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Effect of Methods of Sowing and Spacing on Yield and Economics of Soybean (*Glycine max* L.)

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Abstract

A field experiment entitled "Effect of methods of sowing and spacing on growth and yield of soybean (*Glycine max* L.)" was conducted at Agronomy Farm, College of Agriculture, Nagpur, during *kharif* season of 2021-22 in Factorial Randomized Block Design (FRBD) with eight treatments and three replications. Treatment combinations were comprised of two sowing methods viz., ridges and furrow and broad bed furrow and four treatments of spacing viz., 45 cm x 5 cm, 45 cm x 10 cm, 45 cm x 15 cm and 45 cm x 20 cm. Results revealed that, seed and straw yield (q ha^{-1}), gross monetary returns, net monetary returns (Rs. ha^{-1}) were significantly higher due to sowing on broad bed furrow. As regards spacing, seed and straw yield (q ha^{-1}), gross monetary returns, net monetary returns (Rs. ha^{-1}) were significantly maximum at spacing 45 cm x 5 cm. The interaction effect between methods of sowing and spacing was found non-significant.

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Keywords

sowing, spacing, growth, yield, soybean, leguminosae.

Introduction

Among the pulses grown in India and Maharashtra, soybean is important pulse growing crop. Soybean (*Glycine max* L.) is most important legume crop belonging to the family leguminosae, subfamily papilionaceae and genus *glycine*. Soybean was cultivated in China from 3000 B.C. It has witnessed phenomenal growth in production, processing and trade from last few years and has revolutionized the rural economy and improved socio-economic status of the farmers. It is one of the important oilseed crop, commonly used as pulse, oilseed, vegetarian meat and soya milk and has been rightly known as "Wonder crop" or "Golden Bean" of the 21st century. It is a reach source of protein (40 to 42%) and oil (20%). It also contain 30% carbohydrates, 5% minerals, 4-5% crude fibers, 0.5% lecithins and 4% saponin. Nutritionally soybean is a good source of vitamin and amino acid (lysine, glycine and tryptophan). It is also a good source of isoflavones and therefore it helps in preventing heart diseases and cancer (Anusha *et al.,* 2021). Due to multiple use of soybean is also known as wonder crop. In Maharashtra, Vidarbha region has attained the highest production of crop, as the average rainfall ranges between 800 to 1000 mm, also black cotton soil of the region is more suitable for the production. In the year 2019-2020, the total production of soybean in Vidarbha was 48.25 lakh tonnes and area sown was 41.24 lakh ha. indicating the productivity 853 kg ha^{-1}. Sowing is an art of placing the seeds in soil to have good germination in the field. There are different methods of sowing adopted for soybean such as drilling,

dibbling, ridge and furrow and broad bed furrow (BBF). Among these, ridges and furrow and broad bed furrow (BBF) method are adopted to conserve soil moisture and increase seed yield (Kinge *et al.,* 2020). Ridges and furrow comprise ridges and furrows to sow the seeds and store the water respectively and broad bed furrow (BBF) is another method of sowing, newly adopted technology consist of 3-4 rows of crop on bed and furrows for water conservation. Both methods are adopted to increase the growth and yield of crop than normal sowing methods. Spacing is the distance between two rows and two plants. It is an important factor for any crop production because it determines the initial and final plant population in field, provide proper aeration in crop canopy and reduce competition for nutrient, sunlight and moisture which may be optimized by suitable plant density enhancing the growth and yield of crop (Kumar *et al.,* 2018).

