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Research Article | *Natural Resource Management*

Growth, Yield and Quality of Soybean [*Glycine max* (L.) Merr.] as Influenced by Weed Management and Fertility Levels in Vertisols of S-E Rajasthan

Chaman Kumari Jadon[1], L. N. Dashora[2], S. N. Meena[1]* and Pratap Singh[1]

[1]Agricultural Research Station, (AU, Kota) Kota, Rajasthan (324 001), India
[2]Rajasthan College of Agriculture,(MPUAT, Udaipur) Udaipur, Rajasthan (313 001), India

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Corresponding Author
S. N. Meena
e-mail: satyanarayan.ars08@gmail.com

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Abstract

A field experiment was conducted at Research Farm, Agricultural Research Station, Kota, Rajasthan during rainy (kharif) season of 2013 and 2014, to evaluate the productivity and quality of soybean as influenced by weed management and fertility levels. The experiment was laid out in split plot design comprising of seven weed management practices in main plot (weedy check, two hand weeding at 20 and 40 DAS, pendimethalin 1.0 kg ha^{-1} PE+one hand weeding at 30 DAS, imazethapyr 100 g ha^{-1} at 15 DAS, imazamox+imazethapyr 75 g ha^{-1} at 15 DAS (ready-mix), clodinafop-propargyl 60 g ha^{-1} at 15 DAS and quizalofop-ethyl 50 g ha^{-1} at 15 DAS) and four fertility levels (100% NPK without sulphur, 100% NPK with sulphur, 125% NPK without sulphur and 125% NPK with sulphur) in sub plots with three replications. Pooled results revealed that all the weed management practices and fertility levels were produced significantly higher seed yield and enhanced quality (protein and oil yield) of soybean. Among the herbicidal treatments, post emergence application of ready mix of imazamox+imazethapyr 75 g ha^{-1} at 15 DAS was produced the highest seed (2013.7 kg ha^{-1}), protein (815.7 kg ha^{-1}) and oil yield of soybean (385.7 kg ha^{-1}) which was significantly superior over clodinafop-propargyl,quizalofop-ethyl and weedy check. Application of 100% NPK (40 N:40 P_2O_5:40 K_2O kg ha^{-1}) along with sulphur (30 kg ha^{-1}) was also found significantly better in terms of yields by giving seed (1736.5 kg ha^{-1}), protein (699.4 kg ha^{-1}) and oil (331.2 kg ha^{-1}) yield of soybean as compared to 100% NPK without sulphur, which was at par with 125% NPK along with sulphur.

Keywords: Soybean, weed management, fertility, productivity, quality

1. Introduction

Soybean [*Glycine max* (L.) Merr.] is also known as golden/miracle/wonder bean crop because it contains 38–42% good quality protein, 18–20% oil, rich in polyunsaturated fatty acids, good amount of minerals (Ca, P, Mg, Fe and K) and vitamins especially B-complex and tocopherols. It provides high amounts of phyto-chemicals and good quality dietary fiber which enables to protect human body against cancers and diabetes (Chouhan, 2007).

It plays a pivotal role in meeting the continuously increasing demand of the edible oil across the world; it contributes 25% in total edible oil production. In India, soybean has become a leading oilseed crop with 41.5% and 28.6% contribution towards the total oilseeds and edible oil production in the country during triennium average ending 2013–14

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(Annual Report 2014–15). It is the world's most inexpensive source of high quality protein and also provides high quality oil.

Soybean is a rainy season crop and it faces severe crop weed competition during active phase of growth. Yield reductions in soybean due to poor weed management ranges from 12 to 85% depending on weed flora and their density (Nagaraju and Kumar, 2009). Although weeds pose problems during the entire crop period but maintaining weed free condition during critical period (first 45 days after sowing) is very much essential (Hosmath, 2014). Next to weed management in soybean, nutrient management an another important aspect has also a significance in augmenting its production. Soybean is considered to be highly exhaustive crop, hence inadequate fertilization is also one of the major factors for its low productivity. Inadequate fertilizer use and emergence of multiple-nutrient deficiencies due to poor recycling of organic resources and unbalanced use of fertilizers are important factors to be considered for low productivity of soybean (Chaturvedi et al., 2010). It is an established fact that amongst nutrients, NPK and S are considered to be the most important for exploiting genetic potential of this crop.

Therefore, keeping in view the present study was undertaken to find out the effect of different weed management practices and fertility levels on quality and yield of soybean.

