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INFLUENCE OF FURROW IRRIGATED RAISED BED SEED DRILL ON GROWTH CHARACTERS AND YIELD OF SOYBEAN (*GLYCINE MAX* L.) IN MANDSAUR DISTRICT OF MADHYA PRADESH, INDIA

Rajesh Gupta[1]*, G. S. Kulmi[1], A. L. Basediya[2] and Mohanlal Jadav[3]

[1]RVSKVV, KVK, Mandsaur - 458 001 (Madhya Pradesh), India.
[2]RVSKVV, KVK, Shivpuri - 473 551 (Madhya Pradesh), India.
[3]RVSKVV, College of Agriculture, Sehore - 466 001 (Madhya Pradesh), India.

Abstract

The field trials were conducted during the two consecutive years 2014-15 and 2015-16 at farmer's field in Daludarail and Gurjarbardia villages of Mandsaur district of Madhya Pradesh to assess the effect of furrow irrigated raised bed (FIRB) seed drill on the growth characters, yield and economic parameters of soybean cultivation. The FIRB seed drill was found superior in terms of plant population, number of branches per plant at 60 DAS, number of root nodules per plant at 60 DAS, number of pods per plant at harvest, seed index and harvest index as compared to conventional seed drill. Though, less consumption of fuel (28.35 l/ha) was recorded in conventional seed drill but the productivity of soybean was observed highest in FIRB seed drill (1318 kg/ha) whereas, it was found lowest in conventional seed drill (1103 kg/ha). The higher net return of 25792 Rs/ha with B:C ratio of 2.36 was recorded for soybean cultivation under FIRB drill as compared to lower net return 18735 Rs/ha with B:C ratio of 2.00 for soybean cultivation under conventional seed drill.

Key words : FIRB seed drill, conventional seed drill, fuel consumption, soybean, B:C ratio.

Introduction

Oilseeds are raised mostly under rainfed conditions and important for the livelihood of small and marginal farmers in arid and semi-arid areas of the country. In India, the soybean (*Glycine max* L.) cultivation has gained momentum in oil front with the steady increase in the area and production. 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 tonnes (Directorate of Economics and Statistics, 2016). The three largest soybean producing states are Madhya Pradesh, Maharashtra and Rajasthan. Owing to possessing and sustaining a major share of soybean area (about 57% at present), Madhya Pradesh is called the Soy-State. Extreme variability in the quantity, time and duration of rains expose the soybean crop to soil moisture deficit as well as excess moisture either on account of delayed monsoon, longer dry spells or early withdrawal of monsoon has been identified as one of the major factors for poor performance of the soybean crop (Joshi and Bhatia, 2003 and Tiwari, 2014).

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. The planting of crops on furrow irrigated raised/broad have been found effective in mitigating the adverse effect of water stress and improvement in soil physical and biological environment (Anonymous, 2007-08 and 2008-09). In Central India, majority of the area under soybean–wheat based cropping system is covered under vertisols and associated soils (Bhatnagar and Joshi, 1999). These soils are potentially productive, if managed properly in terms of overcoming soil, water and nutrient management constraints. Plants

***Author for correspondence :** E-mail: rajgupta171@gmail.com

benefit from the improved soil drainage and aeration, and plant roots penetrate readily. Tomar *et al*. (1996) reported that maximum average seed yield of soybean was recorded in 6 m wide raised bed followed by 9 m raised bed and minimum in flat plots. Besides providing adequate surface drainage to soybean crop, the land configurations were also useful during prolonged dry spell there by, minimizing any adverse effect of soil moisture stress at flowering and seed development stages of rainy season crops. Ram *et al*. (2011) concluded that raised bed, raised broad bed and ridge furrow sowing of soybean should be advocated over flat bed sowing mainly due to their ability to save irrigation water. In adverse climate condition, excess rainwater drained out from the field through furrows to minimize its harmful effect on the crop (Kumar *et al.*, 2002). Therefore, to save the crop from moisture stress as well as excess moisture during crop growth period and to minimize the cost of cultivation without compromising with sustainability, a field experiment was conducted at farmer's fields to observe effect of furrow irrigated raised bed (FIRB) seed drill on the growth characters and yield of soybean in Mandsaur district of Madhya Pradesh.

