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Performance of Soybean (*Glycine max*) under Raised Bed Planting in Malwa region of Madhya Pradesh, India

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A B S T R A C T

On-Farm Testing (OFT) were conducted during the two consecutive years 2014-15 and 2015-16 at farmer's field in Shajapur district of Madhya Pradesh to assess the effect of raised bed planting on the growth characters, yield and economic parameters of soybean crop. The field trials were conducted during *kharif* season 2014 to 2015 for soybean crop to assess furrow irrigated raised bed (FIRB) seed cum fertilizer drill. Furrow irrigated raised bed (FIRB) seed cum fertilizer drill was found better in term of growth characters and yield of soybean in comparison with conventional seed drill. The net return is the best index of profitability of soybean crop and higher net return per ha Rs 34533 was recorded for soybean crop under raised bed planting where as lower net return per ha of Rs 18971 was recorded for soybean crop under control.

Introduction

Soybean (*Glycine max* L.) is an important oil seed crop. The total area under soybean cultivation in India was 10.69 mha and total production was 12.67 Mt with productivity of 1185 kg/ha (SOPA, 2014). The machinery such as raised bed planter, conventional seed cum fertilizer drill, ridge and furrow planter, broad bed planter and zero till seed cum fertilizer drill respectively used to sow the seed on raised bed in better pulverized soil so that the minimum compaction of soil over sown seed, promote seed emergence, higher moisture availability to the plants and better drainage facility during rainfall from furrow are available for sowing of soybean of soybean crop.

Whereas, the conventional seed cum fertilizer drill is used to sow the seed on well prepared seed bed and levelled field with minimum

compaction of soil on the sown seed but it requires irrigation in planting for better germination. It facilitates manual and mechanical weeding between rows, optimum plant population, even with reduced seed rate, lower and more efficient seeding rate than broadcasting. Row seeding also promotes maximum tillering and better sunlight penetration.

Though the best placement depends upon the kind of crop, the nature of soil, the type of fertilizer salt and the climatic conditions, it has been conclusively proved that placing any kind of fertilizer in a band 30-50 mm to the side and 20-30 mm deep to the seed is safe and effective for most of the crops (Martin & Leonard, 1976 and Kepner *et al.,* 1987).

Land treatments (raised sunken bed system, ridges and furrows, broad bed and furrows) increased in situ soil moisture conservation, minimized runoff, and soil erosion (Singh *et al.,* 1999).

Nimje *et al.,* (2003) concluded that use of improved seeding machines such as seed-cum-fertilizer drill and strip-till seed-cum-fertilizer drill reduced the cost of operation by Rs 935 and Rs 1,578/ha and increased the net income by Rs 2,589 and Rs 3,703/ha, respectively, over the local seed drills used by the farmers.

They also colclude that planting density of 440,000/ha increased the seed yield by 61.6% and the net returns by Rs 6,669/ha over farmers' practice in farmers field in Bhopal district. Jat and Singh (2003) reported higher biological yield and highest net and gross return from land configuration treatment as compared to conventional system has been reported. Ali and Behera (2014) reported that the performance of soybean was better in raised-bed than flat-bed conventional system of planting.

Beneficial effects of ridge and furrow method of sowing on soybean yield have been reported through an improved soil aeration, moisture, temperatures, better root development and nitrogen fixation (Tisdall and Hodgson, 1990; Jayapaul *et al.,* 1995; Jain and Dubey, 1998; Raut *et al.*, 2000).

Ram & Singh. (2011) conducted an experiment on four sowing methods namely raised bed planting, raised broad bed planting, ridge-furrow. sowing and flat sowing for soybean crop. The highest seed yield was recorded in raised bed sowing, which was 6.70 and 5.29% higher than ridgefurrow and flat sowing methods, respectively.

Dhakad & Khedkar (2014) concluded that field demonstration was conducted during kharif season 2012 to 2013 to study effect of seed-cum-fertilizer drill sowing machine for soybean crop that soybean sown by seed-cum-fertilizer drill was found better in term of growth characters and economics parameters with comparison to simple seed drill sowing machine. Dhakad *et al.,* (2019) concluded that net return is the best index of profitability of soybean crop and higher net return per ha of Rs 25144 was recorded for soybean crop under ridge and furrow seed cum fertilizer drill whereas lower net return per ha of Rs 18025 was recorded under normal seed drill sowing.

With a view to generate information, a field experiment was conducted at at farmer's fields to observe effect of seed-cum-fertilizer drill sowing machine on the growth characters and yield of soybean.

Materials and Methods

The field experiments were conducted at the farmer's fields during *kharif* seasons 2014 and 2015 for soybean crop in the selected village under operational area of Krishi

Vigyan Kendra Shajapur to assess the effect of raisedbed planting on yield and economics of soybean crop . The climate of the region is tropical sub-humid receiving an rainfall of 740 mm and 1387 mm in year 2014 and 2015 respectively with maximum and minimum temperature of 45°C and 5°C, respectively. The soils of experiment sites were medium black soil.

Soybean variety JS 95-60 was used during kharif 2014 and 2015. The tractor operated raised bed planter had been used in sowing of soybean in which two raised bed can be made on which planting is also carried out simultaneous. Machine can sow two rows of soybean on each bed. Fertilizer drilling can also be accomplished on the raised bed.