2. Materials and Methods

A field experiment was conducted at Agricultural Research Station, Ummedganj, Kota (Rajasthan), India during *kharif,* 2013 and 2014 to evaluate the productivity and economical viability of soybean as influenced by weed management and fertility levels. This station is situated at $75^0$25'E Longitude and $25^0$13'N latitude at an altitude of 258 m above mean sea level. The soil of the experimental field was clay loam in textures, alkaline in reaction (pH 7.97 and 7.99), medium in organic carbon (0.55 and 0.53%), medium in available nitrogen (347.00 and 336.0 kg ha^{-1}), medium in available phosphorus (24.89 and 23.92 kg ha^{-1}) and high in available potash (336.00 and 318. 00) and low in available S (9.1 and 9.3 ppm) during the year 2013 and 2014, respectively.

The experiment was laid out in split plot design comprising of seven weed management practices in main plot (Weedy check, two hand weeding at 20 and 40 DAS, pendimethalin 1.0 kg ha^{-1} PE+one hand weeding at 30 DAS, imazethapyr 100 g ha^{-1} at 15 DAS, imazamox+imazethapyr 75 g ha^{-1} at 15 DAS (ready-mix), clodinafop-propargyl 60 g ha^{-1} at 15 DAS and quizalofop-ethyl 50 g ha^{-1} at 15 DAS) and four fertility levels (100% NPK without sulphur, 100% NPK with sulphur, 125% NPK without sulphur and 125% NPK with sulphur) in sub plots with three replications. Sowing of soybean cv. RKS-45 was done in July 2013 and 2014 by drilling 80 kg seeds ha^{-1} in rows 30 cm apart. Nitrogen, phosphorus, potash and sulphur were applied as per treatment at sowing. Full quantity of nitrogen and phosphorus were applied through urea (after adjusting N available through DAP) and DAP, respectively, whereas potash was applied through muriate of potash, and sulphur through gypsum. The recommended dose of fertilizers for soybean in the zone is 40 kg nitrogen, 40 kg phosphorus, 40 kg potash and 30 kg sulphur ha^{-1}, respectively. Observation on chlorophyll content was recorded at 60 DAS and on growth parameters, yield attributes and yields were recorded at harvest. Oil content in seeds from each net plot sample was determined by Soxhlet ether extraction method (AOAC, 1965) expressed as per cent oil content in seed. Oil yield was worked out by multiplying the seed yield with oil content for each corresponding treatment.

Oil yield (kg ha^{-1})=Oil content in seed (%)×seed yield (kg ha^{-1})/100

The protein content in seed was calculated by multiplying per cent nitrogen in the seed by the factor 6.25 (Simson et al., 1965) and expressed as per cent protein content.

Protein yield was worked out by formula;

Protein yield (kg ha^{-1})=Protein content in seed (%)×seed yield (kg ha^{-1})/100

Statistical methods based on analysis of variance technique as described by Gomez and Gomez (1984) were employed and The critical difference for the comparison of treatment mean was worked out, whereas the 'F' test was significant at 5% level of significance.

3. Results and Discussion

3.1. Effect on growth and yield attributes

Pooled data presented in Table 1 revealed that two hand weeding at 20 and 40 DAS and ready mix of imazamox+imazethapyr 75 g ha^{-1} at 15 DAS recorded highest values of growth characters as well as yield attributes and were statistically superior over rest of the herbicides and weedy check. Among the herbicidal treatments, application of ready mix of imazamox+imazethapyr 75 g ha^{-1} at 15 DAS was recorded maximum dry matter accumulation of plants at harvest (17.94 g $plant^{-1}$), total chlorophyll content (2.35 mg g^{-1} fresh leaves), number of branches $plant^{-1}$ (2.43), pods $plant^{-1}$ (47.23) and seed index (9.08 g) which was significantly higher over rest of herbicides and weedy check except imazethapyr alone.

Among the fertility levels, application of 100 and 125% NPK along with sulphur were significantly superior over 100% NPK without sulphur with respect to growth parameters *viz.,* total chlorophyll content at 60 DAS (2.31 and 2.27 mg g^{-1} fresh weight), dry matter accumulation at harvest (17.49 and 16.95 g $plant^{-1}$) and yield attributes *viz.,* number of branches $plant^{-1}$ (2.41 and 2.32), number of pods $plant^{-1}$ (43.72 and 41.18) and seed index (9.04 and 9.00 g), respectively. Improvement in yield attributes occurred when weeds were controlled in early crop growth stages, particularly during critical growth

Table 1: Effect of weed management and fertility levels on growth, yield attributes, quality and yield of soybean (pooled data of 2 years)

