

Yield and Quality of Soybean as Influenced by the Application of Major and Minor Nutrients

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Abstract

On the basis of findings, it could be concluded that there was significant variation between soybean varieties PK 416 and JS 335 for different yield attributes like number of seeds, number of branches, number of pods per plant and 1,000 seed weight. PK 416 gave significantly higher number of pods per plant and 1,000-grain weight than JS 335 and thus gave higher yield. PK 416 seeds also showed higher crude protein content than JS 335. Different yield attributes viz., number of branches per plant, number of pods per plant and 1,000-seed weight were found to be higher with application of Humaur at 1 ml/liter at 30, 45 and 60 DAS but number of grains per pod and 1,000-grain weight were not influenced substantially in comparison to other treatments. The crude protein content of soybean was highest (39.135) under the treatment NP + sprat of Humaur at 1 ml/liter at 45 and 60 DAS, while non-significant difference was observed for oil content due to different treatments. Non-significant differences were also recorded for other seed quality characters like germination percentage, seed vigour index, number of sound seeds, number of shrunken and shrivelled seeds. Interaction between varieties and treatments was observed regarding to crude protein content of both varieties with T₃. Seed quality parameters such as crude protein content can significantly be enhanced with spraying of bio-organic spray like Humaur at 1 ml/liter. The application of nitrogen, phosphorus with spray of Humaur at 1 ml/liter at 30, 45 and 60 DAS gave maximum yield in comparison to other treatments.

Key words : Soybean, Yield, Quality, Nutrients application.

The essential plant nutrients must be applied in balance form to getting maximum productivity and quality of crop. Soybean utilises atmospheric nitrogen by its symbiotic association with *Bradyrhizobium japonicum* to meet a major part of its nitrogen requirement under normal condition. The activity of *Bradyrhizobium japonicum* too is affected by the nutrient content in soil. Full benefit of nitrogen, phosphorus and potassium can be realised only when limitation of other nutrients is not in soil. The development efforts are being made to elucidate the link between micro nutrient content of soil, micro nutrient uptake and utilization by plants and the effects of micro nutrients on yield and crop quality. Plant hormones also play an important role in very small amount by regulating plant physiological processes. They hasten the production efficiency by influencing metabolic and physiological activities. The application of

gibberellins with micronutrient increases the yield in soybean (1). Growth stimulator also has positive effect on yield when it use at pre-flowering and fruiting stage in soybean crop (2). Seed quality is important as it indicates the amount of reserve food supply for seedling to meet out the requirement of food material during the time of germination, field emergence and stress. Generally small and shrivelled seeds do not contain as much food as to give the seedling a vigorous start as the bold and pump seeds. Seed had direct effect on the growing crop because initially it is the only source of nutrition for newly emerging plants. Thus, it is rather essential to see the effect of different nutrients alone and in combination with organic substances on various yield attributes, seed yield and quality of soybean. Keeping these points in view the study on response of soybean varieties to various rates of inorganic and organic nutrients along with

Table 1. Yield and yield attributes of soybean cv JS 335 and PK 416 at harvest as affected by different treatments.

Treatments	Days to 50% flowering	No. of primary branches/plant	No. of pods/plant	No. of grains/pod	1000-grain weight (g)	Yield (q/ha)
Varieties						
JS 335 (V ₁)	75.33	11.34	83.32	2.41	110.86	23.73
PK 416 (V ₂)	69.55	7.26	108.00	2.37	130.50	30.31
SE ±	0.31	0.07	1.73	0.05	2.54	0.78
CD at 5%	0.96	0.22	5.15	NS	7.56	2.24
Fertility Levels						
NP (25 : 50) kg/ha (T ₁)	71.60	8.09	83.06	2.32	118.48	25.95
NP + FYM 10 t/ha (T ₂)	73.00	9.14	98.58	2.49	121.33	27.57
NP + 25 kg ZnSO ₄ /ha (T ₃)	72.60	9.21	91.94	2.38	117.58	26.15
NP + spray of Humaur 1 ml/l at 45 and 60 DAS (T ₄)	72.60	9.79	99.51	2.48	123.89	27.39
NP + spray of Humaur 1 ml/l at 30, 45 and 60 DAS (T ₅)	72.00	9.48	103.71	2.55	122.11	28.05
SE ±	0.62	0.11	2.63	0.095	6.02	1.72
CD at 5%	NS	0.34	7.45	NS	NS	NS

bio-organic spray on yield and quality was undertaken.

