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Original Research Article

Effect of Long Term Application of Chemical Fertilizers and Organic Manure Application on Crop Quality Parameters in Soybean Crop

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A B S T R A C T

A field experiment was conducted in kharif during 2015-16 to study the evaluation of long term application of fertilizer and FYM on crop quality parameters in soybean in a Vertisol at the research farm of Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur (MP). The treatment were applied in combination of different doses of fertilizer viz 50, 100, 150 and 100%NPK+HW, 100%NPK+Zn 100%NP, 100%N, 100%NPK+FYM, 100%NPK-S and control. The results revealed that without or imbalance application of fertilizer (i.e. application of N alone) exhibited the adverse on the contrary effect on crop quality parameters while, successive application of balanced fertilizer promote and improved the grain protein, carbohydrate and oil content and their yield, However, application of chemical fertilizer with organic manure noticed higher content of protein(42.55%), carbohydrate(20.26%) and oil(18.26%) and their yield(510.9, 219.2 and 243.3 Kg ha^{-1}) in soybean. Application of balance amount of fertilizer with organic manure was found to have a prominent effect on content of carbohydrate fractions (reducing, non-reducing and total sugars) in soybean.

Keywords

Nitrogen, Ammonical, Protein, Carbohydrate, Fertilizer

Introduction

Long Term Fertilizer Experiment an important role in understanding the complex and quality of crop interactions involving soil, plant and climate management practices and their consequent effects on soil productivity over a long period of time (Singh et al., 2012). Soybean is rapidly emerging as the most important oil seed crop along with great potential as very rich protein food (Dwivedi et al., 2007). Soybean contains protein, oil, carbohydrate, minerals and several other components including vitamins (Liu, 1997). In India, soybean is grown covering about 110.66 lakh hectare under diverse agro-climatic and soil conditions with average production of 86.43 lakh tonne. While in Madhya Pradesh it is cultivated in an area of 56.13 lakh hactare and production about 44 lakh tonne which contributes about 60% production from around 55% of soybean grown area of the country (SOPA, 2015).

Very few plants equal its quality to produce high quality protein along edible oil with only minimal application of nitrogen for its nutrition (Dwivedi and Bapat 1998).

Materials and Methods

The present investigation is a part of an ongoing All India Coordinated Research Project on long-term fertilizer experiment with soybean-wheat cropping sequence which was initiated during 1972 at the Research Farm of the Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur. The experiment consisted of 10 treatments replicated four times in a randomized block design consist of gross plot size 17x10.8 m with 1 m spacing between plots and 2 m spacing between the replications. The recommended fertilizer dose (100% NPK) for the crop was estimated on the basis of soil test value.

Total carbohydrates in the samples were estimated by hydrolysis method as described in AOAC (1995). Sugars was determined by Lane and Eynon's method reported by Ranganna (1995). The oil content in the sample (soybean grain) was estimated by Sochlet's extraction method as described in AOAC (1995).

Results and Discussion

Crude protein content and crude protein yield in soybean grain

It has been established fact that protein, carbohydrate and oil are the major constituents that contributing to the quality of any crop. The supply of balance nutrient to the growing plant influenced the protein, carbohydrate and oil metabolism to a greater extent and as the supply of nutrient decreases the reduction of the plant-synthesis decline to a considerable extent (Dwivedi and Dwivedi 2015). The data pertaining to protein, carbohydrate and oil content and their yield of soybean seed as influenced by continuous application of chemical fertilizer and organic manure are illustrated protein content and its yield in soybean grain was found to increase with higher application of fertilizer from sub optimal to optimal and supper optimal dose in comparison to imbalance or without fertilizer application suggesting that under balanced fertilizer application the metabolism of nitrogenous compounds was closely related to the N concentration and uptake in the assimilatory zone of the plant as well as status N in the soil pool (Rathke et al., 2005). While, Imbalance application of nutrients reduced the N fixation process in the rhizospheric zone, (Hyten et al., 2004) and which subsequently inhibited the protein synthesis as well as transformation and translocation of protein in the plant system could not occurred adequately therefore, further mobilization of protein was restricted in the ultimate sink i.e. the seed which resulted in deposition of a lower protein content. However, maximum protein content (42.55%) and its yield (510.9 kg ha^{-1}%) was noted when 100% NPK applied with FYM which might be due to better root growth and nitrogen uptake resulting from the balanced use of fertilizer with FYM. Sharma and Namdeo (1999) and Deshmukh et al (2005) reported that application of balance fertilization with 5 tons FYM to soybean increased the protein and oil yield over control. Similar results have been marked on protein synthesis by Singh et al. (2003 and Patil et al. (2003).

