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AD Khaire
Department of Agronomy, College of Agriculture, Pune, Maharashtra, India

AG Jadhav
Department of Agronomy, College of Agriculture, Pune, Maharashtra, India

AC Sawant
Department of Agronomy, College of Agriculture, Pune, Maharashtra, India

DA Sonawane
Department of Agronomy, College of Agriculture, Pune, Maharashtra, India

Corresponding Author:
AD Khaire
Department of Agronomy, College of Agriculture, Pune, Maharashtra, India

Performance of soybean (*Glycine max* (L.) Merrill) varieties to different spacings on growth, yield characters and yield under mechanization

AD Khaire, AG Jadhav, AC Sawant and DA Sonawane

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Abstract
The field experiment was conducted at College of Agriculture, Pune, Maharashtra during *kharif* 2018 to study the performance of soybean (*Glycine max* (L.) Merrill) varieties to different spacings under mechanized conditions. Five spacings S1- 45 x 5 cm^2, S2- 45 x 10 cm^2, S3- 60 x 5 cm^2 and S4- 60 x 10 cm^2.
(Under mechanized condition) and S5- 45 x 5 cm^2 (under conventional condition) and three varieties V1: KDS-344 (Phule Agrani), V2- KDS-726 (Phule Sangam), V3- KDS-753 (Phule Kimaya) were tested in split plot design with three replication. The growth characters *viz*., plant height (cm), plant height (cm), number of branches $plant^{-1}$, number of functional leaves $plant^{-1}$, leaf area $plant^{-1}$(dm^2), number of root nodules $plant^{-1}$, fresh and dry weight of root nodules $plant^{-1}$ (g), days to 50 % flowering and days to maturity and dry matter $plant^{-1}$ and yield attributes viz., number of pods $plant^{-1}$, number of seeds pod^{-1}, weight of pods $plant^{-1}$ (g), seed yield $plant^{-1}$ (g), straw yield $plant^{-1}$ (g) and test weight (g) were significantly influenced at spacing 60 x 10 cm^2 under mechanized condition. Among the varieties KDS-344 gave significantly superior in all growth and yield attributing characters except test weight (g). The test weight (g) was significantly highest value by variety KDS-726 (Phule Sangam).

Keywords: Soybean (*Glycine max* (L.) Merrill), spacing, varieties, growth, yield

Introduction

Soybean (*Glycine max* (L.) Merrill) is the economically most important bean in the world. It is native to eastern Asia. Soybean is grown as long as 2800 BC in China, where it was considered one of five sacred grains. By the 17^{th} century, soybean was planted in Europe. Soybean has been miracle crop of 20^{th} century and is often designated as "Golden Bean". Besides, soybean having a very good nutritive value and it is capable for fixing atmospheric nitrogen at the rate of 65-115 kg ha^{-1} $year^{-1}$ with symbiosis of *Rhizobium japonicum* microorganism (Alexander, 1977) [1]. It builds up the soil fertility and productivity by fixing large amount of nitrogen through the root nodule, and also through leaf fall.

The United States is the world leader in soybean production; growing about 2 billion bushels annually more than 50 per cent of the world crop. In India, soybean was grown on an area of 11.32 million ha with production of 13.79 million tonnes and productivity of 1219 Kg ha^{-1}. Whereas, in Maharashtra, soybean was grown on an area of 3.98 million ha with production of 4.77 million tonnes with average productivity of 1201 Kg ha^{-1} during 2016-17 (Anonymous, 2017) [2].

Soybean possesses a very high nutritional value. It contains about 20 % oil and 40 % high quality protein. Soybean protein is rich in valuable amino acid lysine (5 %) in which most of the cereals are deficient. The biological value of the soybean protein is as good as meat and fish protein (Quayam *et al*., 1985) [12]. It yields more usable protein per hectare than any of the common cereal grains (Cowan, 1973) [3].

