ADVNACE RESEARCH JOURNAL OF CROP IMPROVEMENT
Volume 2 Issue 1 (June, 2011) Page : 86-91

Received : *April, 2011;* ***Accepted :*** *May, 2011*

Research Paper

Growth studies of soybean under different nutritional requirement

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ABSTRACT

A field investigation entitled "Growth studies of soybean [*Glycine max* (L.) Meril.] cv. MAUS-71 under different nutritional requirement" was conducted during *Kharif* season 2009-10 at AICRP for Dryland Agriculture, M.A.U., Parbhani. The experiment was laid out in Randomized Block Design (RBD) with three replications. There were eight treatments with following details. T_1-75% RDF without FYM, T_2-75% RDF with FYM @ 5 t/ha, T_3-100 % RDF without FYM, T_4-100% RDF with FYM @ 5 t/ha, T_5-125% RDF without FYM, T_6-125% RDF with FYM @ 5 t/ha, T_7- FYM @ 10 t/ha and T_8- Absolute control. Growth attributes *viz.,* plant height, number of leaves per plant, number of branches per plant, Significantly recorded more in treatment T_4 (100 % RDF + 5 t FYM/ha). The grain yield and straw yield was also more significantly in treatments T_4 (100% RDF + 5 t FYM/ha). Based on the results it can be concluded that the treatment T_4 (100 % RDF + 5 t FYM/ha) was found beneficial in improving growth and yield of soybean. Treatment T_4 (100 % RDF + 5 t FYM/ha) recorded double yield than absolute control.

Palve, D.K., Oza, S.R., Jadhav, J.D. and Ghule, P.L. (2011). Growth studies of soybean under different nutritional requirement. *Adv. Res. J. Crop Improv.,* **2** (1) : 86-91.

Key words : Soybean, Nutrition requirement

INTRODUCTION

In India, though area is large but the productivity is very low *i.e.* 900 kg ha-1 as compared to world productivity 1900 kg ha-1. Average consumption of soybean in India is 4812 thousand metric tonne gaining the sixth rank in the consumption of soybean in the world. (Anoymous, 2010). Maharashtra ranks second in production of soybean after Madhya Pradesh in the country. Soybean has profitably replaced the main pulses of state other legume like mung bean and black gram. Soybean was introduced in Maharashtra state during the year 1984-1985 and it was grown only on 5.6 lakh hectare till 1994, but today the area has increased rapidly. In Maharashtra, area under soybean cultivation during 2009-2010 was 30.3 lakh hectare with total production of 29.7 lakh metric tonnes with an average productivity of 982 kg per hectare.

At present FYM which is organic source helps in increasing the yield of crop. So the different nutrient combination helps in increasing yield as well as soil physical condition. Nutrient are second most important limiting factor of crop production after water. Most of the soil in the rainfed regions are not only thirsty but also hungry. It was well established after going high yields. The nutrient demand of crop could be met from application of recommended dose of fertilizer as well as FYM application. They help in increasing yield as well as increasing physico-chemical properties of soil. The variety MAUS-71 was recommended by Marathwada Agricultural University, Parbhani. MAUS-71 (Samrudhi) is recommended under rainfed condition in Marathwada region. Hence, MAUS-71 variety was taken in the study.

MATERIALS AND METHODS

The details of the material used and methods adopted during the course of investigation are presented in this chapter. A field experiment was conducted during *Kharif* season in 2009-10 at AICRP for Dryland Agriculture, Marathwada Agriculture University, Parbhani. The present

experiment was laid out in Randomized Block Design (RBD) with three replications. The treatment consisted with two sources of nutrients *i.e.* RDF and FYM. The allotment of treatments to various plot in replication was done by randomization.

