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Effect of Nutrient and Weed Management on Growth and Yield of Soybean [*Glycine max* (L.) Merrill] in Alluvial Soil of Bihar, India

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A B S T R A C T

Field investigation was carried out to study the effect of nutrient and weed management practices on growth and yield of soybean [*Glycine max* (L.)] in alluvial soil of Bihar during *kharif* season 2016. The experiment was laid out in split-plot design having five nutrient levels in main plot and four in weed management practices in subplot. Application of 50% RDF along with 2.5 t FYM/ha and Vermicompost 1.25 t/ha recorded significantly higher plant height (54.60 cm), dry weight/plant (18.60 g), No. of leaves/plant (35.70), leaf area index at 60 DAS (5.36), No. of root nodules/plant at 30 DAS (20.46) and 60 DAS (61.31), No. of pods/plant (23.50), No. of grain/pod (2.52), grain yield (16.94 q/ha) and straw yield (28.64 q/ha) over rest of the treatments but was statistically at par with 50% RDF + 5 t FYM/ha. In weed management practices, hand weeding twice at 25 and 45 DAS recorded significantly higher plant height (55.47), dry weight/plant (18.40 g), No. of leaves/plant (35.10), leaf area index at 60 DAS (5.22), No. of root nodules/plant at 30 DAS (20.14) and 60 DAS (60.30), No. of pods/plant (22.52), No. of grain/pod (2.42), 100-grain weight (9.50 g), grain yield (16.71 q/ha) and straw yield (28.11 q/ha) over control but was at par with Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS.

Introduction

Soybean *Glycine max* (L.) is popular as golden bean has become the miracle crop of 21st century. It serves the dual purpose for being grown both as an oilseed and pulse crop as well (Thakare *et al.*, 2006). It has been termed as miracle bean because of higher protein (40%) and oil (20%) content (Chouhan and Joshi, 2005). It is an excellent source of protein and oil besides it contains high level of amino acids such as lysine, leucine, lecithin and large amount of phosphorus.

Soybean being a high protein and energy crop and its productivity is often limited by the low availability of essential nutrients or imbalanced nutrition forming one of the important constraints to soybean productivity in India. Nutrition imbalance is one of the

important constraints of soybean productivity in the North Indian plains (Tiwari, 2001). Hence, a balanced nutrients application is must to harness the productivity of the crops. Moreover, continuous imbalanced use of fertilizers has also deteriorated soil health. Therefore, the situation warrants adoption of integrated nutrient management systems.

The long-term use of inorganic fertilizers without organic supplements damages the soil physical, chemical and biological properties and causes environmental pollution. Organic manures are good complimentary sources of nutrients and improve the efficiency of the applied mineral nutrients on one hand and improve physical and biological properties of soil on the other hand (Chaudhary *et al.*, 2004). Therefore, any nutrient-management practice that can improve organic matter status of soil is important. A judicious and combined use of organic and inorganic sources of plant nutrients is essential to maintain soil health and to augment the efficiency of nutrients. Additionally, such integration of organic and inorganic nutrients plays an important role in economizing the use of fertilizers under increasing cost, which is restricting their use to an optimum level.

Weed infestation in soybean is one of the main constraints which limits the crop yield. A yield reduction of 20 to 77 per cent was reported in soybean due to weed competition (Kurchania *et al.,* 2001). Weeds compete with crop plants for moisture, light, nutrients and space. Weed grows much faster compared with soybean crop and thus smothers the crop. The research evidence suggests that soybean crop should be provided weed free condition from 15-30 DAS. Weed deprives greater amounts of applied as well as native nutrient of the crops. Weed control is of prime importance to save the wasteful loss and to harvest higher yield. Manual weeding is one of the oldest and most efficient method of weed control. Weed flush come at same time in almost all the *kharif* crops, which also restrict the availability of manpower for weeding operation in this crop. Unavailability of adequate laborers, their increased wages and declining efficiency under uncongenial condition spell of monsoon make the tasks more difficult. Integrated weed management is an integration of effective and workable weed management practices that can be used ecologically and economically by the farmers. Therefore, integrated approach of chemical and cultural control may be more feasible and practicable (Sharma *et al.,* 2009).

This can partially be overcome by various nutrient management practices involving combination of inorganic and organic fertiliser and management of weed through integrated approach. They play an important role in enhancing the productivity and improving the soil physical, chemical and biological properties. No systematic work has been carried out on these aspects on soybean in Bihar, therefore, present experiment was planned to evaluate the effect of both with different levels on growth and yield of soybean.