Current mechanized agriculture includes the use of tractors, trucks, combine harvesters, countless types of farm implements, aeroplanes and helicopters (for aerial application) and other vehicles. Mechanization was one of the large factors responsible for urbanization and industrial economies. Besides improving production efficiency, mechanization encourages large scale production and sometimes can improve the quality of farm produce.

Spacing is one of the important parameter, which ultimately affect nutrients uptake, growth and yield of plant. Increase in spacing, the total population decrease, but with more nutrition the individual plant grow better and get more yield and vice-versa. Row spacing and varieties both are the main factor of crop production. Varieties play an important role in the production of grain yield, selection of proper varieties for a set of agro-climatic conditions is very important to achieve maximum potential, because due to their different growth and development behavior. The reason of low productivity is non cultivation of suitable variety as suited to agro-climatic conditions with proper row spacing.

Materials and methods

The experiment was conducted at College of Agriculture, Pune (18^0 32' North latitude and 73^0 51' East longitude) during *kharif* 2018. It comprised 15 treatments with five spacings S1- 45 x 5 cm^2, S2- 45 x 10 cm^2, S3- 60 x5 cm^2 and S4- 60 x 10 cm^2 (under mechanized condition) and S5- 45 x 5 cm^2 (under conventional condition) and three varieties V1: KDS-344 (Phule Agrani), V2- KDS-726 (Phule Sangam), V3- KDS-753 (Phule Kimaya). The experiment was laid out in split plot design in 6.00 x 3.60 m^2 gross plot size and 5.00 x 2.40 m^2 (for 60 x 50 & 60 x 10 cm), 5.00 x 2.70 m^2 (45 x 5 & 45 x 10 cm) with three replication. The soil of the experimental field was medium black, organic carbon (0.50 %), available nitrogen (166.21 %), available phosphorous (22.21 %) and potassium (407.21 %). The sowing was done by tractor drawn seed- cum- ferti drill on 20 July 2018. The optimum seed and fertilizer were used as per recommendation and necessary calibration. The crop was raised by treating seed with *Rhizobium* and *PSB* culture @ 250 g 10 kg^{-1} of seeds. The fertilizer were applied according to recommended dose of fertilizers (50: 75: 45 kg NPK ha^{-1}) by calculating proper quantity of each straight fertilizer required per plot. To raise good crop 3 irrigations were applied during experiments. Spraying of herbicides Irish @ 2 ml lit^{-1} of water with power spray except conventional condition followed by hoeing was carried out by Kubota tractor drawn hoe and weeding by power weeder under mechanized condition. Whereas, hoeing was carried out by hand hoes and weeding by hand under conventional condition. To control caterpillar pest Chloropyriphos 20 % EC 20 ml in 10 liter of water was sprayed at the stage of pre flowering. The data on growth and yield characters were collected from from randomely selected five plants per plot.

Results and discussion

The data on growth contributing characters and yield attributes of soybean as influenced by different treatments are presented in Table1 and Table 2, respectively.

Effect of Spacings

The growth attributing characters of soybean was influenced significantly due to different treatment of spacings.

Significantly maximum plant height (56.08 cm) were recorded at spacing of 60 x 10 cm^2 (under mechanization) than other spacings and it was at par with spacing 45 x 10 cm^2 and 60 x 5 cm^2 (under mechanized condition). This might be due to availability of more space and nutrient to the plant. Similar results also reported by Mondal *et al.* (2014) [9]. The maximum plant spread (30.12 cm) was recorded at spacing of 60 x 10 cm^2 (under mechanization) and it was significantly more than other treatments of spacings. Kadam and Khanvilkar (2015) [6] also observed similar results. The significantly highest number of branches $plant^{-1}$ (9.44) were recorded at spacing 60 x 10 cm^2 (under mechanization) than other spacings. It is due to stout plants produced by exploiting available space, nutrient, moisture and light resources favouring fast vegetative growth. However, it was at par with spacings 45 x 10 cm^2 and 60 x 5 cm^2 (under mechanizad condition). The significantly maximum number of functional leaves $plant^{-1}$ were recorded at spacing 60 x 10 cm^2 than other rest spacings. This might me due to availability more space, efficient uptake of plant nutrient and effective photosynthesis. Similar results were also reported by Sathe and Patil (2012) [15]. The significantly maximum number of root nodules $plant^{-1}$ (84.33) and fresh and dry weight of root nodules $plant^{-1}$ (0.66 and 0.22 g, respectively) was recorded at spacing 60 x 10 cm^2 than other spacings.

