarily due to reduced oxygen supply to the roots. Therefore, to overcome the crop from excess moisture as well as moisture stress during crop growth period a field experiment was conducted at farmer's fields to study the effect of different seed bed configurations on the growth characters and yield of soybean in Mandsaur district of Madhya Pradesh.

MATERIALS AND METHODS

The study was carried out during the two consecutive years Kharif 2017 and Kharif 2018 at farmer's field in Gogarpura, and Guradia deda villages of Mandsaur district of Madhya Pradesh to assess the effect of different seed bed configurations on growth characters and yield of soybean. The study area is situated in western part of Madhya Pradesh which falls under agro-climatic zone of Malwa plateau. Mandsaur belongs to sub-tropical climate having a mean temperature range of minimum 5^0C and maximum 44^0C in winter and summer, respectively. The topography of the experimental site was uniform and leveled. The soil is clayey in texture with 45 cm depth with pH 7.5 to 7.7, organic carbon 6.1 to 6.4 g/kg soil, EC 0.40 to 0.42 dS/m at the start of experiment. The area normally receives annual rainfall ranging from 750-800 mm per annum out of which about 90 per cent of is received between June and September.

The experiment consists of three seed bed configurations i.e., flat bed sowing at 45 cm inter row spacing (T1), raised bed of 90 cm with 3 crop rows per bed (T2) and raised bed of 60 cm with 2 crop rows per bed (T3) with ten replications. A tractor drawn raised bed seed drill commercially available at custom hiring centre was used to make raised bed system for sowing of soybean crop in experimental plots as per treatments whereas conventional seed drill was used for flat bed sowing under farmers practice. The furrows developed by raised system were useful to drain out excessive rainwater during heavy storms and for storing rainwater in furrows for enriching soil moisture through percolation in case of deficit rainfall. The recommended seed rate 80 kg/ha was used for sowing along with recommended package of practices including use of fertilizers and appropriate Rhizobium inoculation. The recommended dose of nutrient for soybean i.e., 20 kg N, 60 kg P_2O_5 and 20 kg K_2O ha^{-1} was applied in all the treatments. Required plant protection measures were taken as and when found essential.

The observations on plant population, plant height at flowering, number of branches per plant at harvest, number of root nodules per plant at flowering, number of pods per plant, grain yield, straw yield and harvest index were recorded for all the treatments and analyzed statistically. The economics of the present study was also worked out for both the experimental years i.e., Kharif 2017 and Kharif 2018. The technique of representative sample was adopted for recording the observations on various morphological characters in soybean. At every observation, five plants from each treatment plot were randomly selected and tagged. The details of methodology adopted for recording the various observations are given in Table 1.

RESULTS AND DISCUSSION

The year wise (Kharif 2017 and Kharif 2018) and pooled data on parameters related to crop growth and yield as influenced by different seed bed configurations in soybean are presented in Table 2. The statistical analysis showed that there was no significant difference ($P \geq 0.05$) on plant population and number of branches per plant at harvest due to different treatments. The year wise and pooled mean data related to other crop growth and yield parameters were found higher in treatment T3 (raised bed of 60 cm with 2 crop rows per bed) as compared to in treatment T1 (flat bed sowing at 45 cm inter row spacing) and treatment T2 (raised bed of 90 cm with 3 crop rows per bed). The plant height at flowering

was found maximum in treatment T3 (45.70 cm) followed by treatment T2 (43.76 cm) and treatment T1 (43.54 cm). The increase in plant height was mainly due to better soil plant water relationship and soil physical condition in treatment T3. Similarly other crop growth and yield parameters viz., number of root nodules per plant at flowering, number of pods per plant, grain yield, straw yield and harvest index were significantly influenced by different land configuration at all the growth stages. The number of root nodules per plant at flowering, number of pods per plant, grain yield, straw yield and harvest index were recorded lower in treatment T1 than treatment T2 and treatment T3. The increase in root nodules in treatment T3 (27.49) by 21.21% than treatment T1 (22.68) and 9.68% than treatment T2 (25.06) may be due to better root development as treatment T3 and treatment T2 provided better physical condition of soil and lower penetration resistance to roots. Lupwayi *et al*. [7] reported the 33% reduced nodules dry matter due to water logging condition. The raised bed planting also encouraged development of pods as treatment T3 (53.36) and treatment T2 (50.25) recorded higher number of pods per plant as compared to treatment T1 (47.12). The present findings are in close vicinity of Raut *et al.* and Jha *et al.* [8 and 6].