Materials and Methods

A field experiment was conducted during *kharif* season of 2016 at the research farm of Tirhut College of Agriculture, Dholi, Muzaffarpur which is situated on the southern bank of the river Burhi Gandak at an altitude of 52.18 meter above mean sea level and lies at 25º.98' N latitude and 85º.6' E longitude. The soil of the experimental plot was alluvial in nature, having pH 8.3, low in organic carbon (0.41%), available nitrogen, phosphorous and potassium. The experiment was carried out in split-plot design. Nutrient levels having five levels, viz. Control, RDF-N: P_2O_5: K_2O (30: 60: 40 Kg/ha), 50% RDF + FYM 5.0 t/ha, 50% RDF + VC 2.5 t/ha and 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha in

main plot and four weed management in viz. Control, Hand weeding at 25 and 45 DAS, Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS in sub-plot and replicated thrice.

The soybean variety, JS-335 was sown on 03 July, 2016 in row 30 cm apart using seed rate of 75 kg/ha. Full dose of nutrients sources applied as basal prior to sowing in band. Pendimethalin was applied next day of sowing and Imazethapyr was applied at 25 DAS. The spraying was done with flat fan nozzle. Hand weeding was done with the help of *khurpi* at 25, 40 and 45 days after sowing as per treatment.

Five plants from second row of each plot were randomly selected from each treatment for recording observation on growth parameter. The economics of different treatments were computed by considering the prevailing market price of inputs and produce of soybean.

Results and Discussion

Growth parameters

Application of 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha resulted significantly taller plants. However, the plant height in the plots treated with 50% RDF + FYM 5.0 t/ha was similar. Significantly lower plant height was recorded in the control plots where no organic manure or inorganic fertilizer was used (Table 1). The effect of organic and inorganic fertilizer in combination was more pronounced with the advancement of crop growth, indicating better effect on plant height of soybean. This might be due to continuous availability of nutrients to soybean plants because of their slow release of nutrients from FYM during the crop season.

Higher leaf-area index (LAI) and dry matter accumulation was recorded with 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha followed by 50% RDF + FYM 5.0 t/ha, 50% RDF + VC 2.5 t/ha and RDF alone. The control plots recorded significantly lower leaf-area index (Table 1). The LAI is a resultant of leafy growth of the plant. In the present study, increase in leaf area index was due to favourable synthesis of growth favouring constituents in plant system due to better nutrition of the plants owing to FYM and vermicompost application might have resulted in improvement in leaf size, which might have led to significant improvement in LAI with different levels of FYM and vermicompost with inorganic fertilisers. The photosynthetic activities of the plants are well reflected in their dry matter accumulation. An increased production of dry matter indicates the better utilisation of nutrients along with better harvest of solar energy. In present investigation, the slow release of nutrients associated with vermicompost might have resulted in higher concentration of nutrients in plant cells resulting in higher dry-matter accumulation. In association with soil microorganisms, organic manures are known to help in synthesis of certain phytohormones and vitamins which promote the growth and development of crops. The leaves of the plant are normally its main organs of photosynthesis. So higher leaf area-index coupled with vigorous vegetative growth at higher fertility levels might be responsible for higher dry-matter production.

Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS increased all the growth parameters in initial stage at 30 DAS. But at later crop growing stage hand weeding at 25 and 45 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS was highly effective and promoting all growth factor.

Increase in plant dry matter accumulation may be attributed to better utilisation of growth factors and higher photosynthetic efficiency resulting in increased plant height, number of leaves and more leaf area which contributed towards increased dry matter yield.

Yield attributes

Significantly higher number of pods/plant and grains/pod were recorded with integrated application of 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha than the rest of the treatments but was at par with 50% RDF + FYM 5.0 t/ha (Table 2). Since the plants were healthy under the treatment having combination of inorganic fertilizer, FYM and vermicompost and produced more dry matter which was then reflected in their yield attributes. The minimum number of pods/plant and grains/pod were recorded in the control plots. Nutrient management did not influence the 100-seed weight significantly, being a varietal character, is less sensitive to management levels. Similar result was also reported by (Rana and Badiyala 2014). However, higher seed index was obtained with combined application of 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha and minimum seed index was associated with control, but the differences were non-significant. Vermicompost application delayed leaf senescence and this might be the reason for increased seed weight (Devi *et al.*, 2013).

