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Performance of Soybean as Influenced by Plant Spacing and Seed Rate

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ABSTRACT: *A field investigation was carried out on experimental farm, Department of Agronomy, V.N.M.K.V. Parbhani, during* kharif *2012-13. to find out the effect of row spacing and seed rates on growth and yield of soybean. There were nine treatment combinations with three row spacings i.e. S_1-45 cm (row to row), S_2-60 cm (row to row) and S_3-75 cm (row to row) and three levels of seed rate R_1- 55 kg ha^{-1}, R_2-65 kg $ha^{-1}$and R_3-75 kg ha^{-1}. The experiment was laid out in Factorial RBD. From the result of experiment, it can be concluded that, the spacing of 45 cm and 60 cm (row to row) were found highly productive as compared to 75 cm (row to row) and among different seed rates of soybean the seed rate of 75 kg ha^{-1} and 65 kg ha^{-1} were found highly productive as compared to 55 kg ha^{-1}.*

Key words: *Soybean, Row spacing and seed rates.*

The area under soybean is increasing in every successive year mainly due to its multi-advantages, i.e. adoptable under wide spectrum of edaphoclimatic situation. Its high nutritive value, its manifolds use in agriculture, medicinal and industrial sector. Easy marketing stability and good economic returns in short period compared to widely grown pulses like green gram and black gram.

Among various factors influencing growth and yield of soybean, row spacing and plant population are considered important. More scientific efforts needed to increase the productivity of soybean per unit area and per unit time with optimum row spacing. It is necessary to maintain plant population to get high productivity, therefore, it is necessary to study the behavior of soybean under various row spacing . Establishment of an optimum plant density per unit area is a non-monetary input factor for getting higher soybean production. There is a considerable scope for increasing soybean yield by adjusting plant population through adjusting plant geometry. The crop experiences moisture stress during the dry spell ranging from 15-21 days at any growth stage under rainfed condition resulting significant reduction in the yield.

The work on various spacing's and different levels of seed rate is going in India with the inception of AICRP's centers. These results indicated that 20% decrease in seed rate (Robert *et. al*, 2004) can be a cost saving practices. The seeding rate or plant population is one of the most important factors when it comes to profitability for the producer. Seed cost and technology fees are increasing rapidly. With these increases, producers must be more economically disciplined and aware of modern research and technology. Seeding rate is an area of the production cycle where the producer can possibly reduce an input without limiting the yield; thus, realizing additional net return. "Farmers tend to plant 25 per cent more seed than needed. Some of that is to make up for poor equipment or lack of calibration. Some of it is just habit, but some producers feel that the high seeding rates are needed for better weed control. Most people can reduce seeding rate by 25 per cent and without affecting either weed control or yield and therefore, increase profits." Seeding rate is dependent on the size of the seed, width of row and the germination rate of seed. The measurement of seeds per row feet is a good planting guide because of the large variation in seed size among different varieties from year to year.

In view of above fact present research work was carried on experimental farm, Department of Agronomy, College of Agriculture, VNMKV Parbhani with an object to optimize of plant spacing and seed rate in soybean (*Glycine max* (L.) Merrill).

MATERIALS AND METHODS

The field investigation was conducted during *kharif* 2012 at experimental farm, Department of Agronomy,

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College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid out in factorial RBD design with three replications. The size of the plot was 5.4 m x 4.5 m. The main plot was encompassed of three row spacings i.e. 45 cm, 60 cm, 75 cm (row to row) and the sub plot was comprised of three seed rates i.e. 55 kg ha^{-1}, 65 kg ha^{-1}, 75 kg ha^{-1}. The nine treatment combinations of three row spacings and three seed rates were randomly allotted in each replication. Soybean variety used was MAUS-71 .The experimental soil was clayey in texture, low in organic carbon, low in nitrogen and medium in available phosphorous and high in potash and slightly alkaline (pH: 7.8). Sowing was done by dibbling method on 09th July, 2012. Recommended dose of fertilizers incorporated at the time of sowing of the crop. The recommended pakage of practices was followed for plant protection.