Treatments	DMAH	CC	BP	PP	SI	SY	OC	OY	PC	PY
Weed management practices										
Weedy check	15.01	2.02	2.05	27.39	8.84	892.79	18.72	167.47	38.63	345.05
HW (20 and 40 DAS)	18.32	2.47	2.57	53.27	9.16	2204.42	19.25	424.83	41.24	909.68
Pendi. 1.0 kg ha^{-1}+ HW (30 DAS)	16.98	2.30	2.37	43.43	9.04	1899.79	18.98	361.27	40.35	766.91
Imaze. 100 g ha^{-1} (15 DAS)	17.23	2.32	2.39	45.80	9.04	1944.47	19.04	370.62	40.42	786.27
Imazamox+Imaze 75 g ha^{-1} (15 DAS)	17.94	2.35	2.43	47.23	9.08	2013.79	19.12	385.74	40.49	815.78
Clodi. 60 g ha^{-1} (15 DAS)	16.61	2.15	2.21	34.77	8.95	1528.79	18.80	288.22	39.47	604.68
Quiz. 50 g ha^{-1} (15 DAS)	16.91	2.19	2.26	36.89	8.97	1650.75	18.87	312.39	39.55	653.73
SEm±	0.31	0.02	0.04	1.04	0.04	34.88	0.16	7.76	0.23	14.68
CD (*p*=0.05%)	0.91	0.06	0.12	3.04	0.11	101.80	NS	22.65	0.67	42.85
Fertility levels										
100% NPK without S	16.39	2.17	2.20	37.43	8.99	1594.10	18.51	296.41	39.40	631.23
100% NPK with S	16.95	2.27	2.32	41.18	9.00	1736.50	19.01	331.27	40.07	699.44
125% NPK without S	17.18	2.28	2.37	42.69	9.02	1787.10	19.11	342.20	40.17	721.28
125% NPK with S	17.49	2.31	2.41	43.72	9.04	1816.48	19.25	350.43	40.45	737.82
SEm±	0.19	0.01	0.03	0.64	0.01	21.18	0.11	4.82	0.17	9.63
CD (*p*=0.05)	0.54	0.04	0.09	1.80	0.04	59.57	0.31	13.55	0.47	27.09

DMAH: Dry matter accumulation at harvest (g plant^{-1}); CC: Chlorophyll content mg g^{-1} at 60 DAS; BP: Branches plant^{-1} (Nos.); PP: Pods plant^{-1} (Nos.); SI: Seed index (g); SY: Seed yield (kg ha^{-1}); OC: Oil content (%); OY: Oil yield (kg ha^{-1}); PC: Protein content (%); PY: Protein yield (kg ha^{-1})

period either manually or chemically, which scaled down competition and created congenial micro-environment for better establishment and growth of the crop. Malik et al. (2006), Habimana et al. (2013), Kaur et al. (2015), Chouhan (2017) and Patel et al. (2018) were also reported similar results.

3.2. Effect on quality and yields

A perusal of data (Table 1) revealed that all the weed management practices and fertility levels were significantly influenced quality and seed yield of soybean during the years of experimentation. On pooled basis, Protein content was significantly influenced whereas oil content in seeds was not significantly influenced by different weed management practices over weedy check. Pooled data further revealed that two hand weeding registered highest soybean seed yield (2204.4 kg ha^{-1}), protein yield (909.6 kg ha^{-1}) and oil yield (424.8 kg ha^{-1}) followed by ready mix of imazamox+imazethapyr 75 g ha^{-1} (2013.7, 815.7 and 385.7 kg ha^{-1}, respectively) which were significantly superior over clodinafop-propargyl, quizalofop-ethyl and weedy check. Cleaner crop culture seemed to reduce crop weed competition, increased N content and its uptake by seed and resulted in higher seed yield. Hence, it can be improved the oil and protein yield which are directly a function of seed yield. The results are in conformity with the findings of Peer et al. (2013). Based on pooled data (Table 1), it can be inferred that protein and oil content significantly enhanced with fertility levels. Among the fertility levels, 100 and 125% NPK along with sulphur also maximized seed yield (1736.5 and 1816.4 kg ha^{-1}) over 100% NPK without sulphur. Application of 100 and 125% NPK with sulphur were found significantly superior in enhancing protein yield by 68.2 and 106.6 kg ha^{-1} and oil yield by 34.9 and 54.0 kg ha^{-1} over 100% of NPK without sulphur. The results corroborate the findings of Dhakar et al. (2010), Billore and Vyas (2012), Sharma et al. (2014) and Gawali et al. (2016).

Pooled results shows that among the herbicidal treatments, post emergence application of ready of imazamox+imazethapyr 75 g ha^{-1} at 15 DAS produced the highest seed yield (2013.7 kg ha^{-1}) with higher protein yield of 815.7 kg ha^{-1} and oil yields of 385.7 kg ha^{-1} while among the fertility levels application of 100% NPK along with sulphur was also found significant in terms of yields *viz.,* seed (1736.5 kg ha^{-1}), protein (699.4 kg ha^{-1}) and oil yield (331.2 kg ha^{-1}) of soybean as compared to 100% NPK without soybean.

