Influence of Phosphorus and Sulphur Levels on Economics and Yield of Safflower (*Carthamus tinctorius* L.) Under the Eastern zone of UP, India

ABSTRACT

The present study highlights the influence of Phosphorus and Sulphur Levels on Economics and Yield of Safflower (*Carthamus tinctorius* L.): A Field Experiment yield of Safflower (*Carthamus tinctorius* L)". var. "*ISF-764*" was tested at Crop Research Farm during Rabi 2021–23. Ministry of Agriculture Sciences and technology United University, Prayagraj in the U.P. Safflower (Carthamus tinctorius L.) India ranks second in terms of planted area after food crops and is the world's fourth-largest producer of oilseeds in terms of output. The soil of the experimental plot had a sandy loam texture, was almost pH-neutral (7.5), had low organic carbon content (0.50%), and was readily available. N (228.59 kg/ha), available P (29.80 kg/ha) and available K (125.21 kg/ha). The experiment was laid out in randomized block design with nine treatments consists three level of S 20,30,40 kg/ha and three level of P 30,40,50 kg/ha with control (Farmer practice) were replicated thrice. Results obtained that higher plant height (173.33 cm), Number of branches (19.27), dry weight (117.89 g/day), yield attributes and yield *viz.*, seed yield (2.20 t/ha), stover yield (2.98 t/ha) and Hi (42.44 %) were recorded with the application of 40 kg/ha S + 50 kg/ha P, economics *viz.* however, higher gross return (113804.07 INR/ha), net return (77799.97 INR/ha) and B:C ratio (2.16) was observed when 40 kg/ha S and 50 kg/ha P were applied. Application of 40 kg/ha S with 50 kg/ha P was therefore more productive and financially viable. It is concluded that treatment T9 with application of S 40 kg/ha + P 50 kg/ha was found to be the best that recorded highest plant height, number of capitulam / plant , dry weight (g), panicle length, number of panicles, number of grains per panicle, seed yield, straw yield, test weight and harvest index.

Key words: Safflower, Sulphur (S), Phosphorus (P),Growth, yield.

INTRODUCTON

“Safflower (*Carthamus tinctorius* L.) is herbaceous annual broad-leaved plant belong to the family *Asteraceae*. It is native to parts of Asia, Middle East and Africa. It was grown mainly for its flowers, which were used in making dyes for clothing and food, but today, it is grown mainly for its oil. It grows well in both dry land and irrigated areas and is a drought-tolerant plant. Safflower has become a more significant oilseed crop in recent years, particularly with the growing interest in biofuel production. Safflower's direct yield factors include the number of plants per plot, the number of heads per plant, the quantity of seeds in each head, and the weight of the seeds. Numerous variables, like as genetics, climatic circumstances, and cultural practises, influence the relative relevance of each yield component”. **Nathan*et al.*,(2017).** “One of the essential ingredients in diet, vegetable oil serves vital purposes for human health and nutritional physiology. Safflower (*Carthamus tinctorius* L.) India ranks second in terms of planted area after food crops and is the world's fourth-largest producer of oilseeds in terms of output. In terms of both acreage and global safflower production, India leads the pack. In India, 1.453 lakh tonnes of safflower are produced annually on an area of 1,78,400 hectares, with a productivity of 498 kg ha-1. The crop is primarily farmed in Gujarat, Andhra Pradesh, Maharashtra, and Karnataka in India. Safflower is produced on 10,000 hectares in Andhra Pradesh, with an estimated 7000 tonnes of production and 600 kg ha-1 of productivity; yield levels of safflower in India are extremely low when compared to global productivity (878 kg ha-1)”. **(FAO, 2021).** “The cultivation of safflower crop under rainfed condition and poor crop nutrition are the major reasons for low productivity. The seeds contain 35-50% oil, 15-20% protein and 35-45% hull fraction safflower can also be grown successfully on soil with poor fertility and in areas with relatively low temperatures”. **Nathan*et al.* (2017)**

“Because it affects protein metabolism, oil production, and the synthesis of amino acids, sulphur is regarded as a high-quality nutrient whose application not only affects crop productivity but also enhances crop quality. It is a component of the three amino acids that make up protein: methionin (21% S), cysteine (26% S), and cysteine (27% S). These amino acids include about 90 percent of the sulphur found in plants. Moreover, sulphur contributes to the synthesis of glucosides, glucosinolates, and chlorophyll. (mustard oils), Phosphorus retention in vertisols is difficult while in Alfisol and Oxisols, it occurs due to the presence of anhydrous sesquioxides and organic matter. Mineralization of organic matter releases the sulphur in the available form to

the plant" **(Murthy, 2011).** "Plants absorb sulphur mostly through roots in the form of sulphate (SO_4-) and to a much lesser extent from atmosphere in gaseous form (SO_2)" **(Tondon, 1995).**