This raised bed planter is capable of making furrows of desired depth and width at both the sides of the bed and can be used for simultaneous sowing of crop in one operation. These furrows are 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 and the soil moisture thus stored sustain the crop during dry spells (Singh *et al.,* 2011).

Nimje *et al.,* (2002) & Dhakad *et al.,* (2017) reported that effect of seed-cum-fertilizer drill sowing machine for soybean crop. The observations plant height, number of branches per plant, number of root nodules per plant, number of pods per plant, seed index, seed yield, straw yield, harvest index and economics of treatments were calculated for continuously two years for soybean crop. The parameters and procedures followed are given in table 1.

The data collected on various characters of soybean crop was processed and subjected to statistical analysis by t test as suggested by William Sealy Gosset (Fisher Box, Joan 1987). The experiment comprising two treatments with five replications and in this case the number of plots was 02 x 05 = 10 and degree of freedom was 8 {(5-1) + (5-1)}. Statistical analysis was carried out by analyze the difference between two treatments using the 't' test of significance and the formula for T test is given below

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where,

$\bar{x}_1$= Mean of first set of values
$\bar{x}_2$= Mean of second set of values
S_1 = Standard deviation of first set of values
S_2 = Standard deviation of second set of values
n_1 = Total number of values in first set
n_2 = Total number of values in second set.

Finally, the calculated’t’ value is compared with the theoretical value from a 't' table at 5% probability level. Based on the comparison of calculated’t’ value with the theoretical 't' value from the table, we conclude: If the calculated “t” value is greater than the theoretical 't' value, then the difference between the two treatments is significant. If the calculated 't' value is less than the theoretical 't' value, then the difference between the two treatments is not significant.

Results and Discussion

Growth and yield attributing characteristics of soybean are presented in Table 2. Table revealed that the plant growth and yield parameters were found better in raisedbed planting system as compared to ridge and furrow. Its due to proper drainage of excess rainfall through furrows and moisture

conservation during dry spell. Similar results were reported by Ralli and Dhingra (2003) and he found that the higher nodule count under ridge sowing when compared with flat sowing for soybean crop.

The grain yield, straw yield and net monetary returns were higher under raisedbed seed cum fertilizer drill sowing compare to ridge and furrow. The highest productivity of 1644 kg ha^{-1} observed in the seed cum fertilizer drill sowing whereas lowest under normal seeddrill sowing (1235 kg ha^{-1}) for soybean crop. The net return is the best index of profitability of soybean crop and higher net return per ha Rs 34533 was recorded for soybean crop under raisedbed planting where as lower net return per ha of Rs 18971 was recorded for soybean crop under ridge and furrow.The plant height, number of branches per plant, number of root nodules per plant, number of pods per plant, seed yield, straw yield and net monetary returns were statistically higher in raisedbed sowing compare to ridge and furrow for soybean crop. The analysis showed that there was no significant difference on seed index, grain straw ratio and harvest index due to treatments was observed. Nimje *et al.,* (2002) Dhakad & Khedkar (2014) & Dhakad *et al.,* (2019) also reported an increase in net income of soybean due to seed-cum-fertilizer drill.

Table.1 Details of crop growth and economic parameter

S. No.	Parameter	Procedure followed
1.	Plant height	**Plant height at 60 days after sowing, and at harvest stage was recorded In plot five plants were selected randomly and tagged for periodic observation.**
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.	Seed yield (kg/ha)	**The plants were harvested net plot-wise and then threshed after the sun drying.**
7.	Stover yield (kg/ha)	**The produce after harvesting were left in the field then tied the bundles of each net plot for sun drying.**
8.	Harvest Index, HI (%)	**HI = [Economic yield (kg/ha)/Biological yield (kg/ha)] x 100 where, Biological yield = Grain yield + Straw yield**
9.	Net return (Rs/ha)	**Net return (Rs/ha) = Gross return (Rs/ha) – Cost of cultivation (Rs/ha)**
10.	**Benefit cost ratio (B:C)**	**B : C = Gross return (Rs/ha)/Cost of cultivation (Rs/ha)**

Table.2 Growth characters and economics of soybean

Economic parameters	Two year pool data for Soybean			
	Raisedbed planting	Ridge and furrow	% increase	CD at 5%
Plant height at harvesting (cm)	64.8	56.2	15.30	S
Number of Branches per plant at 60 DAS	4.02	3.82	5.24	S
Number of root nodules per plant at 60 DAS	36.4	28.6	27.27	S
Number of pods per plant at harvesting	48.4	36.4	32.97	S
Seed Index (g)	10.4	10.2	1.96	NS
Grain yield (kg/ha)	1644	1235	33.12	S
Straw yield (kg/ha)	2032	1560	30.26	S
Grain straw ratio	0.8	0.79	1.27	NS
Harvest index (%)	44.7	44.1	1.36	NS
Net monetary returns (Rs/ha)	34533	18971	82.03	S
Benefit: cost ratio	2.76	1.99	38.69	S

Effect of raisedbed planting in soybean crop found better in comparison over control due to safe removal of excess rain water, soil moisture stored sustains the soybean crop during dry spells, proper aeration in root zone of soybean crop. The results of experiment indicate that for achieving higher productivity of soybean crop, the soybean crop should be sown by raisebed planter seed drill.

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