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Economics and Production of Soybean-Safflower Cultivation Under Long-Term Fertilizer Experiment

N. A. Meshram[1]*, Syed Ismail[2], S. S. Pinjari[1] and D. N. Jagtap[1]

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra (India) 415712.
Vasantrao Naik Matathwada Agricultural University, Parbhani, Maharashtra (India) 431402.

Abstract

Long-term fertilizer experiments were conducted during 2012-2013 at Vasantrao Naik Marathwada Agricultural University, Parbhani (Maharashtra) on Vertisol. The present investigation was done after completion of 6th rotations of soybean-safflower sequence (2012) to evaluate the impact of long-term fertilization, manuring and their combinations for economical productivity of soybean and safflower. The experiment was laid out in randomized block design with twelve treatments replicated four times with a fix set of nutrient management practices viz., 50% NPK, 100% NPK, 150% NPK, 100% NPK + Hand weeding, 100% NPK + $ZnSO_4$ @ 25 kg ha^{-1}, 100% NP, 100% N, 100% NPK + FYM @ 5 Mg ha^{-1}, T_9 - 100% NPK-S, T_{10}- FYM @ 10 Mg ha^{-1}, T_{11}- Control, T_{12}- Fallow plot without crop.The findings emerged out indicated that conjoint use of FYM with 100% NPK significantly enhanced the economical superiority and yield of soybean and safflower under different treatments. Among the different applications, widely applying with 150% NPK was closely followed by 100% NPK + Zn and 100% NPK+FYM with respect to yield, GMR, NMR and B: C ratio. It can be concluded from these experiment that the balanced use of fertilizers continuously either alone or in combination with organic manures is necessary for sustaining more yield and higher economical gain.

Key words: GMR, NMR, B:C ratio, soybean, safflower

Corresponding author:
nandkishor.meshram@rediffmail.com
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Introduction

Oilseeds occupy a significant place in India's national economy, next only to food grains. Soybean is the third major oilseed crop next to groundnut and mustard. Soybean, a low input cost is getting place pride in agriculture across the edapho-environmental and socio-economical regimes due to its exemplary industrial and nutritional characteristics. Therefore, soybean has gain reputations among the different section in society including farmers. Among the annual oilseed, bulk increase in production during the last two decades is contributed mainly by soybean, safflower, sunflower, rapeseed and mustard. Safflower mostly grown as rainfed (85 % areas) crop on residual moisture, thereafter, type of soil and length of growing period are mostly crucial for successful production. Therefore, now a day's much attention has been given towards oilseed crop to meet the national demand. Area under oilseeds is not likely to go up in the future and production of oilseeds has to come mainly from the increase in the productivity. Balanced fertilization with NPK was proved beneficial in all the oilseed crops both under rainfed and irrigated conditions. However, some specific nutrients are required in more amounts for these crops. Conjunctive use of mineral fertilizers with organic and biological sources of plant nutrients, soil test and cropping system based nutrient management are key approaches to effectively utilize the nutrients for long term sustainability and higher oilseed productivity (Ghosh *et al.* 2002).

Materials and methods

Long-Term Fertilizer Experiment was started in 2006-07 at Research Farm (76°46' E longitude and 19°16' N latitude and an elevation of 408.46 m above the mean sea level) of Department of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Agricultural University, Parbhani, Maharashtra, India. The farm represented semiarid tropic region with the hot summers and mild winters and the annual maximum temperature

Table 1. Soybean and safflower gross monetary returns, net monetary return and benefit cost ratio as influenced by different nutrient management practices

