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Effect of broad bed furrow method for rainfed soybean cultivation at Balodabazar district of Chhattisgarh

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■ **ABSTRACT :** A field study was carried out during *Kharif* 2014-15, 2015-16, and 2016-17 on thirty seven farmers field of Mohbhatta village of Simga block of the district Balodabazar-Bhatapara of Chhattisgarh state with size of trial is one acre each farmers to determine the impact of sowing techniques on yield of soybean under farmers' conditions. Soybean is more water stress crop and at the time of germination sudden rainfall affects the crop. For this purpose, broad bed planting technology was introduced in the study area to compare it with the conventional sowing of soybean by flat bed methods. Six-row broad bed furrow machine was used to plant soybean having top bed width of 2.35 cm. Result showed that growth character (plant height, number of branches per plant and number of root nodules per plant) and yield contributing character *viz.*, number of pods per plant, seed yield weight per plant, seed index, seed yield,straw yield and harvest index (%) were found higher in broad bed furrow compared to the normal flat bed sowing which subsequently resulted in yield enhancement to the extent of 28.38 % for soyabean crop. The average yield in broad bed furrow method recorded 15.20 q ha^{-1}.The B:C ratio was observed 2.05 due to drainage of excessive rain water from the fields and stronger plant anchorage on the beds. Similarly, 40 to 50% saving in irrigation water was recorded with broad bed furrow method of soybean in comparison with flood irrigation of controlled plots. Results indicated that broad bed furrow technology has a lot of potential to increase water productivity of soybean.

■ **KEY WORDS :** Broad bed furrow, Flat bed, Soybean

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The productivity of rainfed farming is low as compared to the irrigated crop production. The crop yield in the rainfed farming is often reduced due to the lack of soil moisture. It is necessary to adopt suitable technology to conserve the rain water *in-situ* to ensure adequate moisture during the various growing stages of the crop in rainfed farming. Animal drawn broad bed-furrow former are available but their efficiency is very less, therefore, it is necessary to develop suitable tractor operated BBF planter to overcome this problem (Srinivas, 2005).

BBF farming has many advantages in regard to water saving, mechanical weeding, fertilizer placement, available moisture conservation, less lodging and better crop stand (Astatke *et al.*, 2002). *In-situ* water conservation makes the moisture available for the sown crop. Use of BBF can have several benefits depending on its use. Raised beds are primarily a field drainage

tool aimed at decreasing water logging and increasing crop yield.

Soybean [*Glycine max* (L.) Merrill] is known as the "golden bean" of the 21st century. 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 associated soils (Bhatnagar and Joshi, 1999).The area normally receives assured annual rainfall ranging from 1000 -1200 mm per annum. Almost 90 % of which is received between June to September.

Tomar *et al.* (1996) reported that maximum average seed yield of soybean was recorded in 6 m wide raised bed followed by 9m 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 thereby, 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. 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. Singh *et al.* (1999) and Nagavallemma *et al.* (2005) reported that land treatments (raised sunken bed system, ridges and furrows, broad bed and furrows) increased *in situ* soil moisture conservation, minimized runoff, and soil erosion and increased the yield of principal crops grown in the region.

Verma (2008) also reported that the plant population of soybean was influenced significantly due to different land configurations, he recorded significantly higher plant population under ridge and furrow planting of soybean. Similar findings were obtained by Tomar *et al.* (1996) for plant population. Raut *et al.* (2000) and Autkar *et al.* (2006) reported that ridge-and-furrow sowing was significantly superior to conventional flat sowing in increasing plant height. The lowest number of root nodules per plant was recorded under flat bed sowing; however, highest number of root nodules per plant was produced under ridge and furrow system. Ralli and Dhingra (2003) reported higher nodule count and nodule dry weight under ridge sowing when compared with flat sowing. Lupwayi *et al*. (1997) reported that water logging adversely influenced the nodules dry matter, it reduced the nodules dry matter by 33%, they recommended broad bed and furrow system to drain the water in the Vertisols.

METHODOLOGY

The trial was carried out during *Kharif* 2014-15, 2015-16 and 2016-17on thirty seven farmer's field of Sigma block of district Balodabazar-Bhatapara of Chhattisgarh state with size of trial is one acre to determine the impact of sowing techniques on yield of soybean under farmers' conditions. Soybean is more water stress crop and at the time of germination, sudden rainfall affects the crop.Broad bed furrow machine was developed basically to cope up with the problem of moisture stress in the soybean fields. The soil moisture is managed by maximizing the use of rainfall through increasing infiltration and moisture retention and reducing runoff and soil erosion. Thus, by this machine the performance of high yielding improved varieties is optimized as the deep furrows created under BBF provides, effective drainage during excess rains while serves as *in-situ* moisture conservation during dry spells, thus, mitigating the detrimental effects of both extreme situations. For this purpose, broad bed furrow technology was introduced in the study area to compare it with the conventional sowing of soybean by broadcasting and seed planter methods.The broad bed furrow machine was provided by Faculty of Agricultural Engineering, IGKV, Raipur (In *Kharif* 2014-15), under central sector scheme of farm mechanization and machine is purchased by KVK Bhatapara under the ICAR project National Initiative on Climate Resilient Agriculture (In *Kharif* 2015-16 and 2016-17). The farmers were selected on the basis of their past experience. Before trial training were conducted to farmers about use of broad bed furrow machine by the KVK scientists. Keeping in the view need,under rainfed farming to increase area in the district, therefore, KrishiVigyan Kendra Bhatapara has taken following technologies.

