RESEARCH PAPER | International Journal of Agricultural Engineering | Volume 11 | Issue 1 | April, 2018 | 205-209
e ISSN–0976–7223 ■ Visit us : *www.researchjournal.co.in* ■ **DOI: 10.15740/HAS/IJAE/11.1/205-209**

Impact of front line demonstration of raised bed seed cum fertilizer drill on growth and yield of soybean *(Glycine max* L.) in Indore district of Madhya Pradesh

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Received : 02.01.2018; **Revised :** 04.03.2018; **Accepted :** 16.03.2018

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■ **ABSTRACT :** The farmer's field front line demonstrations were conducted during *Kharif* season 2014 to 2016 for soybean crop to demonstrate raised bed seed cum fertilizer drill and simple seed drill. Raised bed seed cum fertilizer drill was found better in term of growth characters and yield of soybean in comparison with simple seed drill sowing machine. The net return is the best index of profitability of soybean crop and higher net return per ha of Rs. 25246 was recorded for soybean crop under raised bed seed cum fertilizer drill whereas lower net return per ha of Rs. 17410 was recorded under normal seed drill sowing and yield was found 1440 and 1191 kg/ha, respectively.

■ **KEY WORDS :** Soybean, Raised bed, Front line demonstration, Growth character, Yield

■ **HOW TO CITE THIS PAPER :** Singh, Jitendra, Kumari, Archana, Mishra, D.K. and Pachlaniya, Nitin (2018). Impact of front line demonstration of raised bed seed cum fertilizer drill on growth and yield of soybean *(Glycine max* L.) in Indore district of Madhya Pradesh. *Internat. J. Agric. Engg.*, **11**(1) : 205-209, **DOI: 10.15740/HAS/IJAE/11.1/205-209.**

Soybean (*Glycine max* L.) is a "golden bean" of 21st century mainly due to its high protein (40%) and oil (20%) content and is now making headway in Indian agriculture. M.P. has a unique distinction of having more than 87 per cent soybean (*Glycine max*) (Dwivedi *et al.*, 2006) area of the country and is rightly designated as soya state. 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. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and seed to seed spacing, cover the seeds with soil and provide proper compaction over the seed. The recommended row to row spacing, seed rate, seed to seed spacing and depth of seed placement vary from crop to crop and for different agro-climatic conditions to achieve optimum yields through the proper placement of fertilizers in relation to seeds or plant roots is important for efficient utilization of nutrients. Application of fertilizers directly above or below the seed is not much effective as fertilizer so placed may move into the seed zone with movement of water that takes place mostly in vertical direction. Crop sowing refers to placement of seeds in the soil under optimum condition and as per required seed rate. Line sowing is the most efficient means of sowing the crops and most ideal for crop management (Devnani, 1989). 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. 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.

Rawat *et al.* (2011) concluded that the zero till ferti seed drill was found energy efficient and cost efficient compared to conventional sowing of wheat on the basis of energy ratio, specific energy and benefit cost ratio. The study has revealed that it is possible to save machine labour and irrigation water under zero tillage than under conventional method due to resource saving, net return has been significantly higher in zero tillage technology (Tripathi *et al.*,2013). Muhammad *et al*. (2013) concluded from the results that tillage implements followed by rotavator showed better performance in terms of number of tillers and harvest index of wheat than sole use of tine cultivator twice and sowing by drill produced better results in terms of emergence, number of tillers, spike length and harvest index as compared to broadcasting. Patro *et al*. (2014) conducted experiment on four sowing methods (conventional sowing, seedcum-fertilizer drill sowing, paired row sowing and crisscross sowing) on groundnut production and concluded that paired row sowing gave significantly highest pod yield and net returns (1781 kg ha^{-1} and Rs. 19730 ha^{-1}, respectively). Paired row sowing also improved various yield associated attributes *viz.*, number of pegs (35.1) and pod $plant^{-1}$ (27.6), shelling percentage (66.6), 100 kernel weight (33.6 g) and profitability (Rs.19,730) in groundnut. Dhakad *et al.* (2017) have been conducted the field experiments during *Kharif* season 2014 to 2015 in the Shajapur district of Madhya Pradesh for soybean crop to assess seed-cum-fertilizer drill and simple seed drill. They said that seed-cum-fertilizer drill was found better in term of growth characters and yield of soybean in comparison with simple seed drill sowing machine and they reported that the net return is the best index of profitability of soybean crop and higher net return per ha of Rs. 25569 was recorded for soybean crop under seed cum fertilizer drill whereas lower net return per ha of Rs.17188 was recorded under normal seed drill sowing.