Treatments details	Soybean grain yield (q ha^{-1})	Safflower grain yield (q ha^{-1})	Monetary return of soybean (₹ ha^{-1})			Monetary return of safflower (₹ ha^{-1})			Pooled B:C Ratio
			GMR	NMR	B:C ratio	GMR	NMR	B:C ratio	
T_1-50%NPK	24.34	15.05	45812.59	22652.59	1.98	33209.83	14630.83	1.79	1.88
T_2-100%NPK	26.77	17.28	50376.44	26206.44	2.08	38136.96	18718.96	1.96	2.02
T_3-150%NPK	28.20	19.32	53062.99	27882.99	2.11	42633.72	22376.72	2.10	2.11
T_4-100%NPK+HW	27.11	17.69	51025.73	26155.73	2.05	39036.31	19618.31	2.01	2.03
T_5-100%NPK+Zn	27.52	18.33	51787.94	27037.94	2.09	40448.79	21030.79	2.08	2.09
T_6-100%NP	25.66	16.29	48282.71	24344.71	2.02	35946.51	16528.51	1.85	1.93
T_7-100%N	13.23	11.66	24898.86	2384.86	1.11	25728.10	8260.10	1.47	1.29
T_8-100%NPK+FYM	28.32	18.87	53288.83	25918.83	1.95	41640.57	21383.57	2.06	2.00
T_9-100%NPK-S	25.91	15.91	48757.92	24594.92	2.02	35113.37	15656.37	1.80	1.91
T_{10}-FYM	20.63	14.81	38825.66	13825.66	1.55	32691.19	15051.19	1.85	1.70
T_{11}-Control	12.66	11.63	23821.42	1551.42	1.07	25661.89	8021.89	1.45	1.26
Mean	23.67	16.07	44540.10	20232.37	1.82	35477.02	16479.75	1.86	1.84
SE ±	1.34	1.00	2537.56	2537.56	0.11	2212.49	2212.49	0.12	0.09
CD at (P=0.05)	3.89	2.89	7329.00	7329.00	0.31	6390.14	6390.14	0.35	0.26

during study areas (2012), the maximum and minimum temperature varied between 29.1°C to 42°C and 9.2°C to 27.8°C. A total annual rainfall was 720.5 mm for 2012-13. The soil of the experimental site was Vertisol, particularly montmorillonitic, hyperthermic family of *Typic Haplustert*. The present experiment was framed in randomized block design (RBD) with twelve treatments and four replications in soybean-safflower cropping system. The treatment comprises viz. T_1–50% NPK, T_2–100% NPK, T_3–150% NPK, T_4–100 % NPK+Hand weeding, T_5–100% NPK+ $ZnSO_4$@ 25 kg ha^{-1}, T_6–100% NP, T–100% N, T_8–100% NPK+FYM@ 5 Mg ha^{-1}, T_9–100% NPK-Suphur, T_{10}–Only FYM@ 10 Mg ha^{-1}, T_{11}–Absolute control and T_{12}-Fallow. The crops soybean (cv. JS-335) and safflower (cv. PBNS-12) were raised during *kharif* (rainy) and *rabi* (post rainy) respectively with recommended package of practices. Soybean and safflower crops were sown with 45 to 5 cm and 45 to 10 cm spacing between row to row and plant to plant respectively. The 100% NPK was 30:60:30 kg ha^{-1} for soybean and 60:40:00 kg ha^{-1} for safflower respectively. The fertilizers used were urea, single super phosphate (SSP) and muriate of potash. FYM was applied before 15 days of sowing only for *kharif* (rainy) crop and NPK applied through straight fertilizers urea, single super phosphate and muriate of potash as per treatments, whereas in treatment (T_9) diammonium phosphate was used in place of single super phosphate (SSP) to avoid sulphur application. In T_4 treatment only two hand weeding were taken for weed control, without use of any weedicide. Inorganic fertilizers were applied as per recommended dose of fertilizer, micronutrients through chemical fertilizer ($ZnSO_4.5H_2O$) and FYM was incorporated @ 5 Mg ha^{-1} at sowing time in *kharif* (rainy) season only. All the economical measurements and calculations were determined with the help of standard economics method and formulae (Devasenapathy *et al.* 2008). The experimental statistical data was subjected to analysis of variances (ANOVA) and treatment means were compared, significant differences were tested at P = 0.05 using randomized block design (RBD) as described by Panse & Sukhatme (1985) using computer design MAUSTAT.

