"To work out the economics of various treatment combinations calculate economics of sulphur and zinc under linseed (*Linum usitatissimum*) Crop."

Comment [K1]: Use appropriate title

ABSTRACT

A study was conducted ~~on To~~to work out the economics of various treatment combinations calculates the economics of sulphur and zinc under linseed (*Linum usitatissimum*) Crop, to calculate economics of sulphur and zinc. For the present study factorial randomized block design~~ed~~ was used keeping three replications. Among the S and Zn level treatments performed the best with the highest grain productivity up to 19.84 q ha^{-1}, net return up to Rs. 77360 ha^{-1}. Treatment interactions were found to be non-significant in ~~case of~~ grain yield – However, the combined application of S and Zn level treatments with dual further raised all these parameters synergistically according to their combined role. Economy in the uses of phosphatic fertilizers may be done with application S and Zn level treatments. The total availability of nutrients i.e. nitrogen, phosphorus and potassium per hectare were also increased in all these treatments with suggests that soil must be recouped every year with NPK nutrients with a minimum level on soil test values and the nature of the crop to be grown. This would maintain the nutrient~~s~~ balance in the soil to ensure sustainable crop production per unit area.

Comment [K2]: Which level is economic and effective? Please complete the results

Key words – linseed, cost of cultivation, sulfur, zinc net return B:C ratio

Introduction

Flax-seed (*Linum usitatissimum* L.) is an annual, self-pollinating, diploid (2n=30) species belonging to the family Linaceae and is the only species in the family, which is of economic importance contains 33-45% non -edible oil and 24% crude protein. The oilcake left after the oil is pressed out is a most valuable feeding cake for the cattle feed. The protein in flax seed is about 36% linseed used for increasing milk and fat in animals. Its cake is also used as manure. It contains about 5 per-cent nitrogen. 1.4 percent phosphorus and 1.8 per-cent potash. The use of sulphur is one of the most important factors in increasing yields. It is well known that amino acids, fat parentage,

protein content ~~in is~~ are increasing by application of sulphur in linseed crops by ~~many~~ much Balanced use of sulphur commensurate with crop needs and soil nutrient status is indispensable for sustained production of high yield level. Experimental evidences indicate that sulphur is the most essential plant nutrient which is generally lacking in Indian soils. To fulfill the necessities for sulphur nutrient, it is necessary to supply these to the ~~hungry~~ poor soil ~~in~~ is concentrated and readily available from i.e. fertilizers. It is also essential to know the optimum level of sulphur. Though many workers have worked on this aspect ~~but~~ the requirement of sulphur ~~vary~~ varies from soil to soil and place to place. Even agro-climatic conditions have a great ~~influence~~ effect on the sulphur requirement of crops. Zinc is trace element~~s~~ ~~hence~~ used in a very small amount. Zinc has a specific vital role in the growth ~~development~~ development ~~-~~and quality of crops. It also plays an important role in biosynthesis of proteins and amino acids in crop plants. It is a component of important enzymes such as dehydrogenises and proteinases etc. Flax seed~~s~~ ~~is~~ important is oil crop which contributes a significant role in oil production. The whole plants of the linseed are useful. The straw of the linseed ~~have~~ has ~~the~~ economic value. On a very small scale, the seed is directly used for edible purposes, and about 20 percent of the total oil produced is used by farmers. About 80 percent of the oil goes to industries for the manufacture of paints, varnish, oilcloth, linoleum, pad-ink, printing ink, etc. The fiber of linseed is having excellent quality and blends in many types for making cloths. It is grown predominantly in the states of Madhya Pradesh, Maharashtra, Chhattisgarh, Uttar Pradesh, Bihar, Orissa, and Jharkhand, besides other states on a limited scale. The state of Madhya Pradesh grows linseed on the largest area of 1.02 lakh hectares in the country and produces 0.53 lakh tones seed with 520 kg/ha productivity level. The productivity level of linseed in the country and also in the state of Madhya Pradesh is very low as compared to the production potential as realized in the frontline demonstrations. There is sufficient scope of increasing the productivity level of linseed even under the rainfed condition~~s~~ with proper management practices and optimum use of balanced fertilizers.

Research methodology

The present study entitled **"Studies on the Effect of Sulphur and Zinc fertilization to linseed (*Linum usitatissimum*) under rainfed condition"** was carried out during rabi 2015-16 and 2016-17. The experiment was conducted at

Rajoula Agriculture farm of Mahatma Gandhi Chitrakoot Gramodaya Vishwavidyalaya, Chitrakoot Satna (M.P.). This farm is situated in Bundelkhand Zone of northern Madhya Pradesh. There were 16 treatment combinations of 4-levels of sulphur applied through granulargrainular sulphur powder (90%S) and 4-levels of Zinc applied through Zinc Cloride (50% Zinc). The treatments comprised four Sulphur levels (0, 15, 30 and 45 kg ha^{-1}) and four treatments of Zinc (0, 2.5, 5 and 7.5 Kg ha^{-1}). Nitrogen, phosphorus and potash were applied @ 30 kg N + 15 kg P2O5 + 15 kg K2O/ha in all treatment plots uniformly through UREA, DAP and MOP fertilizers, respectively. All fertilizers were applied as basal placement at sowing with the help of funnel attached country plowplough used for sowing. Sulphur as per treatment was applied through though granular powder 'sulfex' (90% S) along with NPK fertilizers. Zinc was applied through the application of Zinc Chloride Cloride (50% Zn) as per treatment. Recommendation and adoption of any practices by cultivators depends upon the economical grain per hectare from Linseed. Therefore, it becomes essential to work out economics of the different treatments for getting higher net profit (Rs ha^{-1}). Thus, the sixteen treatment combinations were laid out in the field in a factorial randomized block design keeping with three replications. **Panse, U.G. and Sukhatme, P.V. (1957)**. Linseed ver. JS-26 was sown @ 30 kg seed ha^{-1} the details of treatment are given below.