METHODOLOGY

The field experiments were conducted at the farmer's fields during *Kharif* seasons 2014 to 2016 for soybean crop in the village Ashakhedi, Mundi, Ramukhedi and Rampuria of Madhya Pradesh to demonstrate the effect of raised bed seed cum fertilizer drill on yield and economics of soybean crop. Raised bed seed cum fertilizer drill sowing machine was used for sowing of soybean crop in experimental plot and conventional seed drill was used under farmers practice. Raised bed seed cum fertilizer drill is a machine that places seeds and fertilizer in separate bands at specified rates in rows at proper depth and covers with soil on the raised bed formed by raised bed former and shaped by trapezoidal shaper attachment. The raised bed seed cum fertilizer drill consists of a seed box, fertilizer box, seed and fertilizer metering mechanisms, seed tubes, furrow openers, seed and fertilizer rate adjusting lever, raised bed former and transport cum power transmitting mechanism. Time required in sowing, diesel consumption, field capacity of implement, require labour and cost of operation during sowing were measured from raised bed seed cum fertilizer drill and normal seed drill sowing machine (farmers practice). The observations like plant height, number of branches per plant, number of pods per plant, seed index, seed yield, straw yield, harvest index and economics of all the treatments were measured/ counted/calculated for continuously three years for soybean crop.

Measurement of different parameters for soybean and wheat:

Theoretical field capacity:

For calculation of theoretical field capacity the following equation as stated by Smith and Wilkes (1977) was used:

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

where,

TFC = Theoretical field capacity, ha/h

W = Implement width, m

S = Tractor speed, km/h

Effective field capacity:

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

where,

EFC = Effective field capacities, ha/h

A = Area of the field, m^2

T = Time needed to cover field, h.

Field efficiency:

$$FE\ (\%) = \frac{EFC}{TFC} x100$$

Plant height:

Plant height at 55 days after sowing, and at harvest stage was recorded. In plot five plants were selected randomly and tagged for periodic observation. The height (cm) was recorded at 55 DAS and at harvest stage of the crop in all the plots. It was measured from the ground surface to the main stem apex.

Number of branches per plant:

Number of branches was recorded at 55 DAS and at harvest stage of the crop in all the plots. It was measured on five plants which were selected randomly and tagged.

Number of root nodules per plant:

Nodulation studies of soybean were done from 5 random plants in each demonstration. Five plants dug up randomly in each plot and the nodules were washed out and counted. This study was done at 55 days after sowing.

Number of pods per plant:

The total number of pods of five plants was counted and average figures were worked out.

Seed index (weight of 100 seeds):

The seed samples from the produce of each plot were taken and samples comprising of 100 seeds were drawn irrespective by shape and size from the produce and weight of these seeds was recorded.

Seed yield:

The plants were harvested net plot-wise and then threshed after the sun drying.

Straw yield:

The produce after harvesting were left in the field then tied the bundles of each net plot for sun drying. The straw and stick yield of each net plot was obtained in kg/plot by subtracting the seed yield of respective plot from the weight of these bundles.

Harvest index:

Harvest index is the ratio of economic yield (kg/ha) to biological yield (kg/ha) and multiplied by 100 to obtain its value in percentage. The harvest index was calculated by the following formula:

$$Harvest\ index\ (\%) = \frac{Economic\ yield\ (kg/ha)}{Biological\ yield\ (kg/ha)} x100$$

where,

The biological yield = Seed yield + Stover yield.