The technical details of broad bed furrow machine is given in Table A. 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. The soil moisture, thus, stored sustains the crop during dry spells. The plant growth character and yield contributing data such as plant height, number of branches per plant, root length, number of root nodules per plant, number of pods

Table A : Technical specification of broad bed furrow machine		
Sr. No.	Particulars	Details
1.	No. of ridgers	2
2.	Width of bed	2.35 meter
3.	No. of plant rows in bed	6
4.	Row to row spacing of plants	14 inch (35 cm)
5.	Seed and fertilizer metering mechanism	Fluted roller type
6.	Type of furrow openers	Shoe type

per plant, pod length, number of seeds per pod, seed index (weight of 100 seeds), seed yield per plant, stover yield, harvest index (%), seed yield, net monetary returns, benefit: cost ratio (B: C ratio) were recorded for soybean crop.

■ RESULTS AND DISCUSSION

The data collected from the field were analyzed and the results of the study in respect of (i) Growth characteristics of soybean (ii) Yield attributing characters of soybean: (iii) Percentage increase in yield and (iv) Benefit cost ratio and are summarized below:

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* 2014, 2015 and 2016 and are presented in Table 1. Plant growth parameters were found better in broad bed furrow system plot as compared to normal flat bed sowing.The increase in plant growth due to proper drainage of excess rainfall through furrows. The plant population ranged 9 -11 % higher on planting soybean using broad bed furrow seed cum fertilizer drill machine as compared to sowing by normal seed drill.

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, pod length and seed index were observed more in the broad bed furrow system compared to normal flat bed sowing.

Percentage increase in yield:

The yield in recommended practice increased 28.38% over farmers practice. The average yield in broad bed furrow seed cum fertilizer drill method was recorded 15.20q ha^{-1}over conventional sowing it is 11.84q ha^{-1}.

Table 1 : Average growth character of soybean for broad bed furrow system (Avg. of 3 years)		
Parameters	Broad bed-furrow system s- *Kharif*	Normal flat bed sowing- *Kharif*
Plant population (No./m^2)	45.6	41.2
Plant height (cm) at harvest	58.7	55.4
No. of branches/plant at harvest	5.12	5.03
Root length (cm) at 60DAS	24.3	19.7
No. of root nodules/plant at 60DAS	31.4	27.3

Table 2 : Yield attributes and economics of soybean (Avg. of 3 years)		
Parameters	Broad bed-furrow system - *Kharif*	Normal flat bed sowing- *Kharif*
Number of pods / plant	47.21	36.54
Pod length (cm)	4.68	4.32
No. of seeds / pod	2.61	2.37
Seed yield wt. / plant (g)	11.14	10.78
Seed index (g)	5.79	4.37
Seed yield (kg/ha)	1520	1184
Straw yield (kg/ha)	1821	1523
Harvest index (%)	45.32	43.48

Table 3 : Analysis of broad bed furrow and flat bed method

Treatments	Avg. yield ($q\ ha^{-1}$)	Avg. % change in yield	Parameter* (Avg. No. of pods per plant)	Avg. % change in Parameter	Avg. cost of cultivation ($Rs.\ ha^{-1}$)	Avg. gross return ($Rs.\ ha^{-1}$)	Avg. net return ($Rs.\ ha^{-1}$)	Avg. B:C ratio
T_1	11.84	28.38	36.54	29.20	26447	40848	14401	1.54
T_2	15.20		47.21		25610	52440	26830	2.05

T_1: Farmers practice (flat bed method)
T_2: Recommended practice (broad bed furrow method)

The difference of yield in BBF and conventional sowing is justified in Table 3.

Benefit cost ratio:

B:C ratio were also worked out for both farmers practice and demonstration plots from sowing to harvesting as given in Table 3. The B:C ratio as observed from table has been more in BBF field as compared to conventional method of sowing of soybean. It is because of reduction in primary tillage operation BBF method as well as due to higher production.

Conclusion :

Soybean is more water stress crop and at the time of germination sudden rainfall affects the crop.These rainfed crops are often subjected to extreme stresses of soil saturation as well as poor moisture due to erratic rainfall pattern.The BBF machine was introduced basically to cope up with the problem of moisture stress in the soybean fields. The soil moisture is managed by maximizing the use of rainfall through increasing infiltration and moisture retention and reducing runoff and soil erosion.Thus, by this machine, the performance of high yielding improved varieties is optimized as the deep furrows created under BBF provides effective drainage during excess rains, while serves as in situ moisture conservation during dry spells, thus mitigating the detrimental effects of both extreme situations.

The maximum seed yield of soybean was recorded when grown on broad bed furrow system of planting as compared to conventional method of sowing *i.e.* flat bed sowing. Effect of on broad bed furrow planting system on the growth characters of soybean was found better in comparison with normal flat bed sowing. The results of experiment indicate that for achieving maximum productivity from soybean crop in Balodabazar district of Chhattisgarh, the soybean crop should be sown on broad bed furrow planting system.

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