As regards to the days to 50 % flowering and days to physiological maturity (44.89 and 100.56, respectively) was found non-significant in all the spacings under investigation. This might be due to meteorological conditions occurred during the growth period of soybean. Similar results also reported by Gebrelibanous and Fiseha (2018) [4]. The maximum dry matter $plant^{-1}$ at spacing of 60 x 10 cm^2 (under mechanization) and was significantly higher than other remaining treatments of spacings under study due to maximum growth and development of individual plant in various characters. Malek *et al.* (2012) [7] were also reported similar results.

Table 1: Performance of soybean varieties to different spacings under mechanized operations on growth contributing characters of soybean

Treatment	Plant height (cm)	Plant spread (cm)	Number of branches $plant^{-1}$	Number of functional leaves $plant^{-1}$	Leaf area $plant^{-1}$ (dm^2)	Number of root nodules $plant^{-1}$	Fresh weight of root nodules $plant^{-1}$ (g)	Dry weight of root nodules $plant^{-1}$ (g)	Days to 50 % flowering	Days to physiological maturity	Dry matter $plant^{-1}$ (g)
A. Main plot : Spacings											
45 x 5 cm^2 (Under mechanization)	52.32	27.20	8.07	2.58	3.71	76.11	0.55	0.19	42.78	98.44	20.01
45 x 10 cm^2 (Under mechanization)	54.73	29.34	8.99	3.62	4.22	83.78	0.58	0.21	44.33	99.67	21.63
60 x 5 cm^2 (Under mechanization)	53.42	27.83	8.85	3.11	4.03	82.78	0.57	0.20	43.89	99.33	20.71
60 x 10 cm^2 (Under mechanization)	56.08	30.12	9.44	3.96	4.62	84.33	0.60	0.22	44.89	100.56	22.89
45 x 5 cm^2 (Under conventional)	52.10	27.17	7.84	2.51	3.58	75.33	0.54	0.19	42.44	98.11	19.92
S.Em±	0.77	0.37	0.26	0.19	0.16	1.62	0.006	0.004	0.78	1.30	0.63
C.D. at 5%	2.52	1.22	0.85	0.63	0.51	5.27	0.02	0.01	NS	NS	2.05
B. Sub plot : Varieties											

KDS- 344	54.50	28.86	8.99	3.30	4.27	81.53	0.61	0.22	45.13	105.07	22.15
KDS- 726	52.47	27.61	8.05	2.87	3.64	78.60	0.53	0.18	43.53	98.20	18.91
KDS- 753	54.21	28.53	8.88	3.30	4.19	81.27	0.56	0.20	42.33	94.40	22.04
S.Em±	0.55	0.30	0.14	0.11	0.16	0.86	0.008	0.004	0.49	0.99	0.57
C.D. at 5%	1.62	0.88	0.42	0.31	0.47	2.55	0.02	0.01	1.46	2.92	1.69
C. Interaction (A×B)											
S.Em±	1.23	0.67	0.32	0.24	0.36	1.93	0.02	0.009	1.11	2.21	1.28
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	53.73	28.33	8.64	3.15	4.03	80.47	0.57	0.20	43.67	99.22	21.03