Results and Discussion

The effect of long term use of organic manuring and inorganic fertilization on economics of soybean-safflower cropping sequence under the study was worked out (Table 1) by considering the prevailing market prices of the input and output commodities, hire charges of tractor and labour wages etc. The monetary return of soybean was obtained significantly highest in treatment T_8 (₹ 53288.83 ha^{-1}) receiving 100% NPK + FYM @ 5 Mg ha^{-1} followed by treatments T_3 (₹ 53062.99 ha^{-1}) and T_5 (₹ 51787.94 ha^{-1}) treated with 150 % NPK and 100% NPK + $ZnSO_4$@ 25 kg ha^{-1}which were found to be at par with each other and also at par with T_2, T_4, T_6 and T_9. But NMR was noted significantly highest in treatment T_3 (₹ 27882.99 ha^{-1}) and at par with T_1, T_2, T_4, T_5, T_6, T_8 and T_9 and significantly superior over rest of all the treatments. Lowest GMR (₹ 23821.42 ha^{-1}) and NMR (₹ 1551.42 ha^{-1}) were noted in absolute control treatment T_{11}. However, in safflower GMR (₹ 42633.72 ha^{-1}) and NMR (₹ 22376.72 ha^{-1}) was significantly highest in treatment T_3 treated with 150% NPK on residual. GMR was found to be at par with treatment T_2, T_4, T_5, T_6 and T_8 except GMR of T_6 and significantly superior over rest of all the treatments. The lowest GMR and NMR were recorded in control treatment T_{11} (₹ 25661.89 ha^{-1}) and (₹ 8021.89 ha^{-1}).

Regarding B:C ratio of soybean, safflower as well as their pooled mean during the year of 2011-12, reveal the highest benefit cost ratio in treatment T_3 (2.11, 2.10 and 2.11) receiving 150% NPK followed by treatments T_5 (2.09, 2.08 and 2.09) and T_8 (1.95, 2.09 and 2.00) and these treatments were found to be at par with each other and in addition to this treatments T_1, T_2, T_4, T_6, T_9 and T_{10} except B :C ratio of soybean with respect of T_{10}, in safflower T_1 and pooled means T_{10} were at par with T_3. Among all treatments, the higher benefit cost ratio under soybean-safflower system was obtained with 150% NPK *i.e.* T_3 and found significantly beneficial as compared to all the treatments. Among all treatments the higher benefit cost ratio under soybean-safflower system was obtained with 150 % NPK which was found significantly beneficial as compared to all the treatments. According to the higher benefit cost ratio under soybean-safflower system was obtained with 150 % NPK and 100% NPK + FYM @ 5 Mg ha^{-1} and were found to be closely at par as compared to the other treatments resulted both the treatments are beneficial over rest of the treatments. Moreover, the conjunctive use of organic manures with chemical fertilizers for the substitution of 100% NPK was recorded significantly more grain yield of soybean and safflower as compared to chemical fertilizers treatments T_3 and T_5 *i.e.*150% NPK and100% NPK + $ZnSO_4$@ 25 kg ha^{-1} but it was closely followed by treatments T_3 and T_5 treated with 150% NPK and 100% NPK + $ZnSO_4$ @ 25 kg ha^{-1} which were found at par with each other. Our findings are in conformity with Meena *et al.* (2006), Jain and Sharma (2009), Nagaraju *et al.* (2009),

Tomar and Khajanji (2009) and Tomar (2011). Naik *et al.* (2012) also reported that organic manure to safflower had significant influence on the economics of safflower production and also application of 150% NPK recorded significantly higher gross returns, net returns, cost of cultivation and B:C ratio over 100% NPK, but was on par with 125% NPK in black clay loam soil. Recently, Singh and Kushwaha (2013) noted that the residual effect of organic manure and inorganic fertilizers which were used in previous soybean crop with 100% NPK to wheat has been given maximum net monetary returns (NMR) and B: C ratio residual effect of FYM @ 10 t ha^{-1} + 50 % NPK and direct effect of 100% NPK under soybean-wheat cropping sequence.

Conclusion

It can be concluded from the above finding that under continuous cropping with soybean-safflower system over 6^{th} years, applying 150% NPK was significantly superior over rest of the treatments with respect to grass monetary return, net monetary return, benefit cost ratio and productivity. Amongst different nutrient management supply systems, application of chemical fertilizers along with manure (i.e. 100% NPK+FYM) was also noted better option for cultivation.

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