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Economics of Safflower Cultivation under Different Sources and Levels of Sulfur

Divya V.U. , N. C. Sarkar

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ABSTRACT

A field experiment was carried out during *rabi* season of 2016-17 to study the economics of safflower cultivation under different sources and levels of sulfur. Experimental findings revealed that the use of different sources and levels of sulfur had significantly influenced seed yield, gross income (Rs), net income, return per rupee. Application of zinc sulfate recorded 33.2% and 14.4% more seed yield over single super phosphate and elemental sulfur respectively. On an average, highest (Rs 54,078) gross income, highest (Rs 45, 14.6) net income was observed with zinc sulfate treated plots over SSP and elemental sulfur. Application of zinc sulfate at all levels were at par with each other and application @ 40 kg S ha^{-1} resulted highest (Rs 60,866) gross income and highest (Rs 12,135) net income. Treatments significantly affected return per rupee (Rs). On an average, highest return per rupee (Rs 1.21) was observed with SSP treated plots. Among the different levels of sulfur applied by SSP, 40 kg S ha^{-1} reported highest (Rs 1.27) net return per rupee.

Keywords Sulfur, Safflower, Economics, Seed yield, Gross income.

Divya V. U*.
Department of Agronomy, Visva-Bharati University, West Bengal, India

N. C. Sarkar
Asst Professor, Department of Agronomy, Visva-Bharati University, West Bengal, India
email: divyaunnikrishnan53@gmail.com
*Corresponding author

INTRODUCTION

Though India has achieved a break through in production of food grains mainly through wheat and rice, it is yet to achieve self-sufficiency in the yield and production of oil seeds and pulses. Safflower is an important crop for dry land agriculture and has been under cultivation in India since ancient time both for oil and dye. Safflower plants are hardy in nature and have a capacity to withstand drought conditions hence it is grown successfully in rainfed condition (Knowles and Miller 1965). It is becoming popular among the farmers because of its drought tolerance, short duration, deep tap root system, cultivable on all types of soil, well adaptation to dry and saline land conditions and commercial value. Dense root structure can improve soil tilth and porosity. Roots also add to organic matter, improving soil water holding capacity. For oilseed crop producers, sulfur containing fertilizer is important because oilseed crops require more sulfur than cereals. Sulfur is very crucial for the formation of sulfur containing amino acids and oil synthesis (Gangadhara et al. 1990). It is a part of coenzyme A, pyrophosphates, vitamins such as biotin and thiamine. Its nutrition to crops is vital both from quality and quantity point of view. It lowers the HCN content of certain crops, promotes nodulation in legumes and produces heavier grains of oilseeds (Tandon 1986) seed production and oil content of seed were restricted only under severe sulfur deficiency (Coleman 1966). Hence, an attempt was made to study economics of safflower cultivation under different sources and levels of sulfur.

MATERIALS AND METHODS

The experiment was laid out in a Randomized Block Design. There were 10 treatments and each treatment was replicated thrice giving a total of 30 unit plots each measuring 3 m × 2 m. The treatments consisted of three different sources of sulfur (viz.,single super phosphate, elemental sulfur and zinc sulfate) and three levels of sulfur (20, 40 and 60 kg S ha^{-1}) and one control. Lime application was done to correct pH since the soil is acidic soil. The full dose of sulfur was applied from different sources of sulfur i.e. single super phosphate, zinc sulfate and elemental sulfur at 20, 40 and 60 kg S ha^{-1} at the time of sowing as per treatment combinations. The recommended dose of nitrogen, phosphorus and potassium were applied at the rate of 40:20:20:kg N, P_2O_5 and K_2O per hectare in the form of urea, di ammonium phosphate and muriate of potash after taking into consideration of the contribution of P_2O_5 from single super phosphate. Urea was given in two split doses. First dose was given at the time of sowing and second dose was given one month after sowing. The crop matured in 130 days. At the maturity period, the leaves were dried and turned to brown color and seed became hard which could be separated easily from the heads. This was taken as the sign of crop maturity. First border rows were harvested. Then the five randomly selected observation plants were harvested from the net plot. Finally, the net plot was harvested. Harvesting was carried out in the early hours of the day to prevent shattering of the grain.