Methods

The experimental trials were conducted at the Agricultural Research Farm of Amar Singh (PG) College, Lakhaoti, Bulansshahr (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 JS-335 and PK-416 was inoculated by *Bradyrhizobium japonicum* and sown in the experimental field. Experiment was conducted in factorial randomized block design with two varieties and five fertility levels in three replications. The five fertility levels were-25 kg N + 50 kg P per ha, 25 kg N + 50 kg P + FYM at 10 t/ha, 25 kg N + 50 kg P + 25 kg ZnSO₄ per ha, 25 kg N + 50 kg P + spray of Humaur at 1 ml at 45 days and 60 days after sowing and 25 kg N + 50 kg P + spray of Humaur at 1 ml at 30, 45 and 60 days after sowing. Basal application of fertilizers and manure's and aerial spray of bio organic spray (Humaur) as per the treatments was done. The source for nitrogen was urea, for phosphorus SSP, for Zn application ZnSO₄ and for other micronutrients, Humaur as bio-organic spray was

used. The net plot size was 4.0 × 1.8 meter square. Observations were recorded for days to 50% flowering, number of primary branches, number of pods per plant, grains per pod and 1,000-grain weight. The net plot yield was expressed as quintals per hectare at 14 per cent moisture content. After the harvesting, seed were analysed for diseased seed (%), ruptured seed (%), shrivelled seed (%), sound seed (%) and their percentage was calculated. The dry seeds were analysed for their total nitrogen content, using modified kjeldahl method (3). 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. After harvesting the crop, seeds were analyzed for germination (%), seed vigor index and seedling length according to the treatments.

Results and Discussion

The data related to days to 50% flowering, number of primary branches per plant, number of pods per plant, number of grains per pod, 1000 grain weight and yield (Table 1). Differences in number of days taken to flowering were significantly affected due to the varieties; JS-335 took significantly more number of days to flower (75.33) than PK-416 (69.5). The mini-

Table 2. Effect of varieties and fertility treatments on quality of (grain) soybean at harvest. Values in parentheses are angular transformed values.

Treatments	Diseased seed (%)	Ruptured seed (%)	Shrivelled seed (%)	Sound seed (%)	Crude protein content (%)	Oil content (%)
Varieties						
JS 335 (V ₁)	4.40 (11.75)	3.40 (10.52)	3.26 (9.99)	89.6 (71.37)	35.54	19.34
PK 416 (V ₂)	3.73 (10.77)	3.33 (10.24)	6.66 (14.17)	86.2 (68.55)	40.02	19.59
SE ±	0.75	0.49	1.45	1.55	0.05	0.15
CD at 5%	NS	NS	NS	NS	0.15	NS
Fertility Levels						
NP (25 : 50) kg/ha (T ₁)	4.00 (11.28)	4.00 (11.40)	3.66 (10.71)	88.3 (70.10)	39.54	19.29
NP + FYM 10 t/ha (T ₂)	3.66 (10.64)	3.00 (9.83)	6.33 (13.06)	87.0 (69.39)	39.60	19.39
NP + 25 kg ZnSO ₄ /ha (T ₃)	5.00 (12.66)	2.83 (9.57)	5.83 (13.23)	86.3 (68.36)	39.60	19.45
NP + spray of Humaur 1 ml/l at 45 and 60 DAS (T ₄)	3.33 (10.08)	3.33 (10.27)	6.00 (13.74)	89.0 (71.13)	40.13	19.67
NP + spray of Humaur 1 ml/l 30, 45 and 60 DAS (T ₅)	4.33 (11.65)	3.66 (10.84)	3.00 (9.70)	89.2 (70.81)	40.03	19.57
SE ±	1.45	0.94	2.21	2.13	0.09	0.21
CD at 5%	NS	NS	NS	NS	0.29	NS

imum number of days (71.60) required with treatment having flowering was recorded for basal application of N, P (25 : 50) kg per hectare. Maximum number of primary branches per plant (9.79) of soybean was recorded with N, P (25 : 50) kg per hectare along with spray of Humaur at 1 ml/liter at 45 and 60 days after sowing. Maximum number of pods per plant (103.71) and number of grains per pod (2.55) of soybean was recorded with the recommended rate of N, P (25 : 50) along with spray of Humaur at 1 ml/liter at 30, 45 and 60 days after sowing which was at par with basal application of Humaur at 1 ml/liter at 45 and 60 days after sowing and significantly greater than rest of the treatments. The maximum 1000-grain weight of soybean was recorded for soybean cv PK-416. Per cent increase in 1,000 grain weight of soybean cv. PK-416 over JS-335 was 18. Sharma et al. (2) reported that the maximum enhancement in soybean growth and yield attributory characters and yield was obtained with Mixtalex (growth stimulant) sprayed at pre flowering + fruit ser stage of crop. Different fertility levels did not affect the grain yield significantly though the maximum yield (28.05 q/ha) was obtained with treatment T₅ having nitrogen at 25 kg, phosphorus at 50 kg and foliar application of Humaur at 1 ml/liter at 30, 45 and 60 days after sowing per hectare. Same result was also reported by Sarma and Ravinder (4) in India

who found that soybean seed yield was increased with the application of micronutrient as foliar and seed treatment. All the yield attributes had their pronounced effect in increasing the seed yield of soybean. Singh et al. (5) observed that foliar application of 20, 4, 2, 2, 2 and 2 kg per hectare Fe, Mn, Zn, Cu, Band Mo respectively in three equal doses sprayed at 20, 40 and 60 days after emergence leads to increased pod yield of groundnut. GA₃ with or without 2 g liberal BMX / liter, 50 ppm BA alone or with librel BMX significantly increased number of pods per plant and increased seed yield as reported by Salem (6). Contrary to this Nagaraj (7) reported that application of two foliar sprays of Mo, Mn, Fe, Mg and B each at three rates to groundnut had no significant effect on pod yields.