RESULTS AND DISCUSSION

The data on groth, yield attributes and yield was influenced significantly due to different row spacings and seed rates and presented in Table 1, 2 and 3.

Effect of row spacings

Row spacing S_3 i.e. (row to row 75 cm) recorded highest plant height which was significantly superior over row spacings S_2 (row to row 60 cm) and S_1(row to row 45 cm). Further row spacings S_2 (row to row 60 cm) and S_1 (row to row 45 cm) were at par with each other. As regards to the number of functional leaves plant^{-1}, the row spacing S_1 (row to row 45 cm) found significantly superior for producing maximum number of functional leaves plant^{-1} over S_3 (row to row 75 cm) but was found at par with row spacing S_2 (row to row 60 cm). Similar trend was observed in case of number of branches, leaf area and dry matter per plant. As regards to yield attributes row spacing

Table 1
Growth attributes of soybean as influenced by different row spacing and seed rates

Treatment	Mean plant height (cm)	Mean number of functional leaves plant^{-1}	Mean number of branches per plant	Mean leaf area (cm^2)	Total dry matter accumulation (g) plant^{-1}
Spacing (S)					
S_1 (Row to row 45 cm)	48.54	29.42	7.22	2005.70	36.47
S_2 (Row to row 60 cm)	49.91	27.95	6.42	1736.70	34.79
S_3 (Row to row75 cm)	51.44	26.01	5.33	1592.20	31.48
SE ±	0.46	0.77	0.26	61.17	0.95
CD at 5 %	1.39	2.31	0.77	183.11	2.86
Seed rate (R)					
R_1 (55 kg ha^{-1})	46.63	31.43	7.42	2217.30	37.71
R_2 (65 kg ha^{-1})	50.11	28.37	6.11	1761.50	34.50
R_3 (75 kg ha^{-1})	53.15	23.38	5.44	1355.80	30.53
SE ±	0.46	0.77	0.26	61.17	0.95
CD at 5%	1.39	2.31	0.77	183.22	2.86
Interaction (S x R)					
SE ±	0.81	1.34	0.45	105.95	1.65
CD at 5 %	NS	NS	NS	NS	NS
General mean	**49.96**	27.76	**6.32**	**1778.20**	**34.25**

Table 2
Yield attributes of soybean as influenced by different row spacing and seed rates

Treatment	Number of pod plant^{-1}	Weight of pod plant^{-1} (g)	Weight of seed plant^{-1} (g)	No. of seed pod^{-1}	Test weight (g)
Spacing (S)					
S_1 (Row to row 45 cm)	31.31	11.25	6.75	2.83	146.54
S_2 (Row to row 60 cm)	31	10.94	6.57	2.73	146.36
S3 (Row to row75 cm)	27.53	9.70	5.81	2.61	145.16
SE ±	0.87	0.31	0.19	0.04	0.40
CD at 5 %	2.62	0.94	0.57	0.13	NS
Seed rate (R)					
R_1 (55 kg ha^{-1})	27.96	9.94	5.95	2.59	146.40
R_2 (65 kg ha^{-1})	30.32	10.75	6.45	2.68	146.38
R_3 (75 kg ha^{-1})	31.57	11.20	6.72	2.89	145.28
S.E. ±	0.87	0.31	0.19	0.04	0.40
CD at 5%	2.62	0.94	0.57	0.13	NS
Interaction (S x R)					
SE ±	1.52	0.54	0.33	0.07	0.70
CD at 5 %	NS	NS	NS	NS	NS
General mean	**29.75**	**10.63**	**6.38**	**2.72**	**146.02**

Table 3
Seed, straw and biological yield (kg ha^{-1}) and harvest index of soybean as influenced by different row spacing and seed rates