Table.1 Effect of nutrient and weed management on growth attributes of soybean at various growth stages

Treatments	Plant height (cm) at harvest	Dry weight (g)/plant at harvest	No. of leaves/ plant at 60 DAS	LAI at 60 DAS	No. of root nodules/ plant	
					30 DAS	60 DAS
Nutrient levels						
Control	42.80	12.15	27.22	3.86	15.50	40.47
RDF- N: P2O5: K2O (30: 60: 40 kg/ha)	47.62	14.44	29.82	4.26	17.10	50.27
50% RDF +FYM @ 5 t/ha	53.39	17.47	34.78	5.20	19.78	57.71
50% RDF + VC @ 2.5 t/ha	51.45	16.28	32.60	4.85	19.56	55.61
50% RDF +FYM @ 2.5 t/ha + VC @ 1.25 t/ha	54.60	18.60	35.70	5.36	20.46	61.31
S.Em.±	1.15	0.39	0.76	0.12	0.43	1.32
C.D.(P=0.05)	3.79	1.30	2.51	0.38	1.44	4.37
Weed management						
Control	44.50	11.43	27.19	4.12	14.09	39.26
Hand weeding at 25 and 45 DAS	55.47	18.40	35.10	5.22	20.14	60.30
Pendimethalin @ 1.0 kg/ha as PE + one hand weeding at 40 DAS	52.63	17.61	34.11	4.95	19.81	58.81
Pendimethalin @ 1.0 kg/ha as PE and imazethapyr @ 55 g/ha as PoE at 25 DAS	48.90	15.71	31.69	4.54	18.87	53.92
S.Em.±	1.20	0.41	0.79	0.12	0.45	1.35
C.D.(P=0.05)	3.56	1.18	2.28	0.34	1.33	3.93

Table.2 Effect of nutrient and weed management on yield attributes, seed yield and economic return of soybean

Treatments	Pods/ plant	Grains/pod	100-Grain weight (g)	Grain yield (q/ha)	Straw yield (q/ha)	Cost of cultivation (₹ /ha)	Net returns (₹ /ha)	B: C ratio
Nutrient levels								
Control	17.10	1.90	9.04	9.44	19.37	18.94	19.91	1.02
RDF- N: P_2O_5: K_2O (30: 60: 40 kg/ha)	18.88	2.10	9.20	13.86	23.15	23.65	31.80	1.33
50% RDF +FYM @ 5 t/ha	21.90	2.40	9.45	16.28	27.50	24.29	40.23	1.60
50% RDF + VC @ 2.5 t/ha	20.61	2.31	9.36	15.50	26.23	29.49	30.64	1.04
50% RDF +FYM @ 2.5 t/ha + VC @ 1.25 t/ha	23.50	2.52	9.52	16.94	28.60	28.24	39.64	1.41
S.Em.±	0.49	0.05	0.20	0.38	0.62		1.52	0.06
C.D.(P=0.05)	1.63	0.18	NS	1.27	2.05		5.04	0.20
Weed management								
Control	17.19	1.91	8.92	8.79	17.19	20.66	15.26	0.73
Hand weeding at 25 and 45 DAS	22.52	2.42	9.50	16.71	28.11	30.36	36.57	1.20
Pendimethalin @ 1.0 kg/ha as PE + one hand weeding at 40 DAS	21.39	2.37	9.43	16.26	27.65	27.12	38.07	1.41
Pendimethalin @ 1.0 kg/ha as PE and imazethapyr @ 55 g/ha as PoE at 25 DAS imazethapyr @ 55 g/ha as PoE at 25 DAS	20.50	2.28	9.40	15.86	26.93	23.71	39.87	1.70
S.Em.±	0.51	0.06	0.22	0.37	0.64		1.52	0.05
C.D.(P=0.05)	1.47	0.16	8.95	1.10	1.86		4.41	0.16

Yield

Application of Integration of 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha resulted in significantly superior seed and straw yield than the rest of the treatments but was at par with 50% RDF + FYM 5.0 t/ha (Table 2). Inorganic fertilizer with FYM and vermicompost was superior in grain yield than the application of inorganic fertilizer and no fertiliser. This might be attributed to rapid mineralization of N and steady supply of N from FYM and vermicompost, which might have met the N requirement of crop at critical stages. Further FYM acts as nutrient reservoir and upon decomposition produces organic acids, thereby absorbed ions are released slowly during entire growth period leading to improvement in different yield components thereby resulting in higher seed yield (Maheshbabu *et al.*, 2008).

Again 100% RDF also produced a lower seed yield (13.86 q/ha) as compared to the

integration of inorganic fertilizers with biological and organic manures. This might be due to the lesser availability of nutrients, especially nitrogen to the crop at the later stages of crop growth when the root nodules degenerate and the nitrogen supply falls short of crop requirements during the pod development phase of the crop. Similar results were also reported in soybean (Singh and Rai 2004). Like grain yield, An increase in stover yield may be due to beneficial effect of FYM and vermicompost which it was applied conjunctive with chemical fertilizers which could be due to synergistic role of FYM and vermicompost in increasing the nutrient availability and sustaining it over period of time as compared to their individual application (Chaturvedi *et al.*, 2010).