4. Conclusion

Post emergence application of ready of imazamox+imazethapyr 75 g ha^{-1} at 15 DAS produced highest seed yield (2013.7 kg ha^{-1})

along with higher protein (815.7 kg ha^{-1}) and oil (385.7 kg ha^{-1}) yields of soybean while among the fertility levels, application of 100% NPK along with sulphur was also found significant in terms of yields *viz.,* seed (1736.5 kg ha^{-1}), protein (699.4 kg ha^{-1}) and oil yield (331.2 kg ha^{-1}) of soybean.

5. Reference

AOAC, 1965. Official methods of analysis. (10th ed.) Association of Official Agricultural Chemists, Washington.

Annual Report, 2014-15. Director's report and Summary tables of experiments 2014-15. ICAR -All India Coordinated Research Project on Soybean, (i).

Billore, S.D., Vyas, A.K., 2012. Optimization of sulphur levels for soybean production under different agro-climatic regions of India. Soybean Research 10(1), 67–74.

Chaturvedi, S., Chandel, A.S., Dhyani, A.S., Singh, A.P., 2010. Productivity, profitability and quality of soybean (*Glycine max*) and residual soil fertility as influenced by integrated nutrient management. Indian Journal of Agronomy 55(2), 133–137.

Chouhan, G.S., 2007. Soybean products and their export potential. Green Farming 1(3), 55–57.

Chouhan, M., 2017. Evaluation of pre and post emergence herbicides for weed control in Soybean (*Glycine max* (L.) Merrill)+Pigeonpea (*Cajanus cajan* (L.) Millsp.) (4:2) intercropping system in rainfed situation. M.Sc. Ag. (Agronomy) Thesis. Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.)

Dhaker, S.C., Mundra, S.L., Nepalia, V., 2010. Effect of weed management and sulphur nutrition on productivity of soybean [*Glycine max* (L.) Merrill]. Indian Journal of Weed Science 42(3&4), 232–234.

Gomez, K.A., Gomez, A.A., 1984. Statistical Procedure for Agricultural Research. (2nd ed.) Published by John Willey& Sons, New York.

Habimana, S., Kalyana Murthy, K.N., Shankaralingappa, B.C., Sanjay, M.T., Ramachandra, C., 2013. Efficiency and economics of weed control with pre and post-emergence herbicides in soybean (*Glycine max* L.). Asian Journal of Plant Science and Research 3(4), 18–20.

Hosmath, J.A., 2014. Bioefficacy of quizalofop-p-teruryl 4.41 EC against weeds in soybean ecosystems in India. In: Proceedings of SOYCON-2014. International Soybean Research Conference on Mitigating Productivity Constraints in Soybean for Sustainable Agriculture, 22-24 Feb., 2014 held at Directorate of Soybean Research, Indore, 194.

Gawali, D.M., Narkhede W.N., Khazi, G.S., 2016. Impact of Various Organic, Inorganic Nutrient Sources and Bio-fertilizers on Growth, Yield, and Post Harvest Soil Status of Soybean. International Journal of Bio-resource and Stress Management, 1302–1307.

Kaur, S., Kaur., T., Bhullar, M.S., 2015. Residual effect of imidazolinone herbicides applied in greengram on succeeding Indian mustard. Department of Agronomy, Punjab Agricultural University, Ludhiana, Punjab, India 25th Asian-Pacific Weed Science Society Conference on "Weed Science for Sustainable Agriculture, Environment and Biodiversity".

Malik, R.S., Yadav, A., Malik, R.K., 2006. Integrated weed management in soybean (*Glycine max*). Indian Journal of Weed Science 38(1&2), 65–68.

Nagaraju, A.P., Kumar, H.K.M., 2009. Critical period of weed interference in soybean under alfisols. Mysore Journal of Agricultural Sciences 43(1), 28–31.

Patel, S., Dhonde M.B., Kamble, A.B., 2018. Effect of integrated weed management on growth and yield of soybean. International Journal of Agriculture Sciences 10(10), 6058–6062

Peer, F.A., Hassan, B., Lone, B.A., Qayoom, S., Ahmad, L., Khanday, B.A., Singh, P., Singh, G., 2013. Effect of weed control methods on yield and yield attributes of soybean. African Journal of Agricultural Research 8(48), 6135–6141.

Sharma, G.D., Thakur, R., Kauraw, D.L., 2014. Impact of integrated input resource management on production and nutrient uptake of soybean [*Glycine max* (L.)Merrill]. Soybean Research 12(1), 104–109.

Simson, T.E., Adair, C.R., Kohler, G.P., Dabald, H.A., Kestar, F.B., Hlick, J.T., 1965. Quality evaluation studies of foreign and domestic rices. Technical Bulletin No. 1331, USDA, 1–16.