Oil content and their yield in soybean grain

Oil content in soybean seeds was found to be influenced remarkably by varying application of fertilizer. The maximum oil content (18.26%) and its yield (219.2 kg^{-1}) was observed in 100% NPK+FYM. Patel et al. (2014) also found the similar results by addition of optimal dose of fertilizer with organic manure and found oil content had

increased significantly. Singh et al. (2003) reported that 75% NPK+5 tonnes FYM ha^{-1} recorded the increased oil yield (17.87%). Sharma and Namdeo (1999) reported that application of balance fertilization with 5 tons FYM to soybean increased the protein and oil yield over control. Lower content and yield was associated with imbalanced additions and minimum content coincided with control could be a result of lower oil or fat metabolism associated with low nutrition levels while accelerated under supply of balance nutrition (Patil et al., 2003).

Carbohydrate content and their yield in soybean grain

Pertaining to carbohydrate of soybean seed as influenced by long term application of fertilizer established a fact that plant utilizes the nutrient proportionately as the soil available pool concentrated with successive higher fertilizer or manure additions. In this regard, the carbohydrate content in soybean seed ranged from 11.55 to 20.26 percent and it was found that the successive additions of fertilizer progressively increased the carbohydrate content in soybean grain. The result revealed that carbohydrate content (20.26%) and its yield (243.3 kg^{-1}) was receded under treatment receiving 100% NPK + FYM which were significantly higher over all treatments. The lower content was recorded in 100% N alone treatment and control. While, further addition of P (100% NP) was significantly raised its content and yield. The higher carbohydrate content and its yield were recorded where 150% NPK was applied, as compared to 100% N and 50% NPK dose. Applied FYM along with optimal dose helped to increase the carbohydrate as compared to the application of NPK alone, while the lowest N uptake in grain was found in control. Similar results were found by Javed and Panwar (2013) and conducted that maximum carbohydrate content in soybean when increased chemical fertilizer with Vermicompost treated soil as compared to chemical fertilizer application.

Table.1 Impact of long term fertilizer and FYM application on crude protein, oil and carbohydrate content and their yield in soybean grain

Treatments		Crude Protein		Oil		Carbohydrate	
		Content (%)	Yield (Kg ha^{-1})	Content (%)	Yield (Kg ha^{-1})	Content (%)	Yield (Kg ha^{-1})
T_1	**50%NPK**	28.91	180.2	12.51	78.0	13.76	85.8
T_2	**100%NPK**	33.59	301.8	14.45	129.8	16.00	143.7
T_3	**150%NPK**	38.13	438.2	16.36	188.0	18.15	208.7
T_4	**100%NPK+HW**	33.72	261.1	14.47	112.0	16.06	124.3
T_5	**100%NPK+Zn**	33.84	262.5	14.52	112.6	16.12	125.0
T_6	**100%NP**	28.75	238.5	12.49	103.7	13.69	113.6
T_7	**100%N**	22.34	72.8	10.54	34.3	11.58	37.7
T_8	**100%NPK+FYM**	42.55	510.9	18.26	219.2	20.26	243.3
T_9	**100%NPK – S**	29.06	218.7	12.52	94.1	13.84	104.1
T_{10}	**Control**	22.19	69.8	10.50	33.1	11.55	36.3
SEm ±		1.51	17.55	0.64	8.11	0.72	8.47
LSD (p=0.05)		4.37	50.92	1.87	23.53	2.08	24.57

Table.2 Impact of long term fertilizer and FYM application on reducing, non-reducing and total sugar of soybean grain

Treatments		Sugars (%)		
		Reducing	Non-reducing	Total
T_1	50%NPK	1.43	10.16	12.13
T_2	100%NPK	1.64	11.87	14.14
T_3	150%NPK	1.88	13.41	16.00
T_4	100%NPK+HW	1.65	11.87	14.15
T_5	100%NPK+Zn	1.66	11.91	14.20
T_6	100%NP	1.39	10.14	12.06
T_7	100%N	1.15	8.59	10.20
T_8	100%NPK+FYM	2.12	14.94	17.85
T_9	100%NPK – S	1.40	10.25	12.19
T_{10}	Control	1.14	8.58	10.18
SEm ±		0.07	0.63	0.64
LSD (p=0.05)		0.20	1.82	1.84

