RESEARCH ARTICLE

INFLUENCE OF SOWING DATES AND PLANT DENSITIES ON GROWTH PARAMETERS OF SOYBEAN (*GLYCINE MAX* (L.) MERRILL)

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Abstract: A field experiment was conducted during *kharif* season, 2014 to study the influence of different sowing dates and plant densities on growth parameters of soybean. It was comprised of nine treatments with three sowing dates (June 28, July 14 and July 29) as main plot treatments and three row spacing of soybean (30 cm x 10 cm, 45 cm x 10 cm and 60 cm x10 cm) as sub plot treatments and replicated three times. Plant height, dry matter production, leaf area index (LAI), and Days to 50 per cent flowering increased with early sowing crop on June 28 than other two delayed sowings July 14 and July 29. July 14 sown crop is on par to June 28 sown crop. Growth parameters of soybean were inconsistent with different row spacings. The highest plant height, dry matter production and leaf area index (LAI) was recorded at a spacing of 30 X 10 cm, more number of days to 50 percent flowering were recorded at spacing of 60 cm x 10 cm.

Keywords: Sowing dates, Plant densities, Soybean, Growth parameters

INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is an important oilseed crop, which plays an important role in the economy of India. Soybean has now established as number one crop among oilseeds and contributes more than 50 per cent of oilseed production and 30 per cent of vegetable oil production in India (Anonymous, 2008). It is a good source of protein (40%), Oil (20%), unsaturated fatty acids and minerals like Ca and P including vitamin A, B, C, D which can meet-up different nutritional needs of human and animals (Mondal *et al*. 2012). Besides its main use for oil extraction, it can be used as dal, soya milk, *tofu* etc. In 2013, it occupied an area of 12 mha in India with production of 12.8 million tones and with productivity of 1079 kg/ha. It is mainly grown in Madhya Pradesh, Maharashtra and Rajasthan (Anonymous, 2008). The productivity of soybean is low due to various constraints. The time of sowing has a considerable influence on growth and yield of soybean. Early sowing in the season may encourage higher vegetative growth which may invite various diseases and insects pests. However, delayed sowing may shrink the vegetative phase, which in turn reduces dry matter accumulation leading to poor partitioning to reproductive parts and ultimately poor realization of the potential yield. In addition to sowing time planting density is one of the main factors that has an important role on growth and yield of soybean. Optimum plant density ensures proper growth of the aerial and underground parts of the plant through efficient utilization of solar radiation, nutrients, land as well as air spaces and water (Malek *et al*. 2012). There are two general concepts to describe the relationship between plant density and seed yield. Firstly, irrespective of plant spacing within and among rows, plant density must be such that the crop develops a canopy able to intercept more than 95% of the incoming solar radiation during reproductive growth and secondly, a nearly equidistant plant arrangement minimizes interplant competition and produces maximum seed yield. Kang *et al.* (2001) reported that appropriate plant density and cultivar is necessary for obtaining high yield and quality of soybean. The optimum plant density for higher yield may differ from cultivar to cultivar and location to location. There was a need to study the optimum sowing time and optimum plant density for producing higher yield. Therefore, an experiment was initiated in 2014 to study the optimum sowing time and optimum plant density.

MATERIALS AND METHODS

A field experiment was conducted during *kharif*, 2014 at college farm, agricultural college, Mahanandi, ANGRAU. The soil of the experimental site was sandy loam and it was slightly alkaline in reaction with a pH of 7.98, EC of 0.06 dSm^{-1} and low in organic carbon (0.46%) and available nitrogen (266 kg ha^{-1}), medium in available phosphorous (145 kg P_2O_5 ha^{-1}) and high in available potassium (774.3 kg K_2O ha^{-1}). The experiment was laid out in factorial randomized block design and replicated thrice. The treatments consisted of three sowing dates *viz.*, D_1 (June 28), D_2 (July 14) and D_3 (July 29) and three plant densities, *viz.*, S_1: 30 X 10 cm (3.33 lakh plants ha^{-1}), S_2: 45 X 10 cm (2.22 lakh plants ha^{-1}) and S_3: 60 X 10 cm (1.66 lakh plants ha^{-1}). Variety JS335 which matures in 80-85 days was tested in this experiment. A uniform dose of nitrogen, phosphorous and potassium was applied as per the recommendation @30kg N, 60kg P_2O_5 and 40kg K_2O ha^{-1} through urea, single super phosphate (SSP) and muriate of potash (MOP) respectively to all the plots. Entire quantity of phosphorous and potassium

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was applied as basal where as nitrogen was applied in two equal splits, one at the time of sowing and another at 30 days after sowing (DAS). No serious attack of pests and diseases was observed. However, minor incidence of tobacco caterpillar (*Spodoptera litura* (Fab.) was observed at flowering. Monocrotophos @ 2 ml L^{-1} and Acephate (0.08%) @ 2ml L^{-1} were used for effective control of pest. Weeding was done at 15 and 30 DAS of each sowing date to keep the plots free from weeds. When crop was subjected to prolonged dry spell to protect the crop the irrigation was given. The total rainfall received during crop growth was 515.2mm in 28 rainy days. Five plants were randomly selected in the net plot area and tagged. Plant height of these plants was recorded at 30, 60 DAS and at harvest from the base of the plant to the tip of the growing point. The mean value of five plants was computed and expressed as plant height in cm. Dry matter production was measured at 30, 60 DAS and at harvest. Five plants were randomly selected in the gross plot and dug out these plants for destructive sampling. They were oven dried at 60^0C till a constant weight is obtained. The dry weight per m^2 was calculated and expressed as kg ha^{-1}. Leaf area index (LAI) was measured at 30, 60 DAS and at harvest. The leaf area was measured by electronic leaf area meter. LAI was calculated using the formula as Leaf area from the five plants divide by ground area allowed for five plants. The number of days taken from sowing to the attainment of fifty per cent plants to flowering in the experimental plot was considered as days to 50 percent flowering.

