Research Paper

ADVANCE RESEARCH JOURNAL OF
C R P
IMPROVEMENT
Volume 5 | Issue 2 | Dec., 2014 | 79-83
e ISSN-2231-640X

DOI :
10.15740/HAS/ARJCI/5.2/79-83
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Effect of different sources of nutrients on growth, yield and quality of soybean varieties

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ABSTRACT : A field experiment was conducted at P.G. student research farm, Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (M.S.) India during *Kharif* season 2011 to study effect of different sources of nutrients on growth, yield and quality of soybean varieties. The results of the study revealed that growth, yield and quality of soybean differ significantly due to varied nutrient levels. Variety MAUS-71 recorded significantly higher plant height, followed by JS-335. Maximum number of branches, LAI, number of pods per plant, dry matter and number of nodules per plant was observed in variety JS-335 followed by MAUS-71 and the lowest was noticed in cultivar MAUS-158. Yield attributing characters *i.e.* number of pods plant^{-1}, 100 seed weight, seed yield, straw yield and harvest index were significantly higher in variety JS-335. Cultivar JS-335 created maximum protein yield as well as oil yield which was significantly superior over rest of the genotypes. The chemical source of nutrient @ RDF: 30:60:30 NPK kg ha^{-1} gave the highest productivity as compared to other sources of nutrients used in the experiment. The soil fertility can be improved by application of farmyard manure @ 5 tonnes hectare^{-1} in respect of available NPK and OC.

Key **W**ords : Soybean varieties, Chemical fertilizers (30:60:30), FYM, Vermicompost

How to cite this paper : Gokhale, D.N., Kadam, S.R., Karanjikar, P.N. and Jami, Ziauddin (2014). Effect of different sources of nutrients on growth, yield and quality of soybean varieties. *Adv. Res. J. Crop Improv.*, **5** (2) : 79-83.

Paper **H**istory : **Received :** 26.05.2014; **Revised :** 08.10.2014; **Accepted :** 22.10.2014

Soybean has occupied third place in oil seed crops of India, which is rich source of protein (40-42%) and quality oil (20-22%). It also enriches the soil through atmospheric nitrogen fixation and leaves about 30-40 kg N (Nitrogen) per hectare for succeeding crop (Saxena and Chandel, 1992). Soybean also contains 26.9 per cent carbohydrates, 4.6 per cent minerals and 2 per cent phospholipids (Halvankar *et al.*, 1992). Owing to its multiplicity of uses as food and industrial products, it is called a 'wonder crop'. It is the number one oilseed crop of the world. Soybean protein is rich in the valuable amino acid lysines (5%) in which most of the cereals are deficient. In addition, it contains a good amount of minerals, salts and vitamins (thiamine and riboflavin); also it is rich source of vitamin A, B and D. Soybean is globally cultivated over an area of 98.09 million ha with a production of 261.50 million tonnes (2010-11). In 2015 the production will be 289.76 tonnes.

Agriculture continues to be mainstay for livelihood of rural people. Fertilizers have been considered as an essential input to Indian agriculture for meeting the food grain requirements of the growing population of the country. Fertilizers bear a direct relationship with food grain production along with a number of supporting factors like high yielding varieties (HYVs), enhanced total factors of productivity, they face both for inputs and the outputs, etc.

The increasing pressure of population on the available land resources necessitates higher agricultural productivity, which can be achieved through more intensive use of fertilizer nutrients. Crop fertilization can be achieved by using chemical or organic fertilizers. Most chemical fertilizers are composed of a combination of nitrogen, phosphorus and potassium. Organic fertilizers include compost, manure, grass clippings or decaying leaves. Keeping in view the vital role played by chemical fertilizers in the success of India's green revolution and consequent self-reliance in food-grain production, the Government of India has been consistently pursuing policies conducive to increased availability and consumption of

fertilizers in the country. Studies of the effects of humic substances on plant growth, under conditions of adequate mineral nutrition, have consistently produced in positive growth effects (Chen and Aviad, 1990). For instance, applications of humic substances to soils increased dry weights of shoots, roots, and nodules of soybean, peanut, and clover plants (Tan and Tantiwiramanond, 1983). Use of organic manures alone or in combination with chemical fertilizers will help to improve physical and chemical properties of the soils, efficient utilization of applied fertilizers for improving seed yield and seed quality. Organic manures provide a good substrate for the growth of micro organisms and maintain a favourable nutritional balance. Availability of essential nutrients or imbalanced nutrition forming is one of the important constraints to soybean productivity in India. Hence, a balanced nutrients application is must to harness the productivity of the crops. Keeping these in view, an investigation was carried out to study the effect of different sources of nutrients on growth, yield and quality of soybean varieties.

