Himachal Journal of Agricultural Research 48(1): 112-118 (2022)

Short Communication

Effect of organic and inorganic sources of nutrients on growth and growth indices of soybean (*Glycine max* (L.)

Saleman Sultani*, Janardan Singh and Shilpa

Department of Agronomy, College of Agriculture
CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur-176 062, India.

*Corresponding author: salemansultani@gmail.com
Manuscript Received: 15.07.2021; Accepted: 04.10.2021

Abstract

A field experiment was conducted during the rainy (*Kharif*) season of 2020 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to study the effect of organic and inorganic sources of nutrients on productivity of soybean (*Glycine max* L). The experiment was laid out in randomized block design comprising of eight treatments [T_1 - 75 per cent RDN (FYM), T_2 -100 per cent RDN (FYM), T_3 -75 per cent RDF (Fertilizers), T_4 - 100 per cent RDF (Fertilizers), T_5 - 50 per cent RDF (Fertilizers) + 25 per cent RDN (FYM), T_6 - 50 per cent RDF (Fertilizers) + 50 per cent RDN (FYM), T_7 - 100 per cent RDN (FYM) + rest P and K (Fertilizers) and T_8 - Control (N_0 P_0 K_0)]. The soil of the experimental site was silty clay loam in texture and acidic in reaction, low in available nitrogen (N), medium in available phosphorus (P) and potassium (K). Significantly higher plant height and dry matter accumulation recorded in T_6 at all growth stages which was at par with T_7 and T_4. The shortest plants were recorded in control treatment. Significantly higher absolute growth rate was noted at 30 DAS in T_6 while lowest was in control treatment. Significantly higher CGR was noted at 60 DAS in T_6 which was at pat with T_7 and T_4 while significantly higher RGR value noted in T_7 which was at par with T_6 and T_4 while both of CGR and RGR (Relative Growth Rate) remained non-significant at all other growth stages. The lowest values of CGR and RGR were noted in T_8. The highest value of DME (0.93) was recorded in T_5 while the lowest value was in control. The highest UAE (Unit Area Efficiency) was noted in T_5 (1685 kg/ha) followed by T_6 while the lowest was in control treatment. Application of 50 per cent recommended dose of nutrients from fertilizers and 50 per cent of recommended dose of nitrogen from farm yard manure proved to be the best treatment for better growth and growth indices.

Key words: Soybean, Growth indices, Dry matter, Organic and Inorganic.

Soybean (*Glycine max* L.) is an important oilseed crop in Indian sub-continent. It is grown under a wide range of agro-ecological conditions in irrigated, dry land and rainfed areas in different cropping systems. Soybean serves as one of the most valuable crops in the world, not only as an oil seed crop and feed for livestock and aquaculture, but also as a good source of protein for the human diet and as a biofuel feedstock. In India, it is grown on area of 11.39 million ha with production of 10.45 million metric tons. The major soybean growing states are Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, and Telangana. The productivity of soybean is 882 kg/ha. (Anonymous 2021a). Soybean is a potential rainy season crop of mid-hills zone of Himachal Pradesh. In the state, it is grown as a sole crop as well as an intercrop with maize. The area under crop in the state is 0.55 thousand hectares with an average production of 1680 kilogram per hectare (Anonymous 2021b) while the world's average soybean area is 121.53 million ha, with a yield of 2.76 tons/ and a production of 334.89 million tons (Anonymous 2021c). The inorganic

chemical fertilizers provide one or more essential plant nutrient which the soil cannot supply in adequate quantity. Organic manures act as basal dose which provide a number of nutrients but not in enough quantity.

One such strategy to maintain soil fertility for sustainable yield of soybean is through the judicious use of fertilizers. Continuous use of inorganic fertilizers without organic supplements deteriorates the physical, chemical and biological properties of soil and causes the environmental pollution. Combined use of inorganic fertilizers and organic manures improves crop growth, soil health and saves money besides clean environment. Current research on this aspect has resulted in the superiority of using the organic and inorganic sources of nutrients in combination rather than organics alone. The study was conducted to study the effect of organic and inorganic sources of nutrients on growth and growth indices of soybean.