Treatment details (Fertility level 8)	
T_1 75% RDF without FYM	T_5 125% RDF without FYM
T_2 75% RDF with FYM @ 5 t/ha	T_6 125% RDF with FYM @ 5 t/ha
T_3 100 % RDF without FYM	T_7 FYM @ 10 t/ha
T_4 100% RDF with FYM @ 5 t/ha	T_8 Absolute control
RDF (100%) = 30 : 60 : 30 kg NPK/ha	

Fertilizer was applied as a basal dose for sowing according to treatment in RDF. FYM was also applied as a recommended dose. Soybean crop was sown on 9th July, 2009. The sowing was done by drilling at a distance of 45 cm x 5 cm at about 2.5 cm depth. The emergence of seed started from 5 days after sowing and completed by 12 days. At maturity of soybean the plants in each net plot were cut to ground level with the help of sickles. The plot wise harvested plants were collected and sun dried for a week. Threshing and cleaning of seed was done. Biological, grain and stalk yield were recorded separately for each net plot.

Data on important biometric observation were collected on fixed five randomly selected healthy plants in each treatment throughout the crop life. Emergence count was taken on 15 days after sowing and final plant stand from each net plot was recorded at harvest. The number of plants per net plot was recorded a day before .Height of the randomly selected plant was measured from ground level to the base of fully opened leaf at various growth stages starting from 30 DAS. Progressive number of functional leaves and fully opened green leaves per plant were counted at 15 days interval from 30 DAS. Number of branches arising from main stem were counted and recorded as per plant upto harvest at interval of 15 days.

Pods of the five observation plants were threshed and average yield (g) per plant was recorded.The weight of whole dried harvested produce was taken from net plot. After separation of grains from the biological yield, remaining material (stem + bhooosa) was considered as a straw yield and its final weight was recorded and multiplied with hectare factor. The per cent ratio of the economic yield to the total biological yield. Harvest index reflects the proportion of assimilate distribution between economic and total biomass.

Statistical analysis:

Results obtained were statistically analyzed as per the methods given in the book. Statistical Methods for Agricultural Workers by Panse and Sukhatme (1967). The total variance and degree of freedom were partitioned into possible sources. The variance due to treatment was compared against variance due to error to find out 't' value and the significance at p = 0.05. Whenever, the result was significant, Standard Error (SE) and Critical Difference (CD) at 5 per cent level of probability were worked out for comparing the mean of treatment. The data have been suitably illustrated at appropriate place.

RESULTS AND DISCUSSION

The summarized data as influenced by different treatments presented in this chapter under appropriate tables.

Mean emergence count and final plant stand of soybean :

Mean number of plants emerged and final plant stand at harvest in each net plot were counted and converted into per cent. These per cent population was converted into arcsine values and data obtained (Table 1). The data

Table 1 : Mean emergence count and final plant stand of soybean influenced by different treatment

Treatments	Emergence count (%)	Final plant stand (%)
T_1-75% RDF without FYM	76.98	61.85
	(97.35)	(88.15)
T_2-75% RDF with FYM @ 5 t/ha	75.11	61.18
	(96.52)	(87.58)
T_3-100 % RDF without FYM	77.05	61.78
	(97.36)	(88.03)
T_4-100% RDF with FYM @ 5 t/ha	77.13	62.17
	(97.37)	(88.43)
T_5-125% RDF without FYM	75.32	60.30
	(96.42)	(86.84)
T_6-125% RDF with FYM @ 5 t/ha	73.82	60.95
	(95.84)	(87.39)
T_7-FYM @ 10 t/ha	76.12	59.65
	(96.86)	(86.30)
T_8-Absolute control	73.17	59.11
	(95.66)	(85.82)
S.E. $\pm$	2.33	1.02
C.D. (P=0.05)	NS	NS
Mean	75.59	60.87
	(96.67)	(87.32)

NS=Non-significant

on mean emergence, count and final plant stand of soybean at harvest was not influenced significantly due to different treatments under study. This indicated that, variations obtained during the course of investigation were due to treatments and were real effects of treatment.