Significantly more number of pods plant^{-1} were recorded at spacing of 60 x 10 cm^2 (under mechanization) than other spacings and it was at par with spacing 45 x 10 cm^2 and 60 x 5 cm^2 (under mechanized condition). Less competition in wider spacing and ample availability of light, moisture and nutrients might had resulted in more number of branches plant^{-1} which in turn might have increased more number of pods plant^{-1}. Similar results also reported by Halvankar *et al.* (1999) [5]. The highest number of seeds pods^{-1} was recorded at spacing of 60 x 10 cm^2 (under mechanization) and it was significantly more than other treatments of spacings. This indicates that the plants require optimum plant space for better growth and development of yield attributes of the crop and greater utilization of moisture, nutrients and sunlight by the plant and better source-sink relationship. Rahman and Hossain (2013) [13] also observed similar results. The highest weight of pods plant^{-1} (g) were recorded at spacing 60 x 10 cm^2 (under mechanization) than other spacings. However, it was at par with spacings 45 x 10 cm^2 (under mechanized condition). This might be due to the wider spacing which increased in uptake of more plant nutrients and resulted in development of pods as compare to crowding.

The seed and straw yields plant^{-1} were recorded highest at spacing 60 x 10 cm^2 than other rest spacings. The maximum seed yield might be due to greater availability of nutrients, more pods plant^{-1} and more space for their growth resulting in higher photosynthesis and translocation of assimilates. Similar results were also reported by Rajput and Kaushik (1992) [14]. The test weight (g) was recorded highest at spacing 60 x 10 cm^2 than other spacings. This might be due to more space and nutrients available for their pod and seed development which ultimately increased the test weight.

As regards to the seed yield (2488.78 kg ha^{-1}), it was highest at the spacing of 45 x 5 cm^2 (under mechanization) and was significantly higher than other remaining treatments of spacings. Though all the yield attributing characters were higher at wider spacings, these improvements were not sufficient to compensate the yield that obtained due to higher plant population in close spacing. Similar results were also reported by Prasad *et al*. (1993) and Rahman and Hossain (2013) [11, 13]. The straw yield (2792 kg ha^{-1}) recorded maximum at spacing 45 x 5 cm^2 (under mechanization). A progressive decrease in the straw yield from closer spacing to wider spacing was mainly attributed to higher plant number obtained at closed row spacing. Rahman and Hossain were also observed similar results.

Effect of varieties

The growth contributing characters of soybean was influence significantly due to different varieties. Significantly maximum plant height (54.50 cm) were recorded by variety KDS- 3444 than other varieties and it was at par with KDS-753. Similar results also reported by Malusare *et al.* (2015) [8]. The maximum plant spread (28.86 cm) was recorded by variety KDS- 344 and it was significantly more than other treatments of varieties. This might be due to its own genetic makeup and physiological characteristics. The significantly highest number of branches plant^{-1} (8.99) were recorded by variety KDS-344 than other varieties. This might be due to its own genetic makeup and physiological characteristics. Similar results also reported by Malusare *et al.* (2015) [8]. However, it was at par with variety KDS-753. The significantly maximum number of functional leaves plant^{-1} were recorded by variety KDS-344 than other rest varieties. This might me due to genetic makeup. Similar results were also reported by Thakur and Vyas (2005) [16]. The significantly maximum number of root nodules plant^{-1} (81.53) and fresh and dry weight of root nodules plant^{-1} (0.61 and 0.22 g, respectively) was recorded by variety KDS-344 than other varieties. Similar results were also reported by Vyas and Khandwe (2014) [17]. As regards to the maximum number days to 50 % flowering and days to physiological maturity was recorded by variety KDS-344. The occurrence of days to 50% flowering and physiological maturity might be due the genetic and physiological characteristics of variety. Similar results were also reported by Malusare *et al*. (2015) [8].