A field experiment was conducted during the rainy (*Kharif*) season of 2020 at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, to observe the effect of organic and inorganic sources of nutrients on growth and growth indices of soybean. The experiment was laid out under randomized block design (RBD) with eight treatments and three replications. Treatments were T_1 - 75 per cent RDN (FYM), T_2 -100 per cent RDN (FYM), T_3 -75 per cent RDF (Fertilizers), T_4 - 100 per cent RDF (Fertilizers), T_5 - 50 per cent RDF (Fertilizers) + 25 per cent RDN (FYM), T_6 - 50 per cent RDF (Fertilizers) + 50 per cent RDN (FYM), T_7 - 100 per cent RDN (FYM) + rest P and K (Fertilizers) and T_8 - Control (N_0 P_0 K_0). The soil of the experimental site was silty clay loam in texture and acidic in reaction. The soil was low in available nitrogen (145.06 kg/ha), medium in available phosphorus (14.33 kg/ha) and available potassium (255.36 kg/ha).

A brief study about of weekly meteorological data showed that the weekly maximum and minimum temperature ranged from 18.57°C to (31.57°C and 26.93°C October) to 15.89°C, respectively. The average relative humidity ranged from 44.93 to 92.07 per cent and total of 1672.6 mm rainfall was received during the crop season. The mean bright sunshine hours ranged from 2.36 to 9.86 during the crop growing season. Seed of soybean was treated with Bavistin fungicide for the protection of soybean crop from seed borne diseases. Soybean variety 'Harit Soya' was sown manually at distance of 45cm of inter-row spacing. The seeds in furrows were covered by light planking with soil. Farm yard manure was used as per the treatments in each experimental plot at the time of sowing before seeding. Nitrogen (N) phosphorus (P) and (K) potassium were applied through urea, SSP (single super phosphate) and MOP (muriate of potash) accordingly. The fertilizers were applied in the furrows followed by mixing it in soil with stick and harrow and then the seeds were sown in the furrows. Pendimethalin (Stomp 30 EC) was applied at the rate of 4.5 l/ha within 48 hours of sowing as a pre-emergence and spray of chlorpyriphos @ 750 ml/ha + Quizalofop ethyl @ 37.5 g/ha as post-emergence was also applied at 25 days after sowing to control grassy and broadleaf weeds. One hand weeding was also done at 55 days after sowing for the control of weeds. Other package of practices recommended for soybean crop were also applied. Total number of plants in each plot at 20 days after sowing from two observational units (next to border row) each of 1.0 m row length was counted and the mean number of plants was shown as number of plants per meter row length. Number of plants per square meter was calculated as number of plants per running meter × 2.22. Four randomly selected plants in each plot were tagged initially for height measurement. Plant height was measured in centimeters from the base of plant from earth surface to the top of plant. The average height of the four plants was calculated and noted as plant height. For observing dry matter accumulation, plant samples (0.5 m row length from each side) from the sampling rows of both the sides of the each plot next to border rows were taken from at 30 days interval up to harvest. Samples were weighed down when they got constant weight. The absolute growth rate of four randomly selected plants was

calculated by using the below given formula at 30 days period up to 90 DAS and averaged by dividing total absolute growth rate by four and expressed as cm/day (Radford 1967).

$$AGR = \frac{h_2 - h_1}{t_2 - t_1}$$

Where h_1 and h_2 are the plant height at t_1 and t_2 times, respectively.

The crop growth rate of four randomly selected plants was calculated by using the below given formula at 30 days period up to 90 DAS and averaged by dividing total crop growth rate by four and expressed as g/m^2/day (Watson 1956). The dry weight of ½ meter length of both side except border area was collected and then converted to g/m^2 by multiplying weight of ½ meter length with 2 into weight of plants/m^2.

$$CGR = \frac{(w_2 - w_1)}{P(t_2 - t_1)}$$

Where w_1 and w_2 are whole plant dry weight at t_1 and t_2 time, respectively.

P is the ground area on which w_1 and w_2 are recorded.

The relative growth rate of four randomly selected plants was calculated by using the below given formula at 30 days interval up to 90 DAS and averaged by dividing total relative growth rate by four and expressed as g/g/day (Blackman 1919).

$$RGR = \frac{(\log_e w_2 - \log_e w_1)}{(t_2 - t_1)}$$

Where w_1 and w_2 are dry weight of whole plant at times t_1 and t_2, respectively.