Materials and Methods

The present field experiment entitled "Effect of sowing methods and spacing on growth and yield of soybean (*Glycine max* L.)" was carried out during *kharif* season 2021-22. The experiment was laid out in FRBD with two levels of sowing methods as one factor and four levels of spacing as another factor with eight treatment combination replicated three times. Seeds were obtained from Head, Regional Research Centre, Amravati of Dr. P.D.K.V, Akola. Soybean variety of AMS-100-39 (PDKV Amba) used for experiment. The seed of soybean variety AMS-100-39 was treated with thiram @ 3 g kg^{-1} of seed and inoculated with *rhizobium* before sowing in order to keep the crop from seed born diseases. Seed rate of soybean was used as per recommended. Sowing of seed as per treatment was done on 28th June 2021 at an optimum soil moisture level. Appropriate and timely plant protection measures for control of leaf eating caterpillar were followed. Before harvesting the crop from each net plots, five plants from each plot were taken for recording post harvest observation. Then net plot rows were harvested, winnowed and cleaned separately plot wise. The produce was sun dried and weight was recorded. Yield ha^{-1} was calculated. Standard method of analysis of variance was used for analyzing the data for FRBD design (Panse and Sukhatme, 1967). The "F" test of significance was used for testing the null hypothesis and a standard error of mean in order to determine whether the result of treatment real and discernible from chance effects and where the treatment effects were found to be significant, the critical difference (C.D.) at 5 per cent probability level was calculated for comparison of treatments.

Results and Discussion

Seed yield (q ha^{-1})

The seed yield (q ha^{-1}) of soybean was significantly influenced due to different sowing methods. The sowing of soybean on broad bed furrow gave significantly highest seed yield (20.38 q ha^{-1}) over the sowing of soybean on ridges and furrow (18.81 q ha^{-1}). This might be due to efficient utilization of moisture and nutrients under sowing of soybean on broad bed furrow favorably enhanced the growth and yield which resulted into increase in total seed yield (q ha^{-1}) under sowing of soybean on broad bed furrow. Asewar *et al.,* (2017) and Swapna *et al.,* (2020) also reported similar results who recorded highest yield of crop with BBF.

Effect of spacing

The seed yield (q ha^{-1}) was significantly influenced due to different spacings at harvest of soybean. Seed yield (21.84 q ha^{-1}) was registered significantly highest at spacing of 45 cm x 5 cm as compared to other spacings. However, it was at par with the spacing of 45 cm x 10 cm (20.01 q ha^{-1}) and lowest seed yield (17.53 q ha^{-1}) was recorded at the spacing of 45 cm x 20 cm. This might be due to at narrow spacing higher plant population per unit area resulted into highest seed yield (q ha^{-1}) showed higher yield at wider spacing. Similar results were recorded by Kumar *et al.,* (2018) who reported more seed yield due to narrow spacing.

The seed yield (q ha^{-1}) of soybean was found to be non-significant due to interaction with sowing methods and spacing.

Straw yield (q ha^{-1})

Effect of sowing methods

The straw yield (q ha^{-1}) of soybean was significantly influenced by different sowing methods at harvest. The sowing of soybean on broad bed furrow gave significantly highest straw yield (27.11 q ha^{-1}) over the sowing of soybean on ridges and furrow (25.07 q ha^{-1}). This might be due to enhanced vegetative growth as resulted into highest straw yield (q ha^{-1}) on broad bed furrow due to better soil aeration, scope for more space, light interception and benefit for more moisture conserved on broad bed furrow than other sowing methods. Similarly, these results were correlated with Kinge *et al.,* (2020) who also reported higher straw yield due to sowing on broad bed furrows.

Table.1 Effect of methods of sowing and spacing on yield and economics of soybean.

Treatments		Seed yield (q ha^{-1})	Straw yield (q ha^{-1})	Gross monetary returns (Rs. ha-1)	Net monetary returns (Rs. ha-1)	B:C ratio
Factor A- Methods of sowing						
M_1	Ridges and furrows	18.81	25.08	75576	38410	2.03
M_2	Broad bed furrows	20.38	27.11	81847	45961	2.28
SE (m) ±		0.51	0.62	1998	1998	--
CD at 5%		1.54	1.87	6063	6063	--
Factor B- Spacing						
S_1	45 cm × 5 cm	21.84	28.82	87696	50748	2.38
S_2	45 cm × 10 cm	20.01	26.56	80360	43748	2.19
S_3	45 cm × 15 cm	19.02	25.37	76389	39976	2.09
S_4	45 cm × 20 cm	17.53	23.62	70400	34270	1.95
SE (m) ±		0.72	0.87	2827	2827	--
CD at 5%		2.17	2.65	8574	8574	--
Interaction effect (MxS)						
SE (m) ±		1.01	1.23	3998	3998	--
CD at 5%		NS	NS	NS	NS	--
General mean		19.60	26.09	78711	42186	2.14

Effect of spacing

The straw yield (q ha^{-1}) was significantly influenced due to different spacings at harvest of soybean. Straw yields (28.82 q ha^{-1}) were found significantly highest at the spacing of 45 cm x 5 cm as compared to other spacing.