The maximum dry matter plant^{-1} by variety KDS- 344 and was significantly higher than other remaining treatments of varieties under study. Variation in dry weight plant^{-1} in varieties might be due to variation in overall growth and development of individual variety as it was also evident from various growth and yield observations like plant height plant^{-1}, number of branches plant^{-1}, number of functional leaves plant^{-1} and number of pods plant^{-1}. These finding was in close agreement with the Nigam *et al.* (1989) [10].

The yield contributing characters of soybean was influence significantly due to different varieties. Significantly highest of number pods plant^{-1} than other varieties were recorded by the variety KDS-344. The number of seeds pod^{-1} were significantly maximum recorded by variety KDS-344 than KDS-726 and it was at par with KDS-753. This might be due to inherent characteristics of said variety. Similar results were recorded by Malusare *et al.* (2015) [8].

Table 2: Performance of soybean varieties to different spacings under mechanized operations on yield attributes of soybean

Treatment	Number of pods plant^{-1}	Number of seeds pod^{-1}	Weight of pods plant^{-1} (g)	Seed yield plant^{-1} (g)	Straw yield plant^{-1} (g)	Test weight (g)	Seed yield (Kg ha^{-1})	Straw yield (Kg ha^{-1})
A. Main plot : Spacings								
45 x 5 cm^2 (Under mechanization)	94.34	2.56	23.92	11.72	14.64	12.38	2488.78	2792.00
45 x 10 cm^2 (Under	95.89	2.86	26.43	14.34	17.40	13.11	2172.67	2439.89

mechanization)								
60 x 5 cm^2 (Under mechanization)	95.63	2.77	24.45	13.28	16.35	12.86	2339.78	2641.56
60 x 10 cm^2 (Under mechanization)	96.65	2.99	27.05	15.48	18.53	13.79	1979.22	2281.22
45 x 5 cm^2 (Under conventional)	94.31	2.54	23.07	11.69	14.62	12.30	2479.22	2779.89
S.Em±	0.46	0.07	0.51	0.26	0.27	0.23	71.88	70.31
C.D. at 5%	1.49	0.24	1.67	0.84	0.90	0.76	234.41	229.31
B. Sub plot : Varieties								
KDS- 344	96.25	2.79	25.29	13.91	16.90	12.72	2420.60	2722.13
KDS- 726	94.24	2.66	23.80	12.60	15.50	13.88	2083.53	2385.27
KDS- 753	95.60	2.77	25.26	13.39	16.45	12.07	2371.73	2653.33
S.Em±	0.42	0.04	0.32	0.34	0.34	0.33	52.77	50.40
C.D. at 5%	1.23	0.11	0.96	1.01	1.01	0.98	155.66	148.69
C. Interaction (A×B)								
S.Em±	0.93	0.08	0.72	0.76	0.78	0.75	117.99	112.70
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS
General Mean	95.37	2.74	24.78	15.30	18.31	12.89	2291.96	2586.91

The variety KDS-344 produced maximum weight of pods plant^{-1} (g) but it was at par with variety KDS-753. The probable reason for this might be the genetic makeup of the variety that has helped in improving the photosynthetic activity due to which increased source capacity and efficient translocation of photosynthates to the sink (seed). Yadahalli *et al.* (2006) [18] were also observed similar results. Seed and straw yield plant^{-1} (g) were recorded highest at variety KS-344 than other varieties. This might be due to genetic makeup and its higher growth and yield attributing characters. The variety KDS-726 registered maximum test weight (g) than remaining varieties. This might be due to well developed and boldness characteristics of the seed.

As regards to the seed yield (2420.60 kg ha^{-1}) and straw yield (2722.13 kg ha^{-1}) were recorded maximum at variety KDS-344 than KDS-726 and KDS-753. This might be due to higher values of expression of yield contributing characters and yield potential of variety KDS-344 over the other varieties and proved be the most efficient in assimilation and translocation of photosynthates resulting in the highest seed and straw yield of soybean.

Conclusion

A spacing 60 x 10 cm^2 was found significantly superior for obtaining growth and yield characters. Among varieties KDS-344 recorded maximum growth and yield characters than other varieties.