Treatment	Seed yield kg ha^{-1}	Straw yield kg ha^{-1}	Biological yield kg ha^{-1}	Harvest index (%)
Spacing (S)				
S_1 (Row to row 45 cm)	2138	2615	4753	44.98
S_2 (Row to row 60 cm)	2068	2398	4452	46.45
S_3 (Row to row75 cm)	1809	2246	4055	44.61
SE ±	68.07	76.98	107.32	–
CD at 5 %	203.78	230.40	321.25	–
Seed rate (R)				
R_1 (55 kg ha^{-1})	1788	2261	4049	44.15
R_2 (65 kg ha^{-1})	2060	2460	4520	45.57
R_3 (75 kg ha^{-1})	2167	2524	4691	46.19
SE ±	68.07	76.98	107.32	–
CD at 5%	203.78	230.40	321.25	–
Interaction (S x R)				
SE ±	117.9	133.3	185.8	–
CD at 5 %	NS	NS	NS	–
General mean	2005	2417	4420	45.32

S_1 (row to row 45 cm) recorded significantly highest number of pods per plants over row spacing S_3 (row to row 75 cm) and it was found at par with row spacing S_2 (row to row 60 cm). Similar results were observed regarding weight of pods per plant and weight of seeds per plant. The row spacings S_1 (row to row 45 cm) and S_2 (60 cm) were at par with each other in respect of number of seeds per pod and was found significantly superior over row spacing S_3 (row to row 75 cm). The data on test weight as influenced by row spacings was found to be non significant. These results in line with those reported by Deshmukh *et al*., (1977) and Rajput *et al*., (1984).

The spacing of 45 cm (row to row) produced maximum seed yield which was significantly superior over row spacing of 75 cm, but found at par with S_2 (60 cm row spacing). The results are in line with those reported by Kacha *et al*., (1990) and Tourino *et al*., (2002). Similarly the row spacing of 45 cm and 60 cm were at par with each other in case of straw yield, biological yield and was significantly superior over 75 cm row spacing. However the row spacing of 60 cm recorded highest value of harvest index than other treatments of row spacing.

Effect of seed rate

The data on plant height indicated that seed rate R_3 (75 kg ha^{-1}) recorded highest plant height which was significantly superior over seed rate R_2 (65 kg ha^{-1}) and R_1 (55 kg ha^{-1}), this might be due to less space available for plant and more competition for space, nutrient and light due to higher plant population per unit area in case of seed rate 75 kg ha^{-1}, these results in confirmity to those reported by Kumar and Badiyala (2005). The maximum number of functional leaves per plant were recorded with seed rate R_1 (55 Kg ha^{-1}) and was significantly superior over R_2 (65 Kg ha^{-1}) and R_3 (75 Kg ha^{-1}), similar trend was observed in case of number of branches, leaf area and dry matter per plant. Among different seed rates, seed rate R_3 (75 Kg ha^{-1}) recorded significantly maximum number of pods per plant as compared to seed rate R_1 (55 kg ha^{-1}) but it was found at par with seed rate R_2 (65 kg ha^{-1}). Similar results were observed regarding weight of pods per plant and weight of seeds per plant. Seed rates significantly affect the mean number of seeds per pod. Significantly maximum number of seed per pod was recorded by the seed rate R_3 (75 kg ha^{-1}) over seed rate R_1 (55 kg ha^{-1}) but found at par with seed rate R_2 (65 kg ha^{-1}). The data on test weight revealed as influenced by seed rates did not reached to the level of significance. The maximum seed yield produced by the seed rate R_3 (75 Kg ha^{-1}) which was significantly superior over the seed rate R_1 (55 kg ha^{-1}) but it was found at par with seed rate R_2 (65 kg ha^{-1}), This might be due to that the improvement in the performance of individual plant at lower seed rate does not seem to be significant enough to compensate for higher yield obtained at optimum plant density in case of lower seed rate R_1 (55 kg ha^{-1}). Similar result was reported by Kumar and Badiyala (2005) and Jasani *et al*., (1993). Highest straw as well as biological yield was recorded by seed rate R_3 (75 Kg ha^{-1}) and was significantly superior over seed rate R_1 (55 kg ha^{-1}) but was found at par with seed rate R_2 (65 kg ha^{-1}). Highest harvest index was recorded by the seed rate of R_3 (75 kg ha^{-1}) and lowest was observed in R_1 (55 kg ha^{-1}) seed rate.

Interaction

The data on different growth as well as yield attributes and yield was not influenced significantly by the interaction effect of row spacing and seed rates.

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