RESULTS AND DISCUSSION

Effect of sowing dates

Growth parameters

The differences in plant height due to different sowing dates were significant from 30 days after sowing onwards to harvest. Sowing of soybean on June 28 increased the plant height (38.1 cm) significantly over rest of the sowing dates i.e. July 14 and July 29 at 30, 60 days after sowing and at harvest. Similarly next date of sowing July 14 sowing resulted in significantly taller plants than July 29 sowing at 30, 60 days after sowing and at harvest. Taller plants in early sowing date might be due to favorable environment enjoyed by early sown crop than that sown at later dates even after receiving similar inputs and less number of nodes and reduced inter nodal distances caused by non-optimal sowing time could be the reason for reduction in plant height under delayed sowing dates. Shuddhodhan and Jadhao (1986) also reported the enhancement of growth characteristics with early sowings when compared to late sown conditions in soybean. The total drymatter production increased significantly from 30 days after sowing to harvest. A gradual increase in total dry matter production was noted from 60 days after sowing. The total dry matter production recorded at June 28 sowing was significantly higher (3762 kg ha^{-1}) over the rest of sowing dates i.e. July 14 and July 29 sowings. Maximum drymatter accumulation in the early sown crop was perhaps due to more plant height, higher leaf area index and vigorous vegetative growth. These are in conformity with the results reported by Hanumantharao *et al.* (1990). The maximum leaf area index (4.1) was registered with June 28 sowing over July 14 and July 29 sowings throughout the crop growth period. Sowing of soybean on July 29 resulted in early 50 per cent flowering (35 days) than June 28 and July 14 sowings. Similarly July 14 sowing attained early flowering in soybean than June 28 sowing. The reduction in total duration from sowing to 50 percent flowering might be due to photosensitivity of soybean plant.

Effect of plant densities

With regard to spacings narrow row spacing 30 cm x 10 cm recorded more plant height (40.7 cm) than 45 cm x 10 cm and 60 cm x 10 cm spacings at 30, 60 days after sowing and at harvest. Similarly medium row spacing 45 cm x 10 cm resulted in significantly taller plants than wider row spacing 60 cm x 10 cm at 30, 60 days after sowing and at harvest. The positive relationship of closer spacing on plant height might be attributed to high inter-plant competition, which caused internodal elongation as reported by Ravichandran and Ramaswami (1992) and Halvankar *et al.* (1993). Among row spacings 30 cm x 10 cm spacing recorded highest total dry matter production (3532 kg ha^{-1}) and it was significantly superior over rest of row spacings i.e. 45 cm x 10 cm and 60 cm x 10 cm. Higher drymatter production in closer spacing may have been due to the cumulative effect of more number of plants per unit area, higher leaf area index and more light interception. Arnon (1971) indicated that dry matter yield tend to increase linearly with increase in plant density of different crops. The present findings are in accordance with the findings reported by Duraisingh and Gopalaswamy (1991) and Halvankar *et al.* (1999). Narrow row spacing of 30 cm x 10 cm recorded maximum leaf area index (4.7) over the 45 cm x 10 cm and 60cm x 10 cm spacings at all the stages of crop growth. Similarly 45cm x 10 cm spacing recorded a higher leaf area index values over 60 cm x 10 cm spacing throughout the crop growth period. Increase in leaf area index with early sowing due to favorable environment for the crop during vegetative phase. The decrease in leaf index particularly at later stages of crop growth was mainly due to leaf senescence. Similar results were reported by Halvanker *et al.* (1989) and Sahoo *et al.* (1991). With regard to row spacings narrow row spacing 30 cm x 10 cm resulted in early 50 per cent flowering (52 days) than 45 cm x 10 cm and 60 cm x 10 cm spacings. The reduction in days to 50 per cent flowering might be due to intra plant competition in dense planting. This was also

observed by Hariram *et al.* (2010) and Masum Akond *et al.* (2012).

Table 1. Growth parameters as influenced by sowing dates and plant densities

Treatment	Plant height (cm)			Dry matter production (kg ha^{-1})			Leaf area index			Days to 50% flowering
	30 DAS	60DAS	at harvest	30 DAS	60 DAS	at harvest	30 DAS	60 DAS	at harvest	
Sowing dates										
June 28	23.6	36.7	38.1	486	2228	3762	1.5	4.1	3.7	54
July 14	22.4	36.3	37.8	467	2126	3389	1.4	3.6	3.32	46
July 29	21.7	35.8	37.1	441	2005	3051	1.3	3.1	2.6	36
SEm±	0.2	0.2	0.01	1.5	0.01	17	0.009	0.006	0.05	0.1
C.D.(P=0.05)	0.66	0.05	0.01	4.43	2.03	51.57	0.02	0.01	0.16	0.38
Plant densities										
30 X 10 cm	25.0	39.1	40.7	594	2423	3532	1.8	4.7	4.2	43
45 X 10 cm	22.2	36.7	37.8	460	2049	3379	1.6	3.9	3.4	45
60 X 10 cm	20.6	33.7	34.4	341	1887	3292	0.9	2.1	1.8	48
SEm±	0.2	0.2	0.01	1.5	0.01	17	0.009	0.006	0.05	0.1
C.D. (P=0.05)	0.66	0.05	0.01	4.43	2.03	51.57	0.02	0.01	0.16	0.38
D X S										
SEm±	0.3	0.3	0.01	2.6	0.01	30	0.01	0.01	0.09	0.2
C.D.(P=0.05)	NS	0.12	0.03	10	4.61	116.9	NS	0.04	0.37	0.87

NS- Non significant

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