Plant height (cm) :

Data on mean plant height of soybean was recorded at various growth stages in Table 2.The mean plant height was influenced significantly due to different treatments

The mean plant height of plant was increased up to harvest. The rate of height increases was slow up to 45 days and it gradually increased thereafter. Treatment T_4 (100 per cent RDF with 5 t/ha FYM) recorded significantly higher plant height than other treatments (14.50 cm) but it was at par with treatment (T_5) at 30 days. At 45 DAS, treatment T_4 showed significantly more plant height than T_7 and T_8 treatments.At 60 DAS, treatment T_4 recorded significantly more plant height than treatments T_1, T_2, T_3 and T_7. But it was at par with treatment T_5 and T_6. At 75 DAS, treatment T_4 observed greater plant height than other treatment but it was par with treatment T_3 and T_5.The treatment T_8 recorded less plant height than other treatment during all the growth stages.

Mean number of functional leaves :

Data on mean number of functional leaves per plant was recorded at various growth stages of crop growth (Table 3).

The mean number of functional leaves increased up to 60 DAS, thereafter, it decreased due to leaf senescence. The mean number of functional leaves at 30, 45, 60, 75 and 90 DAS were 5.21, 11.00, 22.42, 19.00 and 10.00, respectively. Treatment T_4 showed more number of leaves over the rest of treatments. At 30 DAS it was observed that treatment T_4 showed significantly higher number of leaves than other treatment except treatment T_6. Treatment T_8 recorded lowest number of leaves through out plant growth period. Treatment T_4 recorded significantly more number of leaves throughout the growth stages from

Table 2 : Mean plant height (cm) per plant of soybean as influenced by different treatments at various growth stages of crop

Treatments	Days after sowing					At harvest
	30	45	60	75	90	
T_1-75% RDF without FYM	11.67	15.90	19.93	25.33	30.42	31.08
T_2-75% RDF with FYM @ 5 t/ha	12.43	15.82	20.45	27.23	33.47	34.13
T_3-100 % RDF without FYM	12.13	16.20	20.43	29.27	34.27	35.23
T_4-100% RDF with FYM @ 5 t/ha	14.50	18.23	23.20	31.82	35.33	35.57
T_5-125% RDF without FYM	13.23	17.48	22.47	29.40	33.75	34.08
T_6-125% RDF with FYM @ 5 t/ha	12.27	16.48	21.43	26.42	34.93	35.27
T_7-FYM @ 10 t/ha	11.60	15.63	20.70	24.70	33.63	33.97
T_8-Absolute control	10.30	12.77	19.07	25.30	29.77	30.10
S.E. $\pm$	0.59	0.81	0.64	1.19	0.98	0.97
C.D. (P=0.05)	1.80	2.47	1.96	3.63	2.98	2.59
Mean	12.26	16.12	20.95	27.43	33.21	33.67

Table 3 : Mean number of functional leaves as influenced by different treatments at various growth stages of soybean crop

Treatments	Days after sowing				
	30	45	60	75	90
T_1-75% RDF without FYM	5.20	10.12	20.63	17.57	9.60
T_2-75% RDF with FYM @ 5 t/ha	5.17	10.80	22.27	18.87	9.23
T_3-100 % RDF without FYM	5.26	10.63	23.00	18.67	10.06
T_4-100% RDF with FYM @ 5 t/ha	6.10	14.10	26.57	24.63	12.97
T_5-125% RDF without FYM	5.22	11.13	22.93	18.67	9.97
T_6-125% RDF with FYM @ 5 t/ha	5.53	10.93	22.80	19.00	10.13
T_7-FYM @ 10 t/ha	4.87	10.43	22.23	17.93	10.20
T_8-Absolute control	4.40	9.67	19.00	16.87	8.17
S.E. $\pm$	0.23	0.64	1.04	1.14	0.58
C.D. (P=0.05)	0.71	1.95	3.17	3.47	1.78
Mean	5.20	11.00	22.40	14.00	10.00

45 DAS.

Mean number of branches per plant:

Mean number of branches was influenced by different treatment presented in Table 4.

Maximum mean number of branches were observed at 90 DAS. The mean number of branches per plant increased faster at 75 DAS. At 30 DAS treatment T_5 (125% RDF without FYM) recorded significantly more number of branches than other treatment. At 45 DAS the treatment T_4 showed significantly more number of branches than other treatments, but it was at par with the treatment T_6. At 60, 75 and 90 DAS, treatment T_4 recorded significantly higher number of branches than rest of the treatments.