Dry matter efficiency was expressed as the per cent (%) of dry matter accumulated in the grain from the total dry matter produced over the total crop growth period or crop duration is 122 days.

$$DME = \frac{\text{Grain yield (kg/ha)}}{\text{Biological yield (kg/ha)}} \times \frac{100}{\text{Duration of crop (days)}}$$

Unit area efficiency was expressed as the quantum or amount of grain yield produced over a unit land area for a specified crop growth period (kg/ha/day).

$$UAE = \frac{\text{Grain yield (kg)}}{\text{Land area (ha)}} \times \frac{1}{\text{Duration of crop (days)}}$$

Plant height was significantly affected at all growth stages by different treatments. Similar result was observed by Khan *et al*. (2013).

The tallest plants were recorded in T_6 which was at par with T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)] and T_4 [(100 % RDF) at 60 and 90 DAS and at harvest. Significantly the shortest plants were observed in T_8 (control) at all growth stages (Table 1). This might be due to improved root growth, efficient utilization of rainwater and availability of nutrients for crop. Similar results were also observed by Koushal and Singh (2011), Morya *et al*. (2018) and Chiezey and Odunze (2009).

Dry matter accumulation was significantly affected by different treatments at all growth stages. At 30 and 60 DAS, the highest dry matter was recorded in T_6 [(50 % RDF (Fertilizers) + 50 % RDN (FYM)] although it was at par with T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)]. At 90 DAS and at harvest stages, the highest dry matter accumulation was noted in T_6 which was at par with T_7 and T_4 [(100 % RDF (Fertilizer)] (Table 1). The lowest dry matter accumulation was noted in T_8 (control) treatment. Dry matter increased progressively with advancement in age of the crop up to harvest. This might be due to good effect of FYM on growth might be contributed to presence of readily available NPK and growth increasing. Bandyopadhyay *et al*. (2010) and Dipak *et al*. (2018) also found that using a combination of organic and inorganic sources of nutrients led in significantly higher biomass and dry matter accumulation than using only the recommended amount of chemical fertilisers in soybean.

Absolute growth rate was significantly affected by different treatments at 30 DAS. Significantly higher value (1.50 cm/day) of AGR was noted in T_6 followed by T_7. AGR was not affected by different treatments at 60 and 90 days after sowing, Numerically higher value of absolute growth rate was noted in T_6 [(50 % RDF (Fertilizers) + 50 % RDN (FYM)] which was followed by T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)]

Table 1. Plant height and dry matter accumulation of soybean as influenced by organic and inorganic sources of nutrients

Treatment	Plant height (cm)				Dry matter accumulation (g/m^2)			
	30 DAS	60 DAS	90 DAS	Harvest	30 DAS	60 DAS	90 DAS	Harvest
T_1 – 75 % RDN (FYM)	22.70	106.37	119.50	120.83	25.22	115.00	265.00	280.33
T_2 – 100 % RDN (FYM)	35.87	107.55	124.15	125.48	31.00	145.33	299.33	308.67
T_3 – 75 % RDF (Fertilizers)	34.21	107.25	121.41	122.75	28.50	138.67	294.00	290.30
T_4 – 100 % RDF (Fertilizers)	36.42	108.25	127.00	128.00	30.00	165.67	339.83	317.33
T_5 – 50 % RDF (Fertilizers) + 25 % RDN (FYM)	34.13	106.58	121.33	121.33	26.33	129.00	293.00	286.00
T_6 – 50 % RDF (Fertilizers) + 50 % RDN (FYM)	45.60	111.12	129.12	130.45	42.22	398.67	345.67	346.00
T_7 – 100 % RDN (FYM) + rest P and K (Fertilizers)	41.46	110.83	127.67	128.67	38.67	305.30	342.00	323.33
T_8 - Control (N_0 P_0 K_0)	33.16	100.74	115.96	117.29	24.56	105.33	230.33	197.00
SEm±	4.02	0.98	2.26	2.44	3.87	30.79	19.60	20.85
CD (P=0.05)	12.18	2.98	6.84	7.41	11.73	93.40	59.46	63.24

