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Effect of seed cum fertilizer drill on growth characters and yield of soybean (*Glycine max* L.) in Shajapur district of Madhya Pradesh

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■ **ABSTRACT :** A field experiments was conducted during *Kharif* season 2014 to 2015 for soybean crop to assess seed-cum-fertilizer drill and simple seed drill. 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. 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.

■ **KEY WORDS :** Soybean, Seed-cum-fertilizer drill, Growth character, Yield

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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. 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 and Leonard, 1976 and Kepner *et al.*, 1987).

Nimje *et al.* (2003) have been conducted field experiment during the rainy (*Kharif*) seasons of 1997–98 to 2000–2001 in farmers' fields at Bhopal on clayey loam medium deep Vertisols, to study the effect of planting densities and improved seeding machines on growth, yield and economics in soybean [*Glycine max* (L.) Merr.]. The 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. The planting density of 888,000 plants/achieved by the farmers through sowing at 22.5 cm by use of local seed drill mixing seed and fertilizer together increased the plant height and total dry matter disproportionally, thereby increasing the incidence of pests (32%) and decreasing the branching, filled pods, test weight of seeds and seed yield. Planting density of 440,000/ha increased the seed yield by 61.6 per cent and the net returns by Rs. 6,669/ha over farmers' practice. The planting densities at 666,000/ha and 533,000/ha produced the intermediate effects. 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. Shukla *et al.* (1987 and 2001); Shrivastava *et al.* (2005) and Choudhary and Singh (2002) reported that the performance of strip, zero and conventional till system for wheat cropping gave better results in the light soil. 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 and Raut *et al*., 2000).

Dixit *et al.* (2004) concluded that no-till seed cum fertilizer drill has resulted in 17.09 per cent increase in yield, 83.22 per cent saving in energy and 80.34 per cent saving in cost of production over conventional seed drill. 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, seed-cum-fertilizer drill sowing, paired row sowing and criss-cross 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 and 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. With a view to generate information, a field experiment was conducted at farmer's fields to observe effect of seed-cum-fertilizer drill sowing machine on the growth characters and yield of soybean.

METHODOLOGY

The field experiments were conducted at the farmer's fields during *Kharif* seasons 2014 and 2015 for soybean crop in the village Tilavadgovind and Girwar of Madhya Pradesh to assess the effect of seed cum fertilizer drill machine on yield and economics of soybean crop. 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. 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 the with soil. The 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 and transport cum power transmitting Nimje *et al.* (2002) and Dhakad and Khedkar (2014) reported that effect of seed-cum-fertilizer drill sowing machine for soybean crop. The machine parameters (Time required in sowing, diesel consumption, field capacity of implement, require labour and cost of operation during sowing) were measured from seed-cum-fertilizer drill and seed drill sowing machine. 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.

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

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

where

TFC = Theoretical field capacity, ha/h

W = Implement width, m

S = Tractor speed, km/h

Effective field capacity :

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

where

EFC = Effective field capacities, ha/h

A = Area of the field, m^2

T = Time needed to cover field, hr

Field capacity :

$$\text{EC (\%)} = \frac{\text{EFC}}{\text{TFC}}$$

where

EFC = Effective field capacities, ha/h

A = Area of the field, m^2

T = Time needed to cover field, hr

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. The height (cm) was recorded at 60 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 60 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 plot. Five plants dug up randomly in each plot and the nodules were washed out and counted. This study was done at 60 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.

Stover yield :

The produce after harvesting were left in the field then tied the bundles of each net plot for sun drying. The stover 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 :

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times 100$$

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 - wheat crop was processed and subjected to statistical analysis by t test as suggested by William Sealy Gosset (Fisher and Guinness Fisher, 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 per cent probability level. Based on the comparison of calculated 't' value with the theoretical 't' value from the table, it

Table 1 : Average comparative performance of seed cum fertilizer drill and normal seed drill during sowing of soybean and wheat crop

Implement parameters	Two year pool data for soybean			
	Seed cum fertilizer drill	Normal seed drill	% increase over seed drill	C.D. (P=0.05)
Effective field capacity (ha/h)	10.04	9.76	2.141	NS
Theoretical field capacity (ha/h)	0.477	0.467	-4.623	NS
Field efficiency (%)	80.22	79.90	0.401	NS
Diesel consumption, l/ha	10.04	9.76	2.869	NS
Labour man (h/ha)	4.464	4.338	2.905	NS
Cost of operation (Rs./ha) during sowing	1204	1176	2.411	NS

NS=Non-significant

Table 2 : Growth characters and economics of soybean for seed cum fertilizer drill and normal seed drill

Economic parameters	Two year pool data for soybean			
	Seed cum fertilizer drill	Normal seed drill	% increase over seed drill	C.D. (P=0.05)
Plant height at harvesting (cm)	59.2	51.8	14.28	S
Number of branches per plant at 60 DAS	5.55	5.23	6.119	S
Number of root nodules per plant at 60 DAS	29.4	22.8	28.94	S
Number of pods per plant at harvesting	42.8	31.45	36.09	S
Seed index (g)	12.6	12.3	2.44	NS
Grain yield (kg/ha)	1323	1089	21.48	S
Straw yield (kg/ha)	1606	1362	17.91	S
Grain straw ratio	0.824	0.799	3.01	NS
Harvest index (%)	45.12	44.43	1.55	NS
Net monetary returns (Rs./ha)	25569	17188	48.76	S
Benefit: cost	2.38	1.94	22.68	S

NS=Non-significant

concluded : 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

The pooled data related to sowing machine performances are presented in Table 1 which showed effective field capacity, theoretical field capacity, field efficiency, diesel consumption, required labour and cost of operation during sowing for soybean and wheat crop.

The statistical analysis of data showed no significant differences ($P \geq 0.05$) between the seed cum fertilizer drill and normal seed drill for implement parameters for sowing of soybean crop.

The pooled data related to yield and economics parameters are presented in Table 2. The grain yield, straw yield and net monetary returns were higher in seed cum fertilizer drill sowing compared to normal seed drill sowing. The highest productivity of 1323 kg ha^{-1} observed in the seed cum fertilizer drill sowing whereas lowest under normal seed drill sowing (1089 kg ha^{-1}) for soybean crop. The net return is the best index of profitability of wheat and soybean crop and higher net return per ha Rs. 25569 was recorded for soybean crop under seed cum fertilizer drill whereas lower net return per ha of Rs. 17188 was recorded for soybean crop under normal seed drill sowing (Table 2). 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 seed cum fertilizer drill sowing compared to normal seed drill sowing 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) and Dhakad and Khedkar (2014) also reported an increase in net income of soybean due to seed-cum-fertilizer drill.

Conclusion:

Effect of seed-cum-fertilizer drill sowing soybean crop was found better in comparison with normal seed drill sowing. Seed-cum-fertilizer drill sowing recorded net return significantly higher over the normal seed drill sowing for soybean crop. The results of experiment indicated that for achieving higher productivity of soybean crop, the soybean crop should be sown by seed-cum-fertilizer drill sowing machine.

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