The cost of cultivation was calculated for each treatment based on the cost of the inputs, while gross returns were obtained from market price of the produce during the season. The net returns acquired by deducting the cost of cultivation from gross returns. Finally the benefit cost ratio for each treatment was worked out. Market price of safflower seeds was Rs 30/kg.

Table 1. Seed yield of safflower under different sources and levels of sulfur.

Treatments	Seed yield (kg ha^{-1})
Control (no sulfur)	433.3
SSP @ 20 kg S ha^{-1}	523.3
SSP @ 40 kg S ha^{-1}	583.3
SSP @ 60 kg S ha^{-1}	536.7
Zinc sulfate @ 20 kg S ha^{-1}	646.7
Zinc sulfate @ 40 kg S ha^{-1}	836.7
Zinc sulfate @ 60 kg S ha^{-1}	706.7
Elemental sulfur @ 20 kg S ha^{-1}	566.7
Elemental sulfur @ 40 kg S ha^{-1}	680.0
Elemental sulfur @ 60 kg S ha^{-1}	666.7
SEm (±)	49.2
CD (p=0.05)	146.2

RESULTS AND DISCUSSION

On an average, highest (730 kg ha^{-1}) seed yield was reported with zinc sulfate treated plots over elemental sulfur and single super phosphate, respectively (Table 1). Among the different levels of sulfur applied by zinc sulfate 40 kg S ha^{-1} revealed highest (836.6 kg ha^{-1}) seed yield which was significantly more over zinc sulfate 20 kg S ha^{-1} but at par with 60 kg S ha^{-1}, respectively. Zinc sulfate @ 40 kg S ha^{-1} recorded 18.39% and 29.3% more yield over zinc sulfate @ 60 kg S ha^{-1} and 20 kg S ha^{-1}, respectively. Though the application of elemental sulfur at all levels were at par with each other, elemental sulfur @ 40 kg S ha^{-1} showed highest (680 kg ha^{-1}) seed yield and was producing 2% and 20% yield over 60 and 20 kg S ha^{-1}, respectively. Similar trend was followed in single super phosphate. Single super phosphate @ 40 kg S ha^{-1} resulted highest (583.3 kg ha^{-1}) seed yield which was 8.69% and 11.46% more over SSP @ 60 and 20 kg S ha^{-1}, respectively. Among all treatments 40 kg S ha^{-1} in the form of zinc sulfate significantly resulted highest (836. 7 kg ha^{-1}) seed yield. The result is in accordance with Rasool et al. (2013).

As we go to the economics, treatments signifi-

Table 2. Effect of different sources and levels of sulfur on cost of cultivation, gross income, net income, return per rupee of safflower.

Treatments	Cost of cultivation	Gross income	Net income	Return per rupee
Control (no sulfur)	31930	33233.33	1303.3	1.04
SSP @ 20 kg S ha^{-1}	33280	40333.33	7053.3	1.21
SSP @ 40 kg S ha^{-1}	35213	44833.33	9620.3	1.27
SSP @ 60 kg S ha^{-1}	37729	43366.67	5637.7	1.15
Zinc sulfate @ 20 kg S ha^{-1}	41980	49966.67	7986.7	1.19
Zinc sulfate @ 40 kg S ha^{-1}	48731	60866.67	12135.7	1.25
Zinc sulfate @ 60 kg S ha^{-1}	57982	51403.46	-6578.5	0.89
Elemental sulfur @ 20 kg S ha^{-1}	63482	45466.67	-18015.3	0.72
Elemental sulfur @ 40 kg S ha^{-1}	72715	52200.00	-20515.0	0.72
Elemental sulfur @ 60 kg S ha^{-1}	85681	52696.67	-32984.3	0.62
SEm (±)		3792.44	3792.4	0.100
CD (p=0.05)		11266.64	11266.6	1.04

Table 3. Common cost of cultivation.