RDN : Recommended dose of nitrogen; FYM: (Farm Yard Manure); P and K : Phosphorous and Potassium

Table 2. Effect of organic and inorganic sources of nutrients on absolute growth rate, crop growth rate, relative growth rate, dry matter efficiency and unit area efficiency

Treatment	Absolute growth rate (cm/day)			Crop growth rate(g/m^2/day)			Relative growth rate rate(g/g/day)			Dry matter efficiency	Unit area efficiency
	DAS			DAS			DAS				
	30	60	90	30	60	90	30	60	90	(% day)	(kg/ha/day)
T_1 – 75 % RDN (FYM)	1.14	2.41	0.44	0.87	3.13	0.93	0.08	1.58	1.67	0.76	13.91
T_2 – 100 % RDN (FYM)	1.20	2.39	0.55	1.00	3.51	5.13	0.37	1.52	1.73	0.83	13.26
T_3 – 75 % RDF (Fertilizers)	1.14	2.43	0.47	0.95	3.52	-1.50	0.27	1.59	1.69	0.83	14.40
T_4 – 100 % RDF (Fertilizers)	1.21	2.39	0.62	1.03	4.22	7.81	0.35	1.80	1.82	0.93	12.98
T_5 – 50 % RDF (Fertilizers) + 25 % RDN (FYM)	1.14	2.42	0.49	0.90	3.50	4.50	0.16	1.59	1.73	0.83	16.85
T_6 – 50 % RDF (Fertilizers) + 50 % RDN (FYM)	1.50	2.45	0.60	1.36	9.57	6.11	0.43	1.95	1.80	0.88	15.22
T_7 – 100 % RDN (FYM) + rest P and K (Fertilizers)	1.25	2.45	0.56	1.17	9.14	7.10	0.32	2.02	1.84	0.73	6.99
T_8 - Control (N_0 P_0 K_0)	1.11	2.25	0.51	0.82	2.84	3.96	0.09	1.62	1.61	0.01	0.39
SEm±	0.07	0.05	0.08	0.15	1.31	1.97	0.11	0.11	0.07	0.02	1.18
CD (P=0.05)	0.21	NS	NS	NS	3.97	NS	NS	0.35	NS	0.81	11.93

as compared to control treatment. Similar result was observed by Panneerselvam *et al*. (2000) in soybean.

Crop growth rate was significantly affected at 60 DAS where the highest crop growth rate was recorded in T_6 [(50 % RDF (Fertilizers) + 50 % RDN (FYM)] which was at par with T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)] and the lowest was noted in T_8 (control). At all other stages CGR was remained unaffected. However, numerically maximum value of crop growth rate was recorded in T_6 at 30 DAS followed by T_7, while at 90 DAS higher CGR was in T_4 [(100 % RDF (Fertilizer)] followed by T_7 and T_6 and the lowest value noted in T_3 [75 % RDF (Fertilizers)]. The lowest value of crop growth rate was observed in absolute control at 30 DAS and 60 DAS. This might be due to enough light absorption by soybean and better nutritional environment for crop growth at active vegetative stage as a result in improvement in root and shoot growth which ultimately enhanced the dry matter resulting in higher value of crop growth rate. Similar results were also noted by Saxena *et al*. (2001) and Baghdadi *et al*. (2018).

Relative growth rate (RGR) was significantly affected by different treatments at 60 days after sowing. The highest value (2.02 g/g/day) of relative growth rate was noted in T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)] which was at par with T_6 [(50 % RDF (Fertilizers) + 50 % RDN (FYM)] and T_4 [(100 % RDF (Fertilizer)]. While at 30 and 90 DAS it remained non-significant. The lowest RGR value was recorded in absolute control treatment at all growth stages of crop. It might be due to higher dry matter production with better nutrition and root shoot ratio which resulted in better relative growth rate. Similar results have been recorded by Rathiya *et al*. (2010) in soybean.

Dry matter efficiency was significantly affected by different treatments. The highest dry matter efficiency was recorded in T_5 [(50 % RDF (Fertilizers) + 25 % RDN (FYM)] (0.93%/day) while the lowest was (0.73 %/day) in absolute control (T_8). It might be due to higher grain yield which concluded in higher per cent of dry matter accumulation in grain. Similar result was reported by Saxena *et al*. (2001).

