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EFFECT OF TIME OF SOWING AND ROW SPACING ON GROWTH, YIELD AND ECONOMICS OF SOYBEAN (*Glycine max* L.)

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ABSTRACT

A field experiment was conducted during *kharif* season of 2020 at the College Farm, College of Agriculture, N.A.U, Bharuch to study the effect of time of sowing and row spacing on growth, yield and economics of soybean (*Glycine max* L.). The results revealed that sowing of soybean at onset of monsoon increased growth (plant height, number of branches plant^{-1}), yield attributes (number of pods plant^{-1}, number of seed pod^{-1}) and seed yield (1764 kg ha^{-1}) and stover yield (3431 kg ha^{-1}) as well as highest net realization (₹ 65,393 ha^{-1}) and BCR (2.89). Sowing of soybean at 60 cm row spacing recorded significantly higher growth and yield attributes, seed yield (1741 kg ha^{-1}) and straw yield (3353 kg ha^{-1}) as well as highest net realization (₹ 65,477 ha^{-1}) and BCR (3.06).

(Key words : Soybean, time of sowing, row spacing, growth, yield and economics)

INTRODUCTION

Soybean [*Glycine max* (L.)] is a well known oilseed and pulse crop. It is the richest and cheapest source of high quality proteins, minerals, vitamins and fats. Soybean is called as miracle "Golden bean" of 21st century. It is a boon for malnourished world because it is high nutritive and energy rich monocarp legume with protein (40 %), oil (20 %) and high level of essential amino acid like lysine (5 %), minerals (4 %), phospholipids (2 %) and the vitamins (thiamine and riboflavin). Soybean accounts for 54 per cent of global oilseed production. In India the area under soybean crop was 119.98 million ha with 118.89 million MT of total production in 2021 and an average productivity was 991 kg ha^{-1} (Anonymous, 2021). In Gujarat, it is cultivated in about 2.24 lakh hectares with an annual production of 2.27 lakh tonnes and average productivity of 1015 kg ha^{-1} (Anonymous, 2021). Sowing date plays a significant role in determining growth, development and yield of soybean. Sowing crop at optimum time increases the yield due to suitable environment at all the growth stages of the crop. Spacing is one of the important parameter, which ultimately affected nutrients uptake, growth and yield of plant. The increase or decrease of row spacing and plant population has definite pattern in relation to the yield. Therefore, it is necessary to study effect of time of sowing and row spacing on growth, yield and economics of soybean.

MATERIALS AND METHODS

The field experiment was conducted during the *kharif* season of the year 2020 at College Farm, College of Agriculture, Navsari Agricultural University, Bharuch, Gujarat. The experimental soil was clay in texture, medium in available nitrogen (256 kg ha^{-1}), low in available phosphorus (25 kg ha^{-1}), high in available potassium (340 kg ha^{-1}), low in available sulphur (7 mg kg^{-1}) and slightly alkaline in reaction (pH 7.50). Total nine treatment combinations consisting of three levels of time of sowing (T_1: Onset of monsoon, T_2: One week after T_1 and T_3: One week after T_2), and three levels of row spacing (S1: 30 cm, S2: 45 cm and S3: 60 cm) were evaluated in factorial randomized block design with three replications. Five plants were selected randomly from each net plot and tagged for recording growth parameters i.e. plant height (cm) and branches plant^{-1} at harvest and yield attributing parameters i.e. number of pods plant^{-1}, number of seeds pod^{-1} and test weight. The data on seed and straw yield was recorded from the net plot and converted on a hectare basis. Economics was also calculated, i.e. total cost of production, net realization and B:C ratio. Collected data were analyzed as per the method suggested by Panse and Sukhatme (1973).