Net monetary returns:

Net monetary returns were obtained by subtracting cost of cultivation from gross monetary returns. Net monetary returns are considered to be a good indicator of suitability of a particular cropping system as this represents the accrued net income to the farmer.

Net monetary returns (Rs./ha) = Gross monetary return (Rs./ha) – Cost of cultivation (Rs./ha).

Benefit cost ratio (B:C):

It is the ratio of gross return to cost of cultivation and is expressed as returns per rupee invested.

Benefit cost ratio = Gross monetary return (Rs./ha) / Cost of cultivation (Rs./ha).

The data collected on various characters of implement and soybean crop was processed and subjected to statistical analysis by Randomized Block Design. The experiment comprising two treatments with ten replications and in this case the number of plots was 02 x 10 = 20 each year hence total replications ware 3 x 20=60. Statistical analysis was carried out by analyze Randomized Block Design.

■ RESULTS AND DISCUSSION

The pooled data related to performances of both sowing machine are presented in Table 2 which showed effective field capacity, diesel consumption, required labour and cost of operation during sowing for soybean crop. The statistical analysis of data showed no significant differences (P= 0.05) between the raised bed seed cum

Table 1: Growth, yield and economics of soybean for raised bed seed cum ferti drill and normal seed drill

Parameters	Three year pooled data									
	Grain yield (kg/ha)	Straw yield (kg/ha)	Seed index (g)	Plant height (cm)	No. of branch (No / plant)	No. of pods per plant	Net income (Rs./ha)	B.C ratio	Grain straw ratio	Harvest index (%)
Normal seed drill	1191	1457	11.83	50.77	4.87	32.16	17410	1.82	0.82	44.91
Raised bed seed cum ferti drill	1440	1696	12.24	54.92	5.39	41.57	25246	2.2	0.85	45.8
% Increase over normal seed drill	20.91	16.4	3.47	8.17	10.68	29.26	45.01	20.88	3.66	1.98
C.D. (P=0.05)	S	S	S	S	S	S	S	S	NS	NS

S = Significant, NS= Non-significant

Table 2: Comparative performance of raised bed seed cum ferti drill and normal seed drill for soybean

Method of sowing	Three year pooled data				
	Theoretical field capacity (ha/h)	Effective field capacity (ha/h)	Sowing cost (Rs./ha)	Diesel consumption (l/ha)	Labour (man hour per ha)
Normal seed drill	2.28	0.53	1030	7.49	3.74
Raised bed seed cum ferti drill	1.46	0.39	1399	10.18	5.09
C.D. (P=0.05)	NS	NS	NS	NS	NS

NS= Non-significant

ferti drill and normal seed drill for implement parameters for sowing of soybean crop. The pooled data related to economics parameters and yield is presented in Table 1. The grain yield, straw yield and net monetary returns were higher in raised bed seed cum ferti drill sowing compared to normal seed drill sowing. The highest productivity of 1440 kg ha^{-1} observed in the raised bed seed cum ferti drill sowing whereas lowest under normal seed drill sowing (1191 kg ha^{-1}) for soybean crop. The higher net return per ha Rs. 25246 was found for soybean crop under raised bed seed cum ferti drill whereas lower net return per ha of Rs. 17410 was found under normal seed drill sowing (Table 1). The plant height, number of branches per plant, number of pods per plant, seed yield, seed index straw yield and net monetary returns were statistically higher in raised bed seed cum ferti drill sowing compared to normal seed drill sowing for soybean crop. The analysis showed that there was no significant difference on grain straw ratio and harvest index.

Conclusion:

Impact of raised bed seed-cum-ferti drill on sowing of soybean crop was found better in comparison with sowing of soybean with normal seed drill. Raised bed seed-cum-fertili drill sowing method recorded net return significantly higher than the normal seed drill sowing method for soybean crop. The results of experiment showed that to get higher productivity of soybean crop, the soybean crop should be sown by raised bed seed-cum ferti drill sowing machine.

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