Materials and Methods

A field experiment was conducted during *Ravi* 2023 at Agricultural Research Farm of United University, Rawatpur, Jhalwa, Prayagraj (U.P.), India to study the impact of Influence of Phosphorus and Sulphur Levels on Economics and Yield of Safflower (*Carthamus tinctorius* L.) under integrated approaches of nutrients. The experiment as laid out in randomized block design with three replications. The experiment was comprised of ten treatment *viz*., T_{10} Control, T_1: S 20 kg/ha + P 30 kg/ha , T_2: S 20 kg/ha + P 40 kg/ha, T_3: S 20 kg/ha + P 50 kg/ha, T_4: S 30 kg/ha + P 30 kg/ha, T_5: S 30 kg/ha + P 40 kg/ha, T_6: S 30 kg/ha + P 50 kg/ha, T_7: S 40 kg/ha + P 30 kg/ha, T_8: S 40 kg/ha + P 40 kg/ha, T_9: S 40 kg/ha + P 50 kg/ha Safflower Variety *ISF-764* was sown after pre-sowing irrigation using 20 kg ha^{-1} seed rate. A basal dose of 40 kg N, 40 kg P_2O_5, 20 kg K was applied per hectare asrecommended fertilizer dosage. Before sowing, FYM was administered to the field according to the treatment instructions and blended with the soil. Accordingly, the data gathered for each character was subjected to statistical analysis using the "Analysis of Variance" technique. As recommended by the "F" test of significance at the 5% level of significance, overall differences were evaluated. **Cochran and Cox (**1957**).** Critical differences at a 5% level of probability were calculated for treatment comparison.

Results and Discussion

Grain yield (kg/ha)

Significantly higher grain yield was observed in T_9 (Sulphur 40 kg/ha + Phosphorus 50kg/ha) (2.10 t/ha). However, (2.1 t/ha) T_8 (Sulphur 40 kg/ha + Phosphorus 40 kg/ha) and(1.93 t/ha) was recorded in T_7 (Sulphur 40 kg/ha + Phosphorus 30 kg/ha) which were statistically atpar with treatment 9 (Sulphur 40 kg/ha + Phosphorus 50 kg/ha).

Stover yield (kg/ha)

"Significantly higher stover yield was observed in T_9 (sulphur 40 kg/ha + phosphorus 50kg/ha) (3.62 t/ha). however, (3.48 t/ha) T_8 (sulphur 30 kg/ha + phosphorus 50 kg/ha) and(3.47 t/ha) was recorded in T_7 (sulphur 40 kg/ha + phosphorus 30 kg/ha) which were statistically atpar

with sulphur 40 kg/ha + phosphorus 50 kg/ha increase in stover yield was due to increase in plant height, branches/plant and may be to provide vital nutrients and minerals. balanced quantity, which improved plant growth and development". by **Nathan *et al*., (2017).**

Harvest index (%)

"Significantly higher harvest index was observed in T_9 (Sulphur 40 kg/ha + Phosphorus50 kg/ha) (36.73 %). However, (36.52 %) T_8 (Sulphur 20 kg/ha + Phosphorus 40 kg/ha), (35.72 %) T_7 (Sulphur 40 kg/ha + Phosphorus 30 kg/ha).Which were statistically at par with Sulphur 40 kg/ha + Phosphorus 50kg/ha". [11]

Cost of cultivation (INR/ha)

The maximum cost of cultivation (INR/ha) was observed in T8 (40 kg/haSulphur + 40 kg/ha Phosphorus) and the significantly higher cost of cultivation (INR/ha) was observedin T9 (40 kg/ha Sulphur + 50 kg/ha Phosphorus).

Gross returns (INR/ha)

The maximum gross returns (INR/ha) were observed in T8 (40 kg/haSulphur + 40 kg/ha Phosphorus) and the significantly higher gross returns (INR/ha) was observed in T9(40 kg/ha Sulphur + 50 kg/ha Phosphorus).

Net returns (INR/ha)

The maximum net returns (INR/ha) were observed in T8 (40 kg/ha Sulphur + 40 kg/haPhosphorus) and the significantly higher net returns (INR/ha) was observed in T9 (40 kg/ha Sulphur + 50kg/ha Phosphorus).

B: C Ratio

The maximum B:C ratio was (2.10) observed in T8 (40 kg/ha Sulphur + 40 kg/ha Phosphorus) and thesignificantly higher B:C Ratio was (2.16) observed in T9 40 kg/ha Sulphur + 50 kg/ha Phosphorus**.**

Conclusions

It is concluded that treatment T_9 with application of S 40 kg/ha + P 50 kg/ha was found to

be the best that recorded highest plant height, number of capitulam / plant , dry weight (g), panicle length, number of panicles, number of grains per panicle, seed yield, straw yield, test weight and harvest index.

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Table 1. Effect of sulphur and phosphorus levels on yield attribute and yield of safflower.