RESULTS AND DISCUSSION

Effect of time of sowing

Growth parameters

Significantly the highest plant height of 77.12 cm and 81.78 cm was observed at 60 DAS and at harvest, respectively and number of branches plant^{-1} of 6.24 and 6.36 at 60 DAS and at harvest, respectively with treatment T_1 (Onset of monsoon). While no significant difference in plant height was observed at 30 DAS due to time of sowing. Similar to this results Potbhare *et al.* (2020)

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reported that the plant height influenced by sowing dates recorded at 25 DAS was non-significant and at 50, 75 DAS and at harvest were found significant in *kharif* soybean. The soybean sown during 26th MW has recorded maximum plant height of 33.61, 45.20 and 47.16 cm at 50, 75 DAS and at harvest, respectively. However, it was at par with 27th MW at 25, 50, 75 DAS and at harvest and significantly superior over 25th and 28th MW. They also reported that number of branches plant^{-1} was significantly affected due to different sowing dates. Sowing of soybean at 26th MW produced maximum number of branches plant^{-1} of 12.63, 14.78 and 14.99 at 50, 75 DAS and harvest, respectively. It was followed by 27th MW and 25th MW. This might be due to congenial climatic condition for better germination and further growth and development of *kharif* soybean.

Yield attributes and yield

The significantly highest number of pods plant^{-1} (84.36), number of seeds pod^{-1} (2.76), seed yield (1764 kg ha^{-1}) and straw yield (3434 kg ha^{-1}) was recorded under treatment T_1 (Onset of monsoon). The test weight of soybean was not significantly influenced due to different time of sowing. Similar result reported by Potbhare *et al.* (2020). They reported that sowing taken on 26th MW had recorded significantly superior in number of pods plants^{-1} (31.50), number of seeds pod^{-1} (2.77) and hundred seed weight (11.88 g), however, it was found at par with 27th MW. They also reported that sowing taken on 26th MW had recorded highest seed yield (2470 kg ha^{-1}) and straw yield (3597 kg ha^{-1}) and found at par with 25th MW and 27th MW, however, it was significantly superior over 28th MW and recorded lowest seed yield (2009 kg ha^{-1}) and straw yield (2968 kg ha^{-1}). This might be due to adequate and increased availability of nutrients for development of more number of pods plant^{-1} and better seed filling with maintenance of better source-sink relationship. With delayed planting the growth period becomes short, while high temperature during flowering decreased the seed yield and yield components of soybean planted early.

Economics

The highest net return (₹ 65393 ha^{-1}) and benefit: cost ratio (2.89) was obtained under treatment T_1 (Onset of monsoon) followed by T_2 (One week after T_1) with net return of 53915 ₹ ha^{-1} with BCR 2.38. The lowest net realization (₹ 41315 ha^{-1}) and BCR (1.83) was obtained under treatment T_3 (One week after T_2). A similar economic benefit of soybean with time of sowing was reported by Potbhare *et al.* (2020). They recorded that sowing taken on 26th MW had recorded significantly superior in net monetary return (₹ 76719 ha^{-1}) and B;C ratio (3.12) over sowing carried out on 25th MW and 28th MW in soybean. Singh *et al.* (2014) also reported that net return (₹ 50418 ha^{-1}) and B:C ratio (3.65) were significantly higher in 5 June sowing than 25 June sowing, which were, however at par with 15 June sowing in soybean.

Effect of row spacing

Growth parameters

Significantly the highest plant height of 78.15 cm and 82.18 cm was observed at 60 DAS and at harvest, respectively and number of branches plant^{-1} of 6.10 and 6.23 at 60 DAS and at harvest, respectively with treatment T_1 (Onset of monsoon). While no significant difference in plant height was observed at 30 DAS due to time of sowing. This increase in plant height at wider row spacing might be due to fact that plant gets enough space for growth i.e. 60 cm row spacing showed a better row to row spacing for better plant height. While, higher number of branches plant^{-1} due to sufficient availability of sunlight and nutrient which increased plant growth and development. The present results are in cognizance with those of Mondal *et al.* (2014) in respect to branches plant^{-1}. They reported that the highest branches plant^{-1} (3.7) was observed at the wider spacing of 20 cm x 30 cm followed by spacing of 15 x 30 cm with same statistical rank. In contrast, the lowest branches plant^{-1} was recorded in the plant spacing of 5 cm x 30 cm in soybean crop. Sowjanya *et al.* (2017) also reported that significantly maximum plant height (50.11 cm) was recorded with the wider spacing of 45 cm x 15 cm which was statistically at par (49.23 cm) with spacing of 30 cm x 20 cm in gladiolus crop.