Grain yield, Straw yield, biological yield and harvest index:

Data on grain, straw, biological yield and harvest index presented in Table 5.

Grain yield :

Data presented in Table 5 showed that treatment T_4 (100 per cent RDF + 5 t/ha FYM) recorded significantly more grain yield than other treatment. But, it was at par with treatments T_1, T_2, T_3, T_6 and T_7.

Straw yield :

Straw yield also the treatment T_4 (100 per cent RDF + 5 t/ha FYM) (2923.33 kg/plot) is significantly more over the control treatment. Treatment T_8 showed less straw yield over the rest of treatments.

Biological yield :

Data presented in Table 5 showed that treatment T_4 (100 per cent RDF + 5 t/ha FYM) (4531.66 kg/ha) more biological yield which was significantly superior over the rest of the treatments.

Table 4 : Mean number of branches per plant of soybean influenced by different treatments at various growth stages of crop

Treatments	Days after sowing					At harvest
	30	45	60	75	90	
T_1-75% RDF without FYM	2.13	3.50	4.85	5.03	5.20	5.20
T_2-75% RDF with FYM @ 5 t/ha	2.27	3.70	5.07	5.23	5.60	5.60
T_3-100 % RDF without FYM	2.07	3.73	5.27	5.37	5.60	5.60
T_4-100% RDF with FYM @ 5 t/ha	3.02	4.55	6.17	6.68	6.70	6.77
T_5-125% RDF without FYM	3.20	3.51	5.07	5.23	5.40	5.40
T_6-125% RDF with FYM @ 5 t/ha	2.51	4.17	5.27	5.43	6.20	6.20
T_7-FYM @ 10 t/ha	2.43	3.77	5.13	5.43	5.20	5.20
T_8-Absolute control	2.03	3.38	3.80	4.61	4.57	4.40
S.E. $\pm$	0.13	0.17	0.31	0.28	0.30	0.32
C.D. (P=0.05)	0.39	0.54	0.94	0.86	0.93	0.98
Mean	2.33	3.79	5.07	5.37	5.55	5.52

Table 5: Mean grain yield, straw yield, biological yield (kg/ha) and harvest index of soybean as influenced by different treatments at various growth stages of crop

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T_1-75% RDF without FYM	1466.67	2233.33	3700.00	39.63
T_2-75% RDF with FYM @ 5 t/ha	1408.33	2353.33	3761.66	37.43
T_3-100 % RDF without FYM	1500.00	2343.33	3843.33	39.02
T_4-100% RDF with FYM @ 5 t/ha	1608.33	2923.33	4531.66	35.48
T_5-125% RDF without FYM	1233.33	2463.33	3696.66	33.36
T_6-125% RDF with FYM @ 5 t/ha	1358.33	2498.33	3856.66	35.22
T_7-FYM @ 10 t/ha	1275.00	2436.67	3711.67	34.35
T_8-Absolute control	766.67	2110.00	2876.67	26.65
S.E. $\pm$	117.87	115.24	178.96	
C.D. (P=0.05)	354.53	349.60	542.90	
Mean	1327	2420.00	3747.28	35.14

Harvest index of soybean :

The harvest index in treatment T_4 (35.48) was more than any other treatments.

The findings of the present investigation was carried out during 2009-10 and are discussed briefly under appropriate headings:

Growth attributes:

Various growth attributes like plant height, number of leaves, leaf area, number of branches and pod yield were discussed under appropriate heads.

