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Research Article

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Influence of seed-cum-fertilizer drill machine on the growth characters and yield of soybean (*Glycine max* L.) at farmer's fields

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ABSTRACT : Field demonstration was conducted during *Kharif* season 2012 to 2013 to study effect of seed-cum-fertilizer drill sowing machine for soybean crop at farmer's fields in tribal area in Dhar district of Madhya Pradesh. Soybean sown by seed-cum-fertilizer drill was found better in term of growth character (plant population, plant height, number of branches per plant and number of root nodules per plant) and seed yield weight per plant, seed index, seed yield, straw yield and harvest index (%) comparison with simple seed drill sowing machine.

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

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INTRODUCTION

The agricultural has always been the backbone of India's sustained growth. As the population of India continues to grow, the demand for produce grows as well. Hence, there is a greater need for multiple cropping in the farms and this in turn requires efficient and time saving machines. The basic objective of sowing operation is to put the seed and fertilizer in rows at desired depth and 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 agricultural and climatic conditions to achieve optimum yields and an efficient sowing machine should attempt to fulfil these requirements. In addition, saving in cost of operation time, labour and energy are other advantages to be derived from use of improved machinery for such operations. 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.

Soybean [*Glycine max* (L.) Merrill] is known as the "Golden bean" of the 21st Century. Soybean is a premier oil seed crop in India, mainly in the semi arid tropics of central India. The limited area of 0.03 Mha in 1970 has increased to 9.5 Mha during year 2008. However, still the productivity gap between achievable seed yield (25 q/ha) and current yield level of 10 q/ha remains very wide (Gupta and Rajput, 2001). Though, soybean is a legume crop, yet it is widely used as oilseed. Majority of the area under soybean –wheat based cropping system is in Central India and is covered under Vertisols and

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associated soils (Bhatnagar and Joshi, 1999).These soils are potentially productive, if managed properly in terms of overcoming soil, water and nutrient management constraints. The area normally receives assured annual rainfall ranging from 1000 -1200 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. These include erratic and undependable rainfall, excess and deficient moisture with in a season, harsh thermal regime, soil loss, low level of input use and technology adoption and resource poor farmers (Gupta, 2002).

The small and marginal farmers of Madhya Pradesh resort to planting of soybean with tractor mounted seed drill by using custom hire arrangement. A simple manipulation in the back tines in a form of sweep blade of existing seed-cum- fertilizer drill machine can be of a great help in forming appropriate ridge and furrow. This system of planting seeds can increase corn grain yield by 60–95 per cent in drought and average years, 70–90 per cent in wet years and 20–30 per cent in very wet years (Li *et al*., 2001). Ridge and furrow system changes soil temperature and water patterns compared to flat sowing. These changes lead to an improved soil environment for crop emergence and early growth, because of warmer soil temperatures in cool climates and better water relations in both poorly-drained and moderately well-drained soils. Effects of ridge-tillage on soybean yields have been studied at several locations in the mid western soybean growing region of the United States. In an evaluation of five tillage systems, Erbach (1982) found no differences in soybean yield between ridge tillage, spring disk, till-plant, fall moldboard plow and fall chisel plow systems. Hummel *et al*. (1985) found no soybean yield differences in a corn-soybean rotation when conventional, sweep plow, subsoil and ridge, disk, no-till, and a rotation of no till and conventional tillage systems were evaluated. 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.

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. Post rainy seasons crops were successfully grown with successfully high yields with higher gross and net returns. Gupta *et al.* (1970) at Punjab observed significantly higher grain yield of wheat due to wider row spacing (22.5 cm) as compared to normal sowing (15 cm). Malik *et al.* (2009) conducted the field experiment to evaluate the effect of different seed rates on different sowing dates to suggest the appropriate seed rate of wheat for different sowing dates and suggested the farmers that wheat should be preferably sown on 15 November with seed rate of 125 kg/ha for better production. Iqbal *et al.* (2010) studied the effect of seed rate and row spacing on yield and yield components of wheat and concluded that seed rate of 150 kg/ha performed better for late sowing of wheat up to 28 November. Among row spacing 22.5 cm row spacing produced higher grain yield as compared to 11.25 and 15 cm row spacing. Rajput *et al.* (1984) studied the effect of row and plant spacing on yield and yield components in soybean and concluded that the combination of 45 cm row spacing and 20 cm plant spacing gave the best results. Dransfield *et al.* (1964) reported that rake angle of furrow opener was proportional to the force on it. They found that both the horizontal and vertical forces increased with increase in rake angles. Siemens *et al.* (1965) concluded analytically, as well as from experimental analysis that a rake angle of furrow opener of 25° gave minimum draft. Savings in input cost, fuel consumption and irrigation water-use have been reported due to adoption of zero tillage in wheat cultivation (Malik *et al.,* 2003 and Bhushan *et al.,* 2007).

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. Tomar *et al.* (2007) suggested that the land configuration practices such as raised-sunken bed system for normal as well as problematic soils, broad bed and furrow and tied furrow for conserving rainwater, nutrient and soil resources are appropriate and cost effective. They found higher seed and straw yield under modified land configurations as compared to the traditional planting system. Singh *et al*. (1999) and Nagavallemma *et al.* (2005) reported that Land treatments increased *in situ* soil moisture conservation, minimized runoff and soil erosion and increased the yield of principal crops grown in the region.Verma (2008) conducted a field trial at College of Agriculture, JNKVV, Indore to find out the effects of various land configurations and seed rates on growth and productivity of soybean in Vertisols and reported that ridge and furrow sowing and broad bed and furrow sowing produced significantly higher growth parameters, yield and yield attributes and root parameters as well. The economics of treatments showed that the gross as well as net monetary returns were also recorded under ridge and furrow planting. These parameters were higher than the flat bed planting. 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, there by 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.