Unit area efficiency (UAE) was significantly influenced by different treatments. The highest unit area efficiency (16.85 kg/ha/day) was recorded in T_6 [(50 % RDF (Fertilizers) + 50 % RDN (FYM)] followed by T_7 [(100 % RDN (FYM) + rest P and K (Fertilizers)]. lowest value (6.99 kg/ha/day) was recorded in absolute control treatment. It might be due to combined use of inorganic fertilizer and organic manure which enhanced soil nutrient content.

Conclusions

1. Application of 50 per cent of the recommended dose of nutrients from fertilisers and 50 per cent of the recommended dose of nitrogen from farm yard manure proved to be best treatment.
2. 100 % RDN (FYM) + rest P and K (Fertilizers) proved to be the second-best treatment.
3. In addition to soil fertility, omitting nutrient sources and applying only organic or inorganic sources of nutrients reduced growth and growth indices of soybean.

Conflict of interest: The authors declare that there is no conflict of interest in this research paper.

References

Anonymous. 2021a. Soybean Processors Association of India. *www.sopa.org/crop.po.doc* (21st May 2021)

Anonymous. 2021b. *www.nmoop.gov.in* State-Soybean (21th May 2021)

Anonymous. 2021c.www.google.com/search?q=www.nmoop.gov.in

Baghdadi A, Halim AR, Ghasemzadeh A, Rahman MF and Sakimin SZ. 2018. Impact of organic and inorganic fertilizers on the yield and quality of silage corn intercropped with soybean. Peer Journal 5280:1-26

Bandyopadhyay KK, Misra AK, Ghosh PK and Hati KM.2010. Effect of integrated use of farmyard manure and chemical fertilizers on soil physical properties and productivity of soybean. Soil & Tillage Research **110**: 115–125.

Blackman VH. 1919. The compound interest law and plant growth. Ann. Bot. **33**:353-360.

Chiezey UF and Odunze AC. 2009. Soybean response to application of poultry manure and phosphorus fertilizer in the Sub-humid Savanna of Nigeria. Journal of Ecology and Natural Environment **1**(2):25-31.

Dipak GP, Jaganath MA and Takankhar VJ. 2018. Effect of

integrated nutrient management on growth and yield of soybean (*Glycine max* L. Meril). International Journal of Chemical Studies **6** (4): 264-266.

Khan S, Khalil SK, Amanullah and Shah Z. 2013. Crop stand and phenology of wheat as affected by integrated use of organic and inorganic fertilizers. Asian Journal Agriculture Biology **1**(3):141-148.

Koushal S and Singh P. 2011. Effect of integrated use of fertilizer, FYM and biofertilizer on growth and yield performance on soybean (*Glycine max* (L.) Merill). Research Journal of Agricultural Science **43** (3):193-197.

Morya Jagdesh, Tripathi RK, Kumrawat N, Singh M, Yadav RK, Tomar LS and Sahu YK. 2018. Influence of organic and inorganic fertilizers on growth, yields and nutrient uptake of soybean (*Glycine max* Merril L.) under Jhabua Hills. International Journal of Current Microbiology and Applied Sciences **7** (2): 725-730.

Panneerselvam S and Lourduraj AC. 2000. Growth and yield of soybean [*Glycine max* (L.) Merril] as influenced by organic manures, inorganic fertilizers and weed management practices. Acta Agronomica Hungarica **48** (2): 133–140.

Radford PJ. 1967. Growth analysis formulae-their use and abuse. Crop Science **7**:171–175.

Rathiya PS, Lakpale R, Shrivastava GK and Bargali SS.2010. Effect of nutrient blending with FYM on biomass production and economics under hybrid cotton-soybean intercropping system. Journal of Plant Development Sciences **2**(1&2): 9-18.

Saxena SC, Manral HS and Chandel AS. 2001. Effect of inorganic and organic sources of nutrients on soybean (*Glycine max*). Indian Journal of Agronomy **46** (1): 135-140.

Watson DJ. 1956. Leaf growth in relation to crop yield. FL Milthrope, Butterworths Scientific Publications. London, p 178–191.