Materials and Methods

The study area is situated in western part of Madhya Pradesh, which falls under agro-climatic zone of Malwa plateau. The field trials were conducted during the two consecutive years 2014-15 and 2015-16 at farmer's field in Daludarail and Gurjarbardia villages of Mandsaur district of Madhya Pradesh to assess the effect of furrow irrigated raised bed (FIRB) seed drill on the growth characters and yield of soybean. The area normally receives assured annual rainfall ranging from 750-800 mm per annum. Almost 90 per cent of which is received between June and September. The rainfed agriculture suffers from a number of hydro-physical and socio-economic constraints, which affect the productivity of rainy and post rainy season crops. The topography of the experimental site was uniform and leveled and the soil is clayey in texture with 45 cm depth. A tractor drawn raised bed (FIRB) seed drill commercially available at custom hiring centre was used to make raised bed system for sowing of soybean crop in experimental plot whereas conventional seed drill was used under farmers practice. The parameters related to tractor operated deed drill *viz*., field capacity & field efficiency of seed drill, time & labour required, fuel consumption and cost of operation during sowing were recorded for FIRB seed drill and conventional seed drill. The observations on plant population, number of branches per plant, number of root nodules per plant, number of pods per plant, seed index, seed & straw yield and harvest index were also recorded for both the fields sown by FIRB seed drill and conventional seed drill. The economics of the present study was also worked out for both the experimental years *i.e.*, 2014-15 and 2015-16. 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 parameters and procedures followed are given in table 1. The field efficiency of FIRB and conventional seed drill was calculated using following equation as stated by Smith and Wilkes (1977).

$$\text{Field efficiency (\%)} = \frac{\text{Effective field capacity}}{\text{Theoretical field capacity}} \times 100$$

The effective field capacity (EFC) of the seed drill was calculated using the following equation :

$$\text{EFC}(\text{ha/h}) = \frac{\text{A}}{\text{T} \times 10000}$$

Where,

A = Area of field (m^2).

T = Time required to cover the filed area (h).

The Theoretical field capacity (TFC) is calculated by using following equation :

$$\text{TFC}(\text{ha/h}) = \frac{\text{W} \times \text{S}}{10}$$

Where,

W = Width of seed drill (m).

S = Forward speed of tractor (km/h).

The experimental data recorded were subjected to statistical analysis using 't' test as suggested by Fisher and Guinness Fisher (1987). The experiment comprising two treatments with five replications and in this case the number of plots was 02 × 05 = 10 and degree of freedom was 8 [(5-1) + (5-1)]. The calculated 't' value is compared with the theoretical value from a 't' table at 5 per cent probability level.

Results and Discussion

The result showed no significant differences ($P \geq 0.05$) between the furrow irrigated raised bed (FIRB) seed drill and conventional seed drill for sowing machinery parameters of soybean crop except fuel consumption. The year wise (2014-15 and 2015-16) and pooled data on parameters related to sowing machinery *viz*., effective

Table 1 : Details of crop growth and economic parameter.

S. no.	Parameter	Procedure followed
1.	Plant population (no./m^2)	The plant population was counted from five randomlyselected places for all the experimental plots
2.	Number of branches/plant	The five plants were randomly tagged to count the number of branches per plant for all the experimental plots
3.	Number of root nodules/plant	The five plants were dug up randomly from each plot and nodules were counted after its washing at 60 days after sowing
4.	Number of pods per plant	The total number of pods of five plants was counted and average numbers of pods was calculated
5.	Seed index (g)	The weight of randomly picked 100 seeds from produce of each plot was recorded
6.	Harvest Index, HI (%)	HI = [Economic yield (kg/ha)/Biological yield (kg/ha)] x 100where, 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 : Machine parameters of FIRB seed drill and conventional seed drill.

Parameter	FIRB seed drill			Conventional seed drill			% change over conventional seed drill	CD at 5 %
	2014-15	2015-16	Pooled Mean	2014-15	2015-16	Pooled Mean		
Effective field capacity (ha/hr)	0.384	0.395	0.390	0.377	0.388	0.383	1.83	NS
Theoretical field capacity (ha/hr)	0.603	0.612	0.608	0.566	0.571	0.569	6.86	NS
Field efficiency (%)	63.68	64.54	64.11	66.61	67.95	67.28	-4.71	NS
Labour required (man-h/ha)	4.37	4.41	4.39	4.28	4.32	4.30	2.09	NS
Fuel consumption (l/ha)	34.46	35.38	34.92	27.96	28.73	28.35	23.20	4.56
Cost of operation (Rs/ha)	1294	1322	1308	1246	1302	1274	2.67	NS

NS – Non-significant.

field capacity, theoretical field capacity, field efficiency of implement, time & labour required, fuel consumption and cost of operation during sowing recorded for FIRB seed drill and conventional seed drill are presented in table 2. The pooled data showed that more fuel consumption (34.92 l/ha) was recorded for operating FIRB seed drill as compared to fuel consumption of conventional seed drill (28.35 l/ha).