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.

EXPERIMENTAL METHODS

The experiment was laid out at the 5 farmers fields (each plot 0.4 ha) in the tribal village Bhilbarkheda, Bagadia, Advi and Abalia village in Dhar district of Madhya Pradesh during *Kharif* seasons 2012 and 2013 to accelerate technology of seed-cum-fertilizer drill sowing machine. Seed-cum-fertilizer drill sowing machine was used for sowing of soybean crop in experimental plot and simple seed drill was used for sowing of soybean under farmers practice.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 wheel. The fluted rollers are driven by a shaft which gets power from wheels. Fluted rollers fixed in the seed box, receive the seeds into longitudinal grooves and drop them in the seed tube attached to the furrow openers. By shifting the rollers sideways, the length of the grooves exposed to the seed, can be increased or decreased and hence the amount of seed sown can be varied

Measurement of different growth characters and yield of soybean :

Crop stands (*Plant population*) :

Plant population per running meter was recorded after 20 days after sowing and at harvest and converted in to plants/ ha.

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.

Root length :

Five plants were selected randomly from each plot and the length of root was taken in cm. The observation on root length was taken at 60 days after sowing.

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.

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 per plant :

The five randomly selected tagged plants were threshed separately. Seeds obtained from these plants were weight and expressed as seed weight per plant.

Seed yield :

The soybean 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 is 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 ratio*) :

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).

EXPERIMENTAL RESULTS AND ANALYSIS

The results obtained from the present study have been discussed in detail under following heads :

Growth characteristics of soybean :

The plant population, plant height, number of branches per plant, root length and number of root nodules per plant of soybean crop were recorded for the *Kharif* 2012 and 2013 and are presented in Table 1. Plant growth parameters were found better in seed-cum-fertilizer drill sowing machine plot as compared to normal seeddrill sowing. The increase in plant growth due to proper uses of fertilizer in seed-cum-fertilizer drill sowing machine. The plant population ranged 26 to 30 per cent higher for seed cum fertilizer drill machine as compared to sowing with normal seed drill.

The lowest number of root nodules per plant was recorded under normal seeddrill sowing; however, highest number of root nodules per plant was produced under seed-cum-fertilizer drill sowing machine.

Yield attributing characters of soybean :

Post harvest observation on various yield attributing characters of soybean crop were taken and presented in Table 2 .

The number of pods per plant and seed index was observed more in the seed-cum-fertilizer drill sowing machine compare to normal seeddrill sowing. The highest productivity of 1495 kg/ha observed in the seed-cum-fertilizer drill sowing in the year 2012 whereas it was found lowest under normal seeddrill sowing (1060 kg/ha) for year 2013. Highest net return (Rs. 30005 per ha) and B : C ratio (2.63) were recorded under seed-cum-fertilizer drill sowing whereas, the lowest net return (Rs. 19752 per ha) and B: C ratio (2.09) was recorded under normal seeddrill sowing for year 2013. Ralli and Dhingra (2003) reported from an experiment that the higher nodule count and nodule dry weight under ridge sowing when compared with flat sowing for soybean crop. The number of branches per plant and dry matter accumulation were highest in ridge sowing. Growth and yield attributes were highest in ridge sowing followed by broad bed and furrow and flat sowing. Nimje *et al.* (2003) also reported an increase in planting densities and net income of soybean due to seed-cum-fertilizer drill and strip-till seed-cum-fertilizer drill machine in Vertisol.

Table 1 : Growth character of soybean with seed cum fertilizer drill and seeddrill

Parameters	Seed cum fertilizer drill		Normal seeddrill	
	Kharif 2012	*Kharif* 2013	*Kharif* 2012	*Kharif* 2013
Plant population (No./m^2)	49.6	51.2	39.2	39.1
Plant height (cm) at harvest	69.2	69.6	60.5	59.8
No. of branches per plant at harvest	5.4	5.44	5.13	5.14
Root length (cm) at 60 DAS	24.6	25.2	17.81	16.2
Number of root nodules per plant at 60 DAS	31.2	32.6	25. 8	24. 3

Table 2 : Yield attributes and eeconomics of soybean

Parameters	Seed cum fertilizer drill		Normal seeddrill	
	Kharif 2012	*Kharif* 2013	*Kharif* 2012	*Kharif* 2013
Number of pods per plant	46.43	48.22	34.10	35.38
Seed yield per plant (g)	11.26	11.16	11.11	11.02
Seed Index (g)	5.83	5.82	5.35	5.32
Seed yield (kg/ha)	1495	1346	1220	1060
Straw yield (kg/ha)	1722	1692	1444	1388
Harvest index (%)	46.4	44.3	45.8	43.3
Net monetary returns (Rs./ha)	29440	30005	20230	19752
Benefit: cost ratio	2.60	2.63	2.11	2.09

Conclusion :

The maximum seed yield of soybean was recorded when grown on seed-cum-fertilizer drill sowing as compared to normal seeddrill sowing. Effect of seed-cum-fertilizer drill sowing on the growth characters of soybean was found better in comparison with normal seeddrill sowing. The results of experiment indicate that for achieving maximum productivity from soybean crop in tribal area under Dhar district of Madhya Pradesh, the soybean crop should be sown by seed-cum-fertilizer drill sowing machine.

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