Yield attributes and yield

Significantly higher number of pods plant^{-1} (85.16), number of seeds pod^{-1} (2.84), seed yield (1741 kg ha^{-1}) and straw yield (3353 kg ha^{-1}) were recorded under treatment S_3 (60 cm). The test weight of soybean was not significantly influenced due to different time of sowing. This was possibly due to less competition between plants for nutrient, soil moisture, space and solar radiation etc. in wider spacing than closer spacing. This was due to the fact that at 60 cm row spacing the number of rows m^2 get decreased and as the row to row spacing is decreased the number of rows m^2 get increased hence it increased the plant population per m^2. Plants in close proximity have more competition as compared to wider spacing. Improved yield attributing characters such as test weight, seeds pod^{-1} and number of pods plant^{-1} was recorded at higher spacing ultimately increasing the seed yield and straw yield. This also confirms the results of Khade *et al.* (2017). They reported that the highest number of capsules plant^{-1} (42.7), seed yield (499 kg ha^{-1}) and straw yield (1495 kg ha^{-1}) were obtained in wider spacing of 45 cm x 20 cm, which was at par with spacing of 45 cm x 10 cm and significantly more over closer spacing of 30 cm x 10 cm and 30 cm x 20 cm in *kharif* sesame. Sanap *et al.* (2019) also reported that effect of drilling distance on number of grains panicle^{-1} was found to be significant in rice crop. However, drilling distance of 30 cm recorded higher number of grains panicle^{-1} which was significantly superior over drilling distance of 20 cm but was at par with 25 cm drilling distance.

Table 1. Effect of time of sowing and row spacing on growth parameters, yield attributes, yield and economics of

Treatments	Plant height (cm)			Number of branches plant^{-1}		Number of pods plant^{-1}	Number of seeds Pod^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Total cost of production (Rs.)
	30 DAS	60 DAS	At harvest	60 DAS	At harvest						
(A) Time of sowing (T)											
T_1: Onset of monsoon	19.02	77.12	81.78	6.24	6.36	84.36	2.76	10.37	1764	3431	22619
T_2 : One week after T_1	18.05	72.27	75.84	5.83	5.97	81.53	2.36	10.02	1531	3053	22619
T_3 : One week after T_2	17.14	52.84	57.28	4.98	5.27	74.38	2.05	9.87	1279	2501	22619
S Em ±	0.52	1.63	1.84	0.16	0.17	1.79	0.07	0.25	38.2	70.1	-
C D at 5 %	-	4.90	5.51	0.49	0.51	5.39	0.21	-	115	210	-
(B) Row spacing (S)											
S_1: 30 cm	16.95	50.68	55.61	4.97	6.18	72.86	1.95	9.77	1312	2520	23865
S_2: 45 cm	18.40	73.40	77.12	5.98	5.20	82.25	2.38	10.18	1521	3112	22619
S_3: 60 cm	18.86	78.15	82.18	6.10	6.23	85.16	2.84	10.31	1741	3353	21373
S Em ±	0.52	1.63	1.84	0.16	0.17	1.79	0.07	0.25	38.2	70.1	-
C D at 5 %	-	4.90	5.51	0.49	0.51	5.39	0.21	-	115	210	-
Interaction (TXS)											
S Em ±	0.91	2.83	3.18	0.28	0.29	3.11	0.12	0.44	66.2	121.4	-
C D at 5 %		-			-	-	-	-	-	-	-

Economics

Higher net realization of 65477 ₹ ha^{-1} with higher BCR 3.06 were obtained under treatment S_3 (60 cm row spacing) followed by 53575 ₹ ha^{-1} with BCR of 2.37 under treatment S_2 (45 cm row spacing). However, the lowest net realization of 41571 ₹ ha^{-1} with BCR 1.74 was obtained under treatment S_1 (30 cm row spacing). This result was supported by Khade *et al*. (2017). They reported that wider spacing of 45 cm x 20 cm recorded significantly higher net monetary return over closer spacing of 30 cm x 10 cm and 30 cm x 20 cm but it was at par with 45 cm x 10 cm. They also recorded maximum B:C ratio (4.7) under wider spacing of 45 cm x 20 cm.

Finally it is inferred that for getting potential yield and economic from soybean grown under rainfed condition could be obtained by sowing of soybean during onset of monsoon along with spacing of 60 cm.

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