RESEARCH PROCEDURE

The field experiment was conducted during rainy (*Kharif*) seasons 2011 at P.G. Research Farm, Department of Agronomy, College of Agriculture,Vasantrao Naik Krishi Vidyapeeth, Parbhani. The soil of experimental field was clayey having organic carbon 0.52 per cent, available nitrogen, P_2O_5 and K_2O 150.53, 21.15 and 684 kg/ha, respectively. The present experiment was laid out in Split Plot Design with three replications. The size of the gross plot was 5.4 m x 5.0 m and net plot size was 4.5 m x 4.0 m. The main plot was encompassed of three cultivars *i.e.* MAUS 71, JS 335 and MAUS 158 and the sub plot was comprised of three sources of nutrients *i.e.* chemical fertilizer, FYM and vermicompost. The nine treatments combinations of three varieties and three sources of nutrients were randomly allotted in each replication. The manures and fertilizers were applied as per the treatment combinations. The farmyard manure @ 5 tonne ha^{-1} and vermicompost @ 2.5 tonne ha^{-1} were applied in soil 15 days before sowing. Recommended dose of fertilizers incorporated at the time of sowing of the crop. Recommended fertilizer dose of 30 kg N, 60 kg P_2O_5 and 30 kg K_2O per hectare was applied in the form of urea, diammonium phosphate and muriate of potash, respectively. The seeds were treated with Rhizobium japonicum @ 3g kg^{-1} of seed each. Seeds were sown by dibbling method with the spacing of 5 cm between seeds and 45 cm between rows. Soybean crop was sown on 19th July, 2011. The sowing was done by dibbling method at a distance of 45 cm x 5 cm at about 2.5 cm depth. The total rainfall received during the crop growth period was 553.3 mm over 36 rainy days. All observations were recorded time to time by proper sampling. Experimental crop was raised under rainfed with recommended package of practices. The results are presented on the basis of pooled analysis over years.

RESEARCH ANALYSIS AND REASONING

The findings of the present study as well as relevant discussion have been presented under the following heads :

Table 1 : Growth parameters of soybean as influenced by different varieties and sources of nutrients

Treatments	Plant height	Number of branches	Leaf area index	No. of pods $plant^{-1}$	Dry matter	Number of nodules
Varieties (main plot)						
V_1 MAUS-71	64.02	5.92	7.54	37.53	32.70	28.49
V_2 JS – 335	58.12	6.64	7.88	40.13	33.42	29.17
V_3 MAUS-158	58.07	5.31	7.20	36.52	30.53	29.15
S.E. $\pm$	0.23	0.15	0.09	0.42	0.34	0.15
C.D. (P=0.05)	0.58	0.46	0.30	1.28	1.04	0.45
Sources of nutrients (sub plot)						
F_1 FYM @ 5 tonnes ha^{-1}	58.97	5.48	7.40	36.58	31.38	28.70
F_2 Vermicompost @ 2.5 tonnes ha^{-1}	59.01	6.15	7.43	38.64	32.22	29.53
F_3 Chemical fertilizer @ RDF :30:60:30 NPK kg ha^{-1}	62.23	6.25	7.79	39.96	33.05	28.57
S.E. $\pm$	0.36	0.11	0.10	0.41	0.29	0.21
C.D. (P=0.05)	1.69	0.32	0.32	1.27	0.88	0.63
Interactions (V x F)						
S.E. $\pm$	0.62	0.18	0.18	0.71	0.50	0.35
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS
General mean	60.07	5.96	7.54	38.06	32.22	28.94

NS=Non–significant

Growth parameters of soybean :

Varieties :

The growth attributes given in (Table 1) revealed that the plant height of individual variety was directly proportional to the duration of that variety. Siddiqui *et al.* (2007) also reported significant differences in plant height due to different varieties.

The number of branches was maximum in variety JS–335 followed by MAUS –71. The minimum number of braches was recorded by varieties MAUS–158. This is due to the growing habit of soybean crop. Sharief *et al.* (2010) also found significant variation in number of branches due to different genotypes.

The number of pods differed significantly in different cultivars. Variety JS–335 produced the highest number of pods as that was followed by cultivar MAUS–71. The lowest number of pods was recorded in genotype MAUS–158 and it is due to less branching and the dwarf habit of the cultivar in contrast with the JS–335 and MAUS–71. Anetor and Akinrinde (2006) showed the significant differences between different varieties in respect of number of pods plant^{-1}.

The total dry matter accumulation was highest in variety

Table 2 : Yield and yield attributing parameters of soybean as influenced by different varieties and sources of nutrients

Treatments	No. of pods plant^{-1}	100 seed weight	Seed yield (kg ha^{-1})	Straw yield (kg ha^{-1})	No. of seeds plant^{-1}
Varieties (Main plot)					
V_1 MAUS-71	37.53	13.98	2224	4740	31.98
V_2 JS – 335	40.13	14.57	2306	4830	32.34
V_3 MAUS-158	36.52	13.06	1938	4598	29.60
S.E. $\pm$	0.42	0.21	37.13	43.15	0.41
C.D. (P=0.05)	1.28	0.66	114.27	132.95	1.26
Sources of nutrients (sub plot)					
F_1 FYM @ 5 tonnes ha^{-1}	36.58	13.65	2056	4648	30.56
F_2 Vermicompost @ 2.5 tonnes ha^{-1}	38.64	13.62	2145	4707	31.35
F_3 Chemical Fertilizer @ RDF :30:60:30 NPK kg ha^{-1}	39.96	14.35	2266	4815	32.01
S.E. $\pm$	0.41	0.10	51.28	41.88	0.44
C.D. (P=0.05)	1.27	0.32	157.79	129.07	1.35
Interactions (V x F)					
S.E. $\pm$	0.71	0.18	88.83	75.55	0.77
C.D. (P=0.05)	NS	NS	NS	NS	NS
General mean	38.06	13.87	2156	4723	31.31