T.No.	Treatment combination	Grain yield(t/ha)	Stover yield(t/ha)	Harvestindex (%)
T_1	S 20 kg/ha + P 30 kg/ha	1.63	2.50	39.42
T_2	S 20 kg/ha + P 40 kg/ha	1.67	2.52	39.80
T_3	S 20 kg/ha + P 50 kg/ha	1.70	2.57	39.88
T_4	S 30 kg/ha + P 30 kg/ha	1.75	2.62	39.99
T_5	S 30 kg/ha + P 40 kg/ha	1.79	2.66	40.24
T_6	S 30 kg/ha + P 50 kg/ha	1.88	2.70	40.95
T_7	S 40 kg/ha + P 30 kg/ha	2.08	2.83	42.22
T_8	S 40 kg/ha + P 40 kg/ha	2.13	2.97	41.79
T_9	S 40 kg/ha + P 50 kg/ha	2.20	2.98	42.44
T_{10}	Control	1.40	2.43	36.72
F- test		S	S	NS
SEm±		0.083	0.103	1.31
CD (p = 0.05%)		0.246	0.306	3.89

Table 2. Influence of sulphur and phosphorus levels of safflower

Treatment. No.	Treatment combinations	Cost of cultivation (INR/ha)	Grossreturns (INR/ha)	Net returns (INR/ha)	B:C ratio
T_1	S 20 kg/ha + P 30 kg/ha	33533.66	84352.40	50818.74	1.52
T_2	S 20 kg/ha + P 40 kg/ha	34098.90	86462.13	52363.23	1.54
T_3	S 20 kg/ha + P 50 kg/ha	34670.90	88245.87	53574.97	1.55
T_4	S 30 kg/ha + P 30 kg/ha	34200.26	90716.27	56516.01	1.65
T_5	S 30 kg/ha + P 40 kg/ha	34765.50	92822.13	58056.63	1.67
T_6	S 30 kg/ha + P 50 kg/ha	35337.50	97039.70	61702.20	1.75
T_7	S 40 kg/ha + P 30 kg/ha	34866.86	107380.47	72513.61	2.08
T_8	S 40 kg/ha + P 40 kg/ha	35432.10	109916.57	74484.47	2.10
T_9	S 40 kg/ha + P 50 kg/ha	36004.10	113804.07	77799.97	2.16
T_{10}	Control	29905.00	72716.03	42811.03	1.43

Fig. No.: 1 Influence of phosphorus and Sulphur levels Grain yield and Stover yield of safflower.

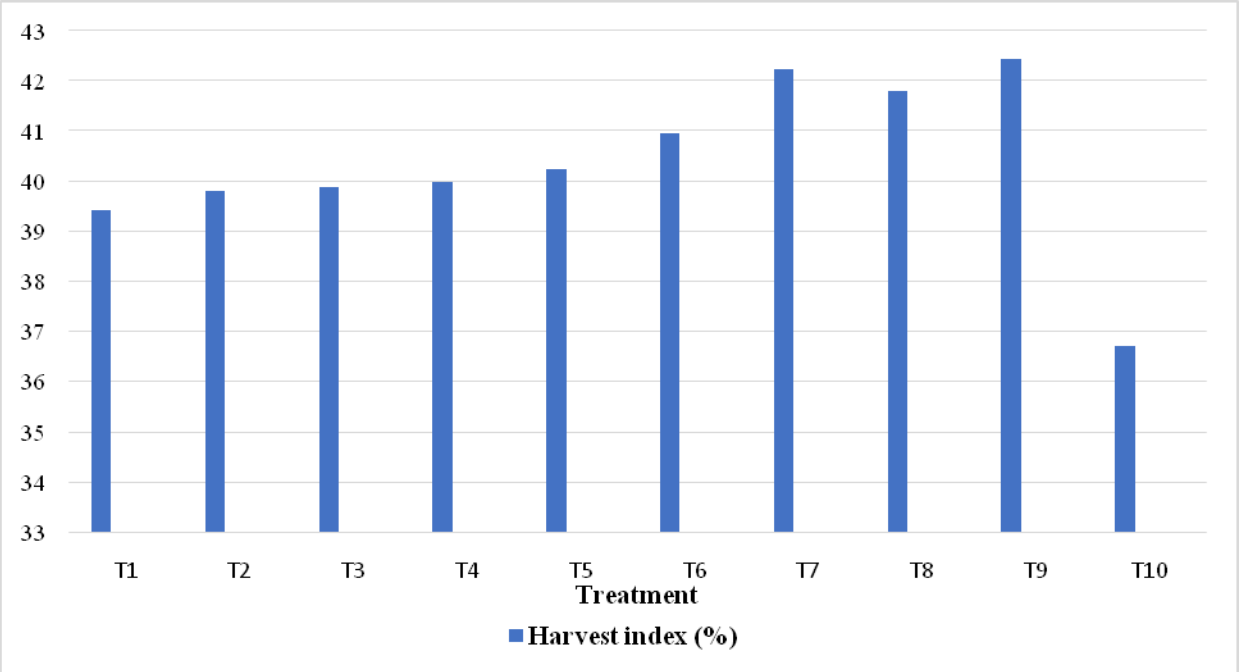

Fig. No.: 2. Influence of phosphorus and Sulphur levels on Harvest index of safflower.

Fig. No.: 3 Initial stage

Fig. No.:4 Starting observation

Fig. No.:5 Mid observation

Fig. No.:6 With observation board

Fig. No.:7 Final observation