The year wise and pooled mean data related to crop growth parameters and economics of soybean cultivation for FIRB seed drill and conventional seed drill are presented in table 3. It is evident from the pooled data that the plant population, number of branches per plant at 60 DAS, number of root nodules per plant at 60 DAS and number of pods per plant at harvest were higher in experimental plots sown by FIRB seed drill as compared to conventional seed drill. The percentage change in plant population, number of branches per plant at 60 DAS, number of root nodules per plant at 60 DAS and number of pods per plant at harvest was observed as 19.89, 6.84, 32.15 and 37.56 per cent, respectively. The present findings are supported by Ralli and Dhingra (2003) for soybean and Shrivastava *et al*. (2017) for wheat crop. The grain and straw yields of soybean were greatly affected by the type of seed drill used. Pooled data revealed that grain yield (1318 kg/ha) and straw yield (1620 kg/ha) of soybean were found higher in FIRB seed drill as compared to grain yield (1103 kg/ha) and straw yield (1386 kg/ha) of soybean in conventional seed drill. It is due the fact that the field sown by FIRB seed drill created better micro-climate as compared to conventional seed drill under both the conditions *i.e.*, the prolonged duration of watering or period of moisture stress. The results are in line with that of Lakpale and Tripathi (2012) and Mandal *et al.* (2013). The statistical analysis showed that there was no significant difference ($P \geq 0.05$) on seed index and harvest index due to different treatments.

The economics of the present study was worked out for both the experimental years *i.e.*, 2014-15 and 2015-16 as well as for pooled mean data. The net return and

Table 3 : Crop growth parameters and economics of soybean for FIRB seed drill and conventional seed drill.

Parameter	FIRB seed drill			Conventional seed drill			% change over conventional seed drill	CD at 5 %
	2014-15	2015-16	Pooled Mean	2014-15	2015-16	Pooled Mean		
Plant population (no./m^2)	46.34	46.79	46.57	38.71	38.97	38.84	19.89	3.25
Number of branches per plant at 60 DAS	5.52	5.57	5.55	5.12	5.26	5.19	6.84	0.20
Number of root nodules per plant at 60 DAS	29.2	30.4	29.8	21.5	23.6	22.6	32.15	3.54
Number of pods per plant at harvest	43.8	44.1	44.0	31.6	32.3	32.0	37.56	3.93
Seed index (g)	12.6	12.4	12.5	11.9	12.2	12.1	3.73	NS
Grain yield (kg/ha)	1314	1322	1318	1091	1114	1103	19.55	4.06
Straw yield (kg/ha)	1606	1634	1620	1374	1398	1386	16.88	5.12
Harvest Index (%)	45.00	44.72	44.86	44.26	44.35	44.30	1.26	NS
Net return (Rs/ha)	25756	25828	25792	18444	19026	18735	37.67	6.74
Benefit cost ratio (B:C)	2.36	2.35	2.36	1.99	2.01	2.00	17.85	0.25

NS – Non-significant.

benefit cost ratio (B:C) 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 25792 Rs/ha with B:C ratio of 2.36 was recorded for soybean cultivation under FIRB seed drill as compared to lower net return 18735 Rs/ha with B:C ratio of 2.00 for soybean cultivation under conventional seed drill. Dhakad and Khedkar (2014) was also reported an increase in net return and B:C ratio of soybean cultivation due to seed drill.

Conclusion

On the basis of the present study, it can be concluded that the practice of soybean cultivation by furrow irrigated raised bed (FIRB) seed drill was found superior in comparison with conventional seed drill. The results of the experiment indicated that the higher productivity (1318 kg/ha) with more net return (25792 Rs/ha) of soybean cultivation can be achieved by FIRB seed drill as compared to conventional seed drill in Mandsaur district of Madhya Pradesh.

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