Table-1: Details of methodology adopted for recording the observations

S.No.	Parameter	Procedure followed
1.	Plant population (no./m row length)	The plant population was counted from five randomly selected places for all the experimental plots
2.	Plant height at flowering (cm)	The five plants were randomly tagged to count the plant height at flowering for all the experimental plots
3.	Number of branches per plant at harvest	The five plants were randomly tagged to count the number of branches per plant for all the experimental plots
4.	Number of root nodules per plant at flowering	The five plants were dug up randomly from each plot and nodules were counted after its washing at flowering stage
5.	Number of pods per plant	The total number of pods of five plants was counted and average numbers of pods was calculated
6.	Harvest Index, HI (%)	HI=[Economic yield(kg/ha)/Biological yield(kg/ha)] x100 where, Biological yield = Grain yield + Straw yield
7.	Net return (Rs/ha)	Net return (Rs/ha) = Gross return (Rs/ha) – Cost of cultivation (Rs/ha)
8.	Benefit cost ratio (B:C)	B:C = Gross return (Rs/ha)/Cost of cultivation (Rs/ha)

Table-2: Crop growth and yield parameters as influenced by different seed bed configurations in soybean

Parameter	Treatment T1			Treatment T2			Treatment T3			SEm±	CD (P=0.05)
	Kharif 2017	Kharif 2018	Pooled	Kharif 2017	Kharif 2018	Pooled	Kharif 2017	Kharif 2018	Pooled		
Plant population (no./m row length)	10.35	10.55	10.45	10.72	10.88	10.80	10.94	11.02	10.98	0.08	NS
Plant height at flowering (cm)	41.77	42.11	41.94	43.54	43.97	43.76	45.68	45.71	45.70	1.03	1.62
Number of branches per plant at harvest	5.98	6.14	6.06	6.33	6.40	6.37	6.55	6.66	6.61	0.22	NS
Number of root nodules per plant at flowering	22.42	22.93	22.68	24.90	25.22	25.06	27.38	27.59	27.49	1.67	8.24
Number of pods per plant	47.03	47.21	47.12	50.14	50.35	50.25	53.27	53.44	53.36	2.45	10.09
Grain yield (q/ha)	11.96	12.37	12.17	14.71	15.04	14.88	16.63	16.82	16.73	1.88	7.57
Straw yield (q/ha)	26.29	26.47	26.38	31.58	31.80	31.69	34.95	34.76	34.86	2.96	11.23
Harvest Index (%)	31.27	31.85	31.56	31.78	32.11	31.95	32.24	32.61	32.43	0.38	1.94

The grain yield and straw yield were found maximum in treatment T3 (16.73 q/ha and 34.86 q/ha respectively) followed by treatment T2 (14.88 q/ha and 31.69 q/ha respectively) and treatment T3 (14.71 q/ha and 31.58 q/ha respectively). Superior yield with treatment T3 was mainly due to increased number of pods as the results of conserving more rainwater, nutrient and soil resources. Similar results of higher yields in altered (raised bed) land configuration over flat bed method were also reported by Autkar *et al.* and Selvaraju *et al.* [1 and 10]. The harvest index was also observed higher in treatment T3 (32.43) as compared to treatment T2 (31.95) treatment T1 (31.56).

The economics of the present study was worked out for both the experimental years i.e., Kharif 2017 and Kharif 2018 as well as for pooled mean data. The benefit cost ratio (B:C) and net return are the best indices to express the profitability of soybean cultivation which were calculated on the basis of cost of cultivation and gross return. From Table 3, it is clear that the higher net return of 38455 Rs/ha with B:C ratio of 2.91 was recorded for soybean cultivation under treatment T3 followed by treatment T2 (31980 Rs/ha and 2.59) and treatment T1 (23045 Rs/ha and 2.18). Gupta *et al.* [4] were also reported an increase in net return and B:C ratio of soybean cultivation due in altered land configuration over flat bed method.

Table-3: Economics parameters as influenced by different seed bed configurations in soybean

Parameter	Treatment T1			Treatment T2			Treatment T3		
	Kharif 2017	Kharif 2018	Pooled	Kharif 2017	Kharif 2018	Pooled	Kharif 2017	Kharif 2018	Pooled
Cost of Cultivation (Rs/ha)	19450	19650	19550	19900	20300	20100	19900	20300	20100
Gross Return (Rs/ha)	41860	43295	42595	51485	52640	52080	58205	58870	58555
Net Return (Rs/ha)	22410	23645	23045	31585	32340	31980	38305	38570	38455
Benefit Cost Ratio (B:C)	2.15:1	2.20:1	2.18:1	2.59:1	2.59:1	2.59:1	2.92:1	2.90:1	2.91:1

CONCLUSION

It can be concluded that the practice of soybean cultivation on raised seed bed configurations was found superior in comparison with flat bed method of sowing. The results of the study indicated that the higher productivity (16.73 q/ha) with maximum net return (38455 Rs/ha) of soybean cultivation can be achieved by raised seed bed configurations as compared to flat bed method of sowing in Malwa region of Madhya Pradesh.

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