Reducing, non-reducing and total sugar of soybean grain

The average percentage of reducing, non-reducing and total sugar was 1.55, 11.17 and 13.31%, respectively. Malik et al. (1977) indicated content reported in general 2.1 per cent reducing sugar and 1.0 per cent non-reducing sugars. The lowest sugar content was (1.14 %) recorded in control. While, it was found to be increased in treatment receiving sub optimal fertilizer dose (50% NPK), which was significantly higher than that obtained with application of 100% N alone. Sharma and Arora (1988) reported that applied nitrogen significantly decreased the starch, increased proteins but did not affect the sugar content of potato tubers. Application of recommended optimal dose (100% NPK) resulted in higher sugar content (16%) but exclusion of sulphur (i.e. 100% NPK-S) dose had resulted in comparatively lower sugar content. On the other hand, the sugar content obtained in 100% NPK + FYM treatment was (20.26%) significantly higher than 150% NPK treatment (18.15%). Similarly, it was also found that 100% N treatment resulted in depleting the level of non-reducing and total sugar content (1.15, 8.59 and 10.20 %, respectively) and progressively increased to 1.39, 10.14 and 12.06%, respectively when P fertilizer (100% NP) was included in fertilizer schedule. Saimbhi and Grewal (1986) reported that maximum sugar and crude protein contents were observed in where P fertilizer was applied. While, there was a further improvement noted when K nutrient included (100% NPK) which was accounted for around 1.64, 11.87 and 14.14%, respect1ively over imbalanced of fertilizers application.

In conclusions, a remarkable improvement in the soybean crop quality parameters as measured in terms of protein, oil, sugar and carbohydrate noticed in balance fertilizer application over imbalance nutrient addition and sustainable productivity and quality of crop was attained when conjoint use of

chemical fertilizer continuously practiced along with organic manures in black soils of central India.

References

A.O.A.C. 1995. Association of Official Agriculture Chemists. Official Methods of analysis 12th Ed. Washington, D.C. USA.

Bachhav PR and Sable RN. 1996. Effect of different sources of nitrogen on growth parameters, yield and quality of soybean. Journal-Maharashtra Agricultural Universities 21: 244-246.

Deshmukh KK, Khatik SK and Dubey DP. 2005. Effect of integrated use of inorganic, organic and biofertilizers on production, nutrient availability and economic feasibility of soybean grown on soil of Kaymore plateau and Satpura hills. Journal of Soils and Crops 15 (1): 21-25.

Dwivedi AK and Dixit PR. 2002. Influence of long-term fertilizer use on productivity and nutrition on soybean and wheat. IInd International Agro Cong New Delhi. 354-356.

Dwivedi AK, Bapat PN and Tembhare BR. 1998. Secondary nutrient composition of soybean as influenced by sulphur and phosphorus nutrition. JNKVV. Res. J. 32 (102): 27-32.

Dwivedi AK, Singh M, Kauraw DL, Wanjari RH and Chauhan SS. 2007. Research bulletin on impact of fertilizer and manure use for three decades on crop productivity and sustainability and soil quality under Soybean-Wheat system on a Vertisol in central India. *IISS (ICAR), Bhopal*.

El-Essawal TM and Abadi D. 1990. Quality and yield of soybean seeds as affected of inoculation, NPK fertilization and soil fertility. Arid Land Research and Management 4(1): 43-51.

Ghosh PK, Ajay, Bandyopadhyay KK, Manna MC, Mandal KG, Mishra AK and Hati KM. 2004. Comparative effectiveness of cattle manure, poultry manure, phosphocompost and fertilizer-NPK on three cropping systems in Vertisols of semi-arid tropics. II. Dry matter yield, nodulation, chlorophyll content and enzyme activity. Bioresource Technology 95: 85-93.

Hyten DL, Pantalone VR, Sams CE, Saxton AM, Landau Ellis D, Stefaniak TR and Schmidt ME. 2004. Seed quality QTL in a prominent soybean population. Theo. App. Genetics. 10: 552-561.

Khajouei NG, Kazemi H, Alyari H, Javanshir A and Arvin MJ. 2004. Irrigation regimes and plant population density effects on seed yield, protein and oil con tent of three soybean cultivars. Turkish J. Field Crops. 9:62-71.

Liu K. 1997. Chemistry and nutritional value of soybean components. In Soybeans (pp. 25-113). Springer US.

Singh M, Wanjari RH, Dwivedi A and Dalal R. 2012. Yield Response to Applied Nutrients and Estimates of N_2 Fixation in 33 Year Old Soybean–Wheat Experiment on a Vertisol. Experimental Agriculture 48(3): 311-325

SOPA 2015. Soybean Processors Association of India.

Dwivedi AK and Dwivedi BS.2015.Impect of long term fertilizer management for sustainable soil health and crop productivity: Issues and chalanges. JNKVV Res. J. 49(3): 387-397

Suman j, BS Dwivedi, AK Dwivedi and SK Pandey Distribution of zinc pools as influenced by long-term application of fertilizers and manure in a Vertisol. Green farming.2017;8(5):1105-1110