However, it was at par with the spacing of 45 cm x 10 cm (26.56 q ha^{-1}) and lowest straw yield (23.62 q ha^{-1}) at the spacing of 45 cm x 20 cm. This might be due to at narrow spacing obtained higher plant population per unit area which resulted into highest straw yield (q ha^{-1}) but straw yield plant^{-1} was recorded more at wider spacing. Similar findings were also noticed by Ali *et al.,* (1999) and Rahman *et al.,* (2013).

The straw yield of soybean (q ha^{-1}) was found to be non-significant due to interaction with sowing methods and spacing.

Gross monetary returns (Rs. ha^{-1})

Effect of sowing method

The gross monetary returns were significantly influenced by different sowing methods after harvest of soybean. The maximum gross monetary returns (Rs. 81847 ha^{-1}) was significant under sowing of soybean on broad bed furrow over the sowing of soybean on ridges and furrow (Rs. 75576 ha^{-1}).

This might be due to higher seed and straw yield (q ha^{-1}) under sowing of soybean on broad bed furrow which resulted into maximum gross monetary returns. The similar results were reported by Swapna *et al.,* (2020) and Dhale *et al.,* (2021) whose findings are in conformity with the present data.

Effect of spacing

The gross monetary returns were significantly influenced due to different spacings after harvest of soybean. The gross monetary returns (Rs. 87696 ha^{-1}) was significantly maximum at the spacing of 45 cm x 5 cm as compared to other spacing. However, it was found at par with the spacing of 45 cm x 10 cm (Rs. 80360 ha^{-1}) and lowest gross monetary return (Rs. 70400 ha^{-1}) was observed at the spacing of 45 cm x 20 cm.

This might be due to maximum final seed and straw yield (q ha^{-1}) at narrow spacing than wider spacing due to maximum pant population, which resulted into maximum gross monetary returns. These findings are in close accordance with Paul *et al.,* (2016).

The gross monetary returns (Rs. ha^{-1}) found to be non-significant after harvest of soybean due to interaction with sowing methods and spacing.

Net monetary return (Rs. ha^{-1})

Effect of sowing method

The net monetary returns were significantly influenced by different sowing methods after harvest of soybean. The maximum net monetary returns (Rs. 45961 ha^{-1}) was significant under sowing of soybean on broad bed furrow over the sowing of soybean on ridges and furrow (Rs. 38410 ha^{-1}). This might be due to higher final seed and straw yield (q ha^{-1}) under sowing of soybean on broad bed furrow which resulted into maximum net monetary returns. The similar results were noticed by Swapna *et al.,* (2020) and Dhale *et al.,* (2021).

Effect of spacing

The net monetary returns were significantly influenced due to different spacings after harvest of soybean. The net monetary returns (Rs. 50748 ha^{-1}) was significantly maximum at spacing of 45 cm x 5 cm as compared to other spacing. However, it was at par with spacing of 45 cm x 10 cm (Rs. 43748 ha^{-1}) and lowest net monetary returns (Rs. 34270 ha^{-1}) was found at the spacing of 45 cm x 20 cm. This might be due to maximum final seed and straw yield (q ha^{-1}) at narrow spacing than wider spacing due to maximum pant population, which resulted into maximum net monetary returns. These findings are in cognizance with the results of Ganvit *et al.,* (2019).

The net monetary returns (Rs. ha-1) were found to be non-significant after harvest of soybean due to interaction with sowing methods and spacing.

B:C ratio

Effect of sowing method

The maximum benefit: cost ratio (2.28) of soybean was recorded under sowing of soybean on broad bed furrow followed by ridges and furrows (2.03).

Effect of spacing

The maximum benefit: cost ratio (2.38) of soybean was recorded at spacing 45 cm x 5 cm followed by 45 cm x 10 cm (2.19) spacing whereas lowest B:C ratio (1.95) was observed at the spacing of 45 cm x 20 cm.

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