NS=Non–significant

Table 3 : Quality (oil yield and protein yield) of soybean as influenced by different treatments

Treatments	Oil yield (kg ha^{-1})	Protein yield (kg ha^{-1})
Varieties (Main plot)		
V_1 MAUS-71	434	881
V_2 JS – 335	466	931
V_3 MAUS-158	384	763
S.E. $\pm$	1.66	5.64
C.D. (P=0.05)	5.12	17.34
Sources of nutrients (sub plot)		
F_1 FYM @ 5 tonnes ha^{-1}	409	816
F_2 Vermicompost @ 2.5 tonnes ha^{-1}	423	851
F_3 Chemical fertilizer @ RDF :30:60:30 NPK kg ha^{-1}	453	909
S.E. $\pm$	5.35	9.85
C.D. (P=0.05)	16.48	30.31
Interactions (V x F)		
S.E. $\pm$	9.27	17.06
C.D. (P=0.05)	NS	NS
General mean	428	858

NS = Non–siginificant

JS–335 followed by variety MAUS–71, whereas the lowest dry matter accumulation was observed in variety MAUS–158. This may be due to larger leaf area in JS–335. Larger leaf area resulted in more photosynthetic activities and more accumulation of carbohydrates and by this means increased dry matter accumulation. Chiezey and Odunze (2005) studied parallel results in respect of total dry matter accumulation.

The maximum number of nodule per plant was verified in soybean variety JS–335. The minimum number of nodules per plant was traced in variety MAUS–158. Tilak (2012) also observed similar results. The superior leaf area index (LAI) was proved in variety JS–335 followed by MAUS–71 and the minor LAI was established in cultivar MAUS–158.

Fertility levels :

Among the assortment and assessment of different growth characters *viz.*, plant height, number of functional leaves, leaf area, number of branches and total dry matter per plant were highest due to application of chemical fertilizer followed by vermicompost, with the disparity that the lowest growth characters was published by application of farmyard manure. The same consequence was quoted by Raut *et al.* (2003) on the aspects of growth characters.

Yield and yield attributing characters :

The data presented in (Table 2) on number of pods plant^{-1}, 100 seed weight, seed yield, straw yield and harvest index differed significantly due to varieties and fertility levels.

Varieties :

The yield contributing characters *viz.*, number of pods plant^{-1}and 100 seed weight were maximum in variety JS–335 followed by genotype MAUS–71. The lowest yield contributory characters were recorded in cultivar MAUS–158. The differences in seed weight are mainly due to genetic character of the varieties under study. Sharief *et al.* (2010) found significant differences in yield attributing characters due to different varieties.

The highest grain and straw yield (kg ha^{-1}) of soybean crop was recorded by variety JS–335 (2306 and 4830 kg ha^{-1}, respectively) followed by variety MAUS–71. The lowest grain and straw yield was obtained by variety MAUS–158, which is due to the minimum yield contributory characters of the genotype. Sharief *et al.* (2010) reported the similar results regarding the grain and straw yield.

Fertility levels :

The yield contributing characters *viz.*, number of pods plant^{-1}and 100 seed weight (g) were highest when nutrient was applied as chemical fertilizer (F_3), that was followed by application of vermicompost and the least was recorded with the application of FYM. The same results were observed by Zhao and Wang (1998).

The highest grain and straw yield (kg ha^{-1}) was viewed with the application of chemical fertilizer followed by vermicompost. On the other hand, the minimum grain and straw yield was achieved by application of farmyard manure. Chiezey and Odunze (2005) reported the same results.

Quality attributing characters :

Varieties :

The data in (Table 3) showed quality parameters of soybean crop, in terms of yield of oil and protein of the crop is the function of the seed yield. The maximum oil and protein yield (466.22 and 931.33 kg ha^{-1}, respectively) was obtained with the variety JS–335 followed by MAUS–71 and the lowest oil and protein yield was attained with MAUS–158. This was the same agreement with the result of Sharief *et al.* (2010).

Fertility levels :

The quality parameters *viz.*, oil and protein yield and of soybean were found higher in chemical fertilizer (F_3). The maximum oil and protein yield (452.70 and 908.72 kg ha^{-1}, respectively) was obtained by application of chemical fertilizer followed by vermicompost, whereas the least was gained in application of farmyard manure as a treatment. The comparable outcomes were reported by Alam *et al.* (2009).

Conclusion :

- Variety JS–335 has the highest production potential and gave better oil and protein content compared to varieties MAUS–71 and MAUS–158.
- The chemical source of nutrient @ RDF: 30:60:30 NPK kg ha^{-1} gave the highest productivity to other sources of nutrients used in the experiment.

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