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Effect of Different Sources of Nutrients on Quality, Yield and Yield Attributing Characters of Soybean (*Glycine max* L. Merrill)

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Abstract

A field experiment was conducted to study the effect of inorganic and organic sources of nutrients on quality, yield and yield attributing characters of soybean (*Glycine max* L. Merrill) during 2006-2007. Experiment was conducted in randomized block design with ten treatments and three replications. Different yield attributes viz. number of branches per plant, number of pods per plant, 1000-seed weight were found to be significantly higher with the application of recommended rates of NPK (20 : 60 : 40) which was at par with 50 kg N + 1 t neem cake per hectare and greater than rest of the treatments. However, number of grains per pod was not influenced by various treatments of inorganic and organic nutrients. Maximum grain yield was obtained with the application of 25 kg N + 5t FYM per hectare. Lowest yield was obtained in control. The grain protein content of soybean was highest (39.67%) with the application of 50 kg N + 1 t neem cake per hectare while oil content of soybean grain was highest (20.38%) with the application of 5 t FYM per hectare.

Key words : Soybean, Quality, Yield, Yield attributes, Nutrient sources.

Soybean being the richest, source of best quality proteins and fats and having a multiplicity of uses as food, fodder and industrial products is also called a wonder crop of 20th Century. It is needless to mention that soybean is the most important and valuable oilseed crop worldwide on account of its wide range in geographical adaptation, unique chemical composition, good nutritional value, functional health benefits and versatile end uses (food, feed and non-edibles). It has good adaptability towards a wide range of soil and climate, and fetches good returns to farmers even with low level of agricultural inputs. With the increasing degradation of soil through chemical fertilizers, the need to replace them with organic sources which are good for improvement of soil properties, besides supplying nutrients for longer period of time without leaving ill effects on soil has been realized. Studying the response of soybean at varying levels of inorganic and organic sources of nutrients, alone/combination would be of interest for getting the information about the amount of these sources required for quality and full yield potential of soybean. Keeping this in view, present investigation was designed to assess the optimum quantity of manures and fertilizers for getting good quality soybean with maximum yield.

Methods

The experimental trials were conducted at the Agricultural Research Farm of Amar Singh (PG) College, Lakhaoti, Bulandshahr, (UP). The soil of the experimental site was low in organic carbon (0.49), available nitrogen (162.0 kg/ha), available phosphorus (10.0 kg/ha) and potassium (208.0 kg/ha) and sandy loam in texture having pH 7.5. The water table during the crop season was at 3.5 m depth. Soybean variety PK-262 having 120—125 days maturity was inoculated by *Bradyrhizobium japonicum* and sown in the experimental field. Experiment was conducted in randomized block design with ten treatments and three replications. The treatments were control i.e. without any application of manures and fertilizers but seed was inoculated with *Bradyrhizobium japonicum,* 25 kg N per ha applied through urea, 50 kg N per ha applied through urea, 5 tonne FYM per ha, 1 tonne neem cake per ha, 25 kg N applied through urea + 1 tonne neem cake per ha, 50 kg N applied

Table 1. Effect of inorganic and organic sources of nutrients on quality, yield and yield attributing characters of soybean.

Treatments	No. of primary branches/ plant	No. of pods/ plant	No. of grains/ pod	1000-grain weight (g)	Yield (q/ha)	Nitrogen concen-tration (%)	Crude protein content (%)	Oil content (%)
T_1 Control (Inoculated)	6.20	59.29	2.22	128.80	8.86	5.62	35.15	19.76
T_2 25 kg N/ha	6.97	65.56	2.28	122.12	11.22	6.18	38.65	16.73
T_3 50 kg N/ha	7.40	84.02	2.15	120.78	10.91	6.04	37.77	19.45
T_4 5t FYM/ha	6.20	64.36	2.15	121.59	9.97	5.83	36.46	20.38
T_5 1t Neem cake/ha	6.83	61.49	2.08	128.44	12.69	5.78	36.17	17.76
T_6 25kg N + 1t neem cake/ha	6.97	81.96	2.08	119.24	17.14	6.18	38.65	19.58
T_7 50kg N + 1 t neem cake/ha	8.10	91.76	2.22	127.61	14.30	6.34	39.67	19.96
T_8 25 kg N + 5 t FYM/ha	7.00	82.82	2.15	114.92	17.64	6.13	38.36	17.56
T_9 50 kg N + 5 t FYM/ha	8.20	113.76	2.02	123.98	14.00	6.20	38.79	18.90
T_{10} Rec. NPK (20 : 60 : 40)	8.53	125.29	2.22	120.92	15.22	6.04	37.77	19.65
SE ±	0.39	3.99	0.07	2.23	1.01	0.025	1.02	0.475
CD at 5%	1.19	12.01	NS	6.71	3.11	0.091	NS	1.541