The minimum diseased seed (3.33%) and ruptured seeds (3.00%) was recorded for the treatment NP + spray of Humaur at 1 ml/liter at 45 and 60 days after sowing. The minimum per cent ruptured seed (2.83%) was recorded for the treatment NP + 25 kg ZnSO₄/ha at 45 and 60 days after sowing (Table 2). The lowest per cent (3.66%) of shrivelled seeds was recorded for NP + spray of Humaur at 1 ml/liter at 30, 45 and 60 days after sowing. In seed health with respect to varieties, minimum diseased seeds (3.73%) and ruptured seeds (3.33%) were noticed in the PK 416 variety

Table 3. Effect of varieties and fertility treatments on seedling length, seed vigour index and germination of soybean after harvest. Values in parentheses are angular transformed values.

Treatments	Germination (%)	Seed vigour index	Seedling length (cm)
Varieties			
JS 335 (V ₁)	96.4 (79.5)	2549	25.50
PK 416 (V ₂)	96.8 (80.5)	2441	24.48
SE ±	1.02	91	0.79
CD at 5%	NS	NS	NS
Fertility Levels			
NP (25 : 50) kg/ha (T ₁)	96.3 (79.1)	2504	25.06
NP + FYM 10 t/ha (T ₂)	97.3 (81.2)	2639	26.31
NP + 25 kg ZnSO ₄ /ha (T ₃)	96.1 (79.2)	2378	23.95
NP + spray of Humaur 1 ml/l at 45 and 60 DAS (T ₄)	95.6 (78.1)	2484	25.60
NP + spray of Humaur 1 ml/l at 30, 45 and 60 DAS (T ₅)	97.6 (82.4)	2419	23.95
SE ±	2.02	140	1.30
CD at 5%	NS	NS	NS

while, minimum shrivelled seeds were recorded in JS 335 variety. But sound seeds (89.6%) were observed in the variety JS 335. While, maximum percent of sound seed (89.2%) was recorded for NP + spray of Humaur at 1 ml/liter at 45 and 60 days after sowing. The difference between varieties for seed health characters was non-significant. In terms of seed quality, the highest amount of crude protein content (39.13%) and oil content (19.67%) was recorded with N, P (25 : 50) kg/ha along with spray of Humaur at 1 ml/liter at 45 and 60 days after sowing which was at par with recommended rate of NP along with spray of Humaur at 30, 45 and 60 days after sowing. Variety PK 416 gave more crude protein (40.02%) and oil content (19.59%) compared to JS 335.

The maximum seed germination (97.6%) was recorded with the treatment having basal application of N, P in combination with spraying of Humaur at 1 ml/liter at 30, 45 and 60 days after sowing while minimum per cent to seed germination was observed for basal application of N, P (25 : 50) kg per hectare along (Table 3). The treatment having NP + FYM at 10 t/ha gave the maximum seed vigour index though the difference non-significant among different treatments. The maximum seedling length was recorded for soybean cv

JS-335, though the two varieties did not differ significantly. The effect of different treatments on seedling length was non-significant but seedling length was recorded highest for the treatment NP in combination with basal application of FYM at 10 t/ha.

Seed quality consists of physical, physiological, genetic, pathological and entomological parameters affecting the well being of seeds. Seed viability and vigor are the foremost parameters of seed quality which have a direct bearing on the field potential of the seed. Several research workers have reported presence of genetic differences in seed quality of soybeans (5). Among treatments NP + FYM at 10 t/ha gave the maximum seed vigor index. The germinability of seeds and other quality parameters like sound seeds, shrunken seed, diseased seeds showed non-significant difference among different treatments. Protein and oil content are important constituents of soybean seeds. Among the treatments spraying of Humaur at 1 ml/liter at 30, 45 and 60 days after sowing gave maximum crude protein content (40.18%). This may be due to direct and indirect influence of micronutrients on protein metabolism in plants. Nagaraj (7) reported that application of two foliar sprays of Mo, Mn, Fe, Mg and B each at three rates to groundnut had no significant effect on pod, yields and seed oil contents. Fe significantly increased the protein content. Mo and Mg increased soluble sugar contents. Mn increased ash content. Jain et al. (8) observed that application of pressmud and FYM increased seed protein and oil content while Negm et al. (9) noted that seed coating with Mn or Mo produced the highest seed crude protein contents of 22.8 and 22.19% respectively. Similar results were confirmed by Singh and Chaudhary (10).

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