Plant height:

It was observed from data on mean plant height (Table 2) that the plant height of soybean increased slowly up to 45 days and it gradually increased thereafter. The growth was slow during 90 DAS to harvesting. The mean plant height was influenced significantly by various treatments with advancement of crop age. It was observed that treatment (T_4) *i.e.* 100 per cent RDF with 5 t FYM/ ha recorded higher plant height than other treatment. This may be due to more water holding under this treatment. The mean plant height of the treatment (T_8) *i.e.* absolute control showed smaller plant height than other treatment. Sekhon (1968) conducted field experiment at Ludhiana and reported that the plant height of soybean was increased due to nitrogen application but phosphorus did not influenced the plant height of plant. Aggrawal and Narang (1975) conducted field experiment at Hissar and observed that nodulation of soybean was significantly affected by P application and highest number and weight of nodules recorded at 100 kg P_2O_5 ha^{-1}. Similar finding have been reported by Saxna and Chandel (1996). Bothe *et al.* (2000) conducted a field experiment and observed that plant height, number of branches, dry matter accumulation were maximum at 30 : 70 : 100 kg NPK ha^{-1} application.

Functional leaves :

The mean number of functional leaves was increased up to 60 DAS than it was decreased due to senescence of leaf. The maximum mean number of leaves (Table 3) showed at 60 DAS *i.e.* 22.42. The effect of treatments on functional leaves per plant *i.e.* treatment T_4 (100% RDF + 5 t FYM/ha) showed more number of functional leaves than treatment T_8 (Absolute control) throughout the growth stages. This may due to higher water holding under treatment T_4 Rani (1999) from Krishna-godavari zone (A.P.) opined that application of Nitrogen levels affected pod and number of branches per plant, while Phosphorus levels increased plant height and pod number of soybean crop.

Number of branches:

Branching in soybean was started 30 DAS (Table 4) and it increased continuously up to 90 DAS and further remained constant. But the rate of increase in number of branches per plant was higher at 60 to 75 DAS. At all growth stages the treatment T_4 *i.e.* 100 % RDF with 5 t FYM/ha showed more number of branches which was par with treatment T_6. The treatment T_8 (Absolute control) showed less number of branches than other treatment. This might be due to less nutrient and moisture supply. Verma *et al.* (1994) revealed that fertilization of soybean with 40 kg N ha^{-1} and 80 kg P_2O_5 ha^{-1} significantly increased the plant height and number of branches. More *et al.* (2006) conducted field experiment at Nagpur and observed that plant height, number of branches, dry matter accumulation of soybean were maximum at 30 : 75 : 100 kg NPK ha^{-1}.

Grain yield :

Grain yield (Table 5) of soybean recorded in kg/ha. Application of 100 per cent RDF + 5 t FYM/ha showed significantly more grain yield over the control. This treatment gave the higher grain yield because nutrient and FYM application enhanced root proliferation which helped in more absorption of nutrients from deeper layer of soil resulting into significant increase in yield. Similar findings were reported by Wanjari *et al.* (1993) and Singh *et al.* (1995), Kumar and Singh (1996), Jadhav *et al.* (1998), Mandal *et al.* (1998), Rao *et al.* (1998), Chaturvedi and Chandel (2003) and Bansode (2008).

Straw yield, biological yield and harvest index of the soybean :

Straw yield recorded was found that treatment T_4 (100 % RDF + 5 t FYM/ha) showed significantly more straw yield over the rest of the treatments. Similar findings were recorded by Singh *et al.* (1995) and Chaturvedi and Chandel (2003).Biological yield and harvest index also recorded more in treatment T_4 (100% RDF + 5 t FYM/ ha), which was significantly superior over rest of treatment.

Conclusion:

The effect of various treatments on growth characters, yield attributes of soybean have been summarized below. The highest plant height of soybean was recorded with treatment T_4 (100 % RDF + 5 t FYM/ ha). Similarly more number branches, number of pod trifoliate leaves, number of nodules dry matter

accumulation, more in treatments T_4 (100 % RDF + 5 t FYM/ha). The grain and straw yield (kg/ha) of soybean increased significantly. The highest grain yield (1608.33 kg/ha) and straw yield (2923.33 kg/ha) in treatment T_4 (100 % RDF + 5 t FYM/ha). While, it was lowest under treatment T_8 (control).

Based on present investigation following conclusions were drawn The treatment T_4 (100 % RDF + 5 t FYM/ha) was found beneficial in improving growth, yield attributes, yield of soybean GMR and NMR as compared to other treatments. Treatment T_4 (100 % RDF + 5 t FYM/ha) recorded double yield than absolute control.

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