through urea + 1 tonne neem cake per ha, 25 kg N applied through urea + 5 tonne FYM per ha, 50 kg N applied through urea + 5 tonne FYM per ha and recommended doses of NPK : 20 kg N + 60 kg P_2O_5 + 40 kg K_2O per hectare applied through urea, diammonium phosphate and muriate of potash. The net plot size was 5.0 × 2.4 meter square. Basal application of fertilizers, manures and neem cake as per the treatment was done. Observations were recorded at harvest included number of primary branches, number of pods per plant, grains per pod and 1000-grain weight. The net plot yield was expressed as quintals per hectare at 14% moisture content. The different plant parts obtained from dry matter accumulation studies were analyzed for their total nitrogen content, using modified Kjeldahl method (1). Per cent crude protein in grain was computed by multiplying nitrogen content by 6.25. The oil content of 2.0 g finely ground grain was determined by extracting it with petroleum ether as solvent (boiling point = 40-60 C) using Soxhlet Extraction Apparatus.

Results and Discussion

Effect of Different Sources of Nutrients on Yield Attributing Characters

The reproductive growth depends on vegetative growth of plant. More vegetative growth increased leaf area index and supply of photosynthates for the formation of branches and other yield attributes. The number of branches per plant (8.53) and number of pods per plant (125.29) of soybean were maximum with recommended doses of NPK per hectare probably because of the increased translocation of the food material for the pod development and grain formation. Increase in N and P rates increased the number of pods per plant and seeds per pod, 1000-seed weight and protein content were reported by the scientists (2).

All the yield attributes had their pronounced effect in increasing the seed yield of soybean. The positive correlation of seed yield with number of seeds, pods and branches per plant and 1000-seed weight in soybean were found (3). Number of grains per pod (2.28) and 1000-seed weight (128.80g) of soybean were maximum with 25 kg N per hectare and control treatments, respectively. The number of seeds, number of pods per plant and 1000-seed weight were increased by applied P and decreased by Zn + *Rhizobium* inoculation in soybean crop (4). Thus, more branching, increased number of pods, more number of grains per pod showed their additive effect in influencing the seed yield with the balanced rate of nitrogen with other nutrients.

Effect of Different Sources of Nutrients on Yield

The grain yield increased significantly with the application of inorganic sources of nitrogen combined with organic sources. Maximum grain yield per hectare (17.64 q/ha) was found with 25 kg N + 5 t FYM per

hectare which was just ahead that of found with 25 kg N + 1 t neem cake per hectare (17.14 q/ha). Both treatments were significantly superior to rest of the treatments. The increase in grain yield of soybean due to nitrogen application may be because of the reason that nitrogen plays an important role in the synthesis of chlorophyll and amino acids.

Nitrogen influenced the grain yield through source-sink relationship resulting in higher production of photosynthates and their increased translocation to reproductive parts. Nitrogen being most important essential plant nutrient was needed for growth and development of plant and known to increase the yield of soybean (5). The superior effect of inorganic and organic sources of nutrients was also recorded as maximum yield and nutrient uptake in soybean with combined application of urea and FYM on 50% N basis along with phosphorus application (6).

Effect of Different Sources of Nutrients on Quality

The total nitrogen concentration (6.34% and 6.20%) of soybean plant was increased with the application of 50kg N + 1 t neem cake per hectare and 50 kg N + 5 t FYM per hectare due to increased dry matter production. Application of nitrogen known to increase the root cation exchange capacity, which enchanced the nitrogen absorption in plants. The nitrogen content in seed and leaves was positively correlated with the applied N, P, and $MnSO_4$ (7).

The protein content was also highest (39.67% and 38.79%) with the application of 50 kg N + 1 t neem cake per hectare and 50 kg N + 5 t FYM per hectare, respectively. Nitrogen is a basic constituent of protein and with the increase in the rates of nitrogen application, the nitrogen availability increased which resulted in increased protein content in seeds. The results were in conformity with the other scientist (8).

The oil content of soybean grain was highest (20.38) with the application of 5t FYM per hectare. The possible cause behind this may be that application of inorganic and organic sources of nutrient provide all the macro and micro-nutrients in balanced quantity caused synthesis of fatty acids by acetyl CoA resulting in higher oil content in seeds. The seed oil and protein contents of soybean increased with NPK rates (9). A negative correlation between oil and protein content but positive correlation between nitrogen and protein content was also reported by many workers (10).

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