Hand weeding at 25 and 45 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS produced significantly more grain yield than weedy check which was 90.10 %, 84.98 % and 80.43% more grain yield than unweeded control. This might be due to reduced crop-weed competition for better utilisation of nutrients, moisture and solar radiation are known to improve of the yield attributing character which ultimately expressed in grain yield. This trend was fully reflected in hand weeding and chemical weeding systems. Treatments recording higher grain yield also recorded higher yield of straw in the weed free environment.

The weed free environment recorded significantly higher harvest index than control condition. This was probably due to better water and nutrient availability resulting in enhanced sink capacity and higher grain productivity under hand weeding and Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS and Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS.

Economics

Crop received 50% RDF + FYM 5.0 t/ha exhibited highest net returns (₹ 40225/ha) and B: C ratio (1.60) which was at par with 50% RDF + FYM 2.5 t/ha + VC 1.25 t/ha (39641) and both of them were significantly superior over other treatments. The lowest net returns and B: C ratio were recorded in the control plots (Table 2). High cost of vermicompost, resulted in increased cost of cultivation without too much increase in net returns. Hence, this overall effect of vermicompost reflected in benefit-cost ratio.

Maximum net returns (₹ 39870/ha) and benefit-cost ratio (1.70) was obtained with application of Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS followed by Pendimethalin 1.0 kg/ha (Pre-emergence) + one hand weeding at 40 DAS, hand weeding twice at 25 and 45 DAS and control. This may be due to facts that although weed free situation gave significantly highest gross returns due to higher value of seed and straw yield, higher cost of manual weeding resulted into lower net returns under weed free situation but comparable yield obtained and lower cost of herbicides to control weeds under Pendimethalin 1.0 kg/ha (Pre-emergence) + imazethapyr 55 g/ha (Post-emergence) at 25 DAS as compared manual weeding resulted in to fetch highest net returns and B: C ratio.

References

Chaturvedi, S., Chandel, A.S., Dhyani, V.C. and Singh, A.P. (2010). Productivity, profitability and quality of soybean [Glycine max (L.) Merrill] and residual

soil fertility as influenced by integrated nutrient management. *Indian Journal of Agronomy* 55 (2): 133-137.

Chaudhary, D.R., Bhandary, S.C. and Shukla, L.M. (2004). Role of vermicompost in sustainable agriculture: A review. *Agricultural Review* 25 (1): 29-39.

Chauhan, G.S. and Joshi O.P. (2005). Soybean [*Glycine max* (L.) Merrill]: 21st century crop. *Indian Journal of Agriculture Science* 75 (8): 461-469.

Devi, K.N., Singh, T.B., Athokpam, S.H., Singh, N.B. and Shamurailatpam, D. (2013). Influence of inorganic, biological and organic manures on nodulation and yield of soybean [*Glycine max* (L.) Merrill] and soil properties. *Australian Journal of Crop Science* 7 (9): 1407-1415.

Kurchania, S. P., Rathi, G. S., Bhalla, S. and Mathew, R., (2001). Bio–efficacy of post-emergence herbicides for weed control in soybean. *Indian Journal of Weed Science* 33(1&2): 34 -37

Maheshbabu, H.M., Hunje, R., Patil, N.K.B and Babalad, H.B. (2008). Effect of organic manures on plant growth, seed yield and quality of soybean. *Karnataka Journal of Agriculture Science* 21 (2): 219-221.

Rana, R. and Badiyala, D. (2014). Effect of integrated nutrient management on seed yield, quality and nutrient uptake of soybean [*Glycine max* (L.) Merrill] under mid hill conditions of Himachal Pradesh. *Indian Journal of Agronomy* 59 (4): 641-645.

Sandil, M.K., Sharma, J.K., Sanodiya, P. and Pandey, A. (2015). Bio-efficacy on tank-mixed propaquizafop and imazethapyr against weeds in soybean. *Indian Journal of Weed Science* 47 (2): 158-162.

Singh, R and Rai, R.K. (2004). Yield attributes, yield and quality of soybean [Glycine max (L.) Merrill] influenced by integrated nutrient management. *Indian Journal of Agronomy* 49 (4): 271-274.

Thakare, K.G., Chore, C.N., Deotale, R.D., Kamble, P.S., Sujata, B.P. and Shradha, R.L. (2006). Influence of nutrients and hormones on biochemical and yield and yield contributing parameters of soybean. *Journal of Soil and Crop* 16 (1): 210-216.

Tiwari, S.P. (2001). Shattering the production constraints in soybean based cropping systems. *J.N.K.V.V. Research Journal* 35 (182): 1-10.

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