Operation	Total cost (Rs ha^{-1})
Ploughing	Rs 2,500/ha
Lime application	Rs 200/ha
Irrigation (4 irrigations) (4 labores)	Rs 650/ha
Layout and fertilizer application (14 laborers)	
Planting (14 laborers)	Rs 350/ha
Herbicide application (4 laborers)	Rs 1,312/ha
Thinning, GAP filling, hand weeding, second dose of fertilizer application (12 laborers)	Rs 38/ha
Fungicide spray (4 laborers)	
Pesticide spray (2 laborers)	Rs 164/ha
Harvesting (14 laborers) Threshing 20 laborers)	
Land revenue	Rs 500/ha
Labor charge (Rs 200/day) (94 laborers)	Rs 18,800/ha
Total	Rs 26,464

cantly influenced gross income (Rs). On an average, highest (Rs 54,078) gross income was observed with zinc sulfate treated plots over SSP and elemental sulfur, respectively. Application of zinc sulfate at all levels were at par with each other and application @ 40 kg S ha^{-1} resulted highest (Rs 60,866) gross income. Among the different levels of sulfur applied by elemental sulfur @ 60 kg S ha^{-1} reported highest (Rs 52,696) gross income which was at par with elemental sulfur 40 kg S ha^{-1} and 20 kg S ha^{-1}, respectively. Though the application of SSP at all levels were at par with each other, SSP @ 40 kg S ha^{-1} showed highest (Rs 44,833) gross income over 60 and 20 kg S ha^{-1}, respectively. Among all zinc sulfate, resulted maximum (Rs 60,866) gross income.

The analysis recorded that the treatments significantly impacted net income (Rs). On an average, highest net income was observed with zinc sulfate (Rs 45, 14.6) treated plots over SSP and elemental sulfur, respectively. Application of zinc sulfate, 40 kg S ha^{-1} resulted highest (Rs 12,135) net income which was significantly more over 60 and at par with 20 kg S ha^{-1}, respectively (Table 2). Similar trend was followed in SSP. Among the different levels of sulfur applied by SSP, 40 kg S ha^{-1} reported highest (Rs 9,620) gross income which was at par with SSP @ 20 kg S ha^{-1} and significantly more over 60 kg S ha^{-1}. Application of elemental sulfur resulted negative net income i.e. economic loss. Among all treatments 40 kg S ha^{-1} in the form of zinc sulfate significantly resulted maximum (Rs 12,135.7) net income. Hedge (1998), Kumar (2009) also found similar result regarding levels of sulfur i.e. application of 40 kg S ha^{-1} resulted highest net income. The analysis reported that the treatments significantly affected return per rupee (Rs). On an average, highest return per rupee (Rs 1.21) was observed with SSP treated plots over zinc sulfate and elemental sulfur, respectively (Tables 3 and 4). This result agrees with the findings of Paslawar et al. (2012). Among the different levels of sulfur applied by SSP, 40 kg S ha^{-1} reported highest (Rs 1.27) net return per rupee which was at par with SSP @ 20 kg S ha^{-1} and 60 kg S ha^{-1}, respectively. Application of zinc sulfate, 40 kg S ha^{-1} (Rs 1.25) resulted highest return per rupee which was statistically non-significant with 20 and 60 kg S ha^{-1}, respectively. Though application of elemental sulfur at all levels were at par with each other, 20 and 40 kg S ha^{-1} resulted highest (Rs 0.72) return per rupee. Among all treatments 40 kg S ha^{-1} in the form of zinc sulfate significantly resulted highest (Rs 1.25) net return per rupee.

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Table 4. Cost of different treatments (Rs ha^{-1}).

Treatments	Urea	DAP	MOP	Zinc sulfate	Elemental sulfur	SSP	Total
T_1		Rs 5,200	Rs 466				Rs 5,666
T_2	Rs 300		Rs 466			Rs 583	Rs 1,350
T_3	Rs 300		Rs 466			Rs 1,166	Rs 1,933
T_4	Rs 300		Rs 466			Rs 2,332	Rs 2,516
T_5	Rs 245	Rs 1,040	Rs 466	Rs 2,500			Rs 4,251
T_6	Rs 245	Rs 1,040	Rs 466	Rs 5,000			Rs 6,751
T_7	Rs 245	Rs 1,040	Rs 466	Rs 7,500			Rs 9,251
T_8	Rs 245	Rs 1,040	Rs 466		Rs 3,733		Rs 5,500
T_9	Rs 245	Rs 1,040	Rs 466		Rs 7,466		Rs 9,233
T_{10}	Rs 245	Rs 1,040	Rs 466		Rs 11,200		Rs 12,966

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