References

1. Alexander M. Pulse crop, Oxford and IBH Publishing Co. Pvt. Ltd., 1977, 55p.
2. Anonymous. Agricultural statistics at glance Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India, New Delhi, 2017.
3. Cowan JC. Proceedings and products in soybean improvement, production and uses. Ed. B. E. Caldwell. Am. society of Agron., U.S.A., 1973, 681p.
4. Gebrelibanous G, Fiseha B. Effect of inter row and intra row spacing on yield and yield components of mung bean (*vigna radiata* L.) in Northern Ethiopia. Internat J. of Engg. Development and Res. 2018; 6(1):2321-9939.
5. Halvankar GB, Varghese, Phillips, Taware SP, Raut VM. Influence of planting geometry and variety on seed yield and related parameters in soybean. [*Glycine max* (L.) Merrill]. Indian J Agric. Sci. 1999; 44(3):601-604.
6. Kadam SS, Khanvilkar SA. Effect of phosphorous, boron and row spacing on growth of summer green gram (*Vigna radiata*). J. of Agric. and crop Sci. 2015; 2:7-8.
7. Malek MA, Shafiquzzaman M, Rahman MS, Ismail MR, Mondal MMA. Standaridization of soybean row spacing based on morpho physiological characters. Legume Res. 2012; 35(2):138-143.
8. Malusare KS, Chavan BH, Dahat DV, Rajput HJ, Deshmukh MP, Karkeli MS. Transgressive segregation studies in soybean. M. Sc. (Agri.) thesis submitted to the M.P.K.V., Rahuri, 2015.
9. Mondal MMA, Puteh AB, Kashem MA, Hasan MM. Effect of plant density on canopy structure and dry matter partitioning into plant parts of soybean (*Glycine max*). Life Sci. J. 2014; 11(3):67-74.
10. Nigam PK, Mishra VK, Sharma RA. Performance of different soybean varieties, growth on black clay soil under rainfed condition. Legume Res. 1989; 12(3):143-147
11. Prasad JVNS, Ramaiah NV, Satyanarayanan V. Response of soybean [*Glycine max* (L.)Merrill] to varying levels of plant density and phosphorus. Indian J. Agron. 1993; 38(3):494-495.
12. Quayam A, Rao MS, Violet K. Soybean [*Glycine max*. (L.) Merril] a miracle oilseed crop its prospects and constraints in Bihar plateau. In Proc. oilseed constraints and opportunities, 1985, 219-232.
13. Rahman MM, Hossain MM. Effect of row spacing and cultivar on the growth and seed yield of soybean [*Glycine max* (L.)Merrill] in *kharif*-II season. A Scientific J. of Krishi Foundation. 2013; 11(1):33-38.
14. Rajput RL, Kaushik JP. Effect of irrigation, phosphorus and row spacing and yield and economic return of soybean. GAU Res. J. 1992; 17(2):134-136.
15. Sathe HD, Patil DB. Effect of planting geometry and phosphate management on growth and growth attributes of semi-*rabi* pigeonpea. Crop Res. 2012; 44(3):331-334
16. Thakur BS, Vyas MD. Relative performance of soybean [*Glycine max* (L.) Merrill] varieties under varying plant population and row spacing. M.Sc. (Agri.) thesis submitted to the J.N.K.V.V. Jabalpur, 2005.
17. Vyas MD, Khandwe R. Effect of row spacing and seed rate on morphophysiological parameters, yield attributes and productivity of soybean [*Glycine max* (L.) Merrill] cultivars under rainfed condition of Vindhyan plateau of Madhya Pradesh. Soybean Res, 2014, 82-91.
18. Yadahalli GS, Palled YB, Hiremath SM. Effect of sowing date and phosphorous levels on growth and yield of black gram genotypes. Karnataka J. Agric. Sci. 2006; 19(3):682-654.