Comment [K3]: Explain about statistical method and analysis of Variance (ANOVA)

Economics of the Treatments of Economics

Cost of Cultivation

The expenditure in earned under for different treatments was calculated on the basis of the prevailing market rate of fertilizer, field preparations, sowing of seeds, labour charges, cultural and intercultural operations, etc.

Gross Return: For different treatments, gross returns were calculated on the basis of prevailing market rate of produce.

Net Profit: It was calculated treatment -wise. The total cost of cultivation per hectare

Economics of the Treatments : Recommendation and adoption of any practices by cultivators depends upon the economical grain per hectare from Linseed. Therefore, it becomes essential to work out the economics of the different treatments for getting a higher net profit (Rs ha^{-1}).

Cost of Cultivation: The expenditure in earned under for different treatments was calculated on the basis of prevailing market rate of fertilizer, field preparations, sowing of seeds, labour charges, cultural and intercultural operations etc.

Gross Return: For different treatments, gross returns were calculated on the basis of prevailing market rate of produce.

Net Profit: It was calculated treatment wise. The total cost of cultivation per hectare was subtracted from the gross income for computing net returns from each treatment.

$$\text{Net profit (Rs ha}^{-1}\text{)} = \text{Gross return (Rs ha}^{-1}\text{)} - \text{Cost of cultivation (Rs ha}^{-1}\text{)}$$

Benefits Cost Ratio (BCR): It was calculated treatment wise. The gross income per hectare of each treatment was divided by the cost of cultivation of respective treatments.

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Gross return}}{\text{Cost of cultivation}}$$

Results -

Net Return per hectare: The two years pooled data for economic gain Net return Rs. per hectare worked out under different treatments are furnished in the table (4.26) their mean sum square have been placed in are also depicted .The two years pooled data economic gain Net return Rs. per hectare significantly due to two applications of sulphur received from 18078 to 17987 Rs./ha the significant~~ly~~ economic gain Net return Rs. per hectare were recorded with the application of sulphur @ 30 Kg/ha (18059) followed by sulphur @ 45 Kg/ha (18078) and significantly lowest were observed under sulphur control treatments(16455 Rs./ha)

The two-year pooled data estimate interaction so as received economic gain net return Rs. per hectare due to the interactive effect of both elements at the stage. At initial ranged from 17646 to 18228 Rs/ha however the combination of Zn @ 7.5 Kg/ha + sulphur@ 30 Kg/ha recorded second highest received economic gain net return Rs. per hectare (18059Rs/ha).

Benefit-: Cost Ratio (B:C Ratio)

The two years pooled data for economic gain benefit-cost ratio worked out under different treatments are furnished in the table (1) their mean sum square ~~have~~ has been placed in are also depicted in (Fig.no.1).

The two years pooled data economic gain ~~benefit~~ benefit-cost ratio significantly due to two applications of sulphur received from 1.30 to 1.65 Rs./ha the significantly economic gain benefit cost ratio were recorded with the application of sulphur @ 30 Kg/ha (1.40) the followed by sulphur @ 45 Kg/ha (1.63) were as significantly lowest were recorded under treatments sulphur control (1.17 Rs./ha)

The ~~two~~ two-year pooled data estimate interaction (table no.1-) so as received economic gain benefit cost ratio due to interactive effect of both elements at the stage. At initial ranged from 1.30 to 1.65 however the combination of Zn @ 7.5 Kg/ha + sulphur@ 30 Kg/ha recorded second highest received economic gain ~~benefit~~ benefit-cost ratio is (1.58).

Comment [K4]: Need to be revised

Table-1: Economical grain (Rs ha^{-1}) from different treatments and their interaction (Pooled for 2 years)

Zinc	Economic gain				Mean
	S_0	S_{15}	S_{30}	S_{45}	
Net income (Rs ha^{-1})					
Control	16820	16755	16455	16540	16643
$Zn_{2.5}$	17970	18228	17950	17987	18034
Zn_5	17895	18025	17985	18023	17982
$Zn_{7.5}$	17898	17986	18059	18078	18005
Mean	17646	17749	17612	17657	17666
B:C ratio					
Control	1.17	1.15	1.22	1.04	1.15
$Zn_{2.5}$	1.41	1.30	1.65	1.44	1.45
Zn_5	1.26	1.35	1.34	1.33	1.32
$Zn_{7.5}$	1.35	1.39	1.58	1.63	1.49
Mean	1.30	1.30	1.45	1.36	1.35

Comment [K5]: Need to be the comparison of means

Economic Gain

Net Return per hectare

The two years pooled data economic gain Net return Rs. per hectare significantly due to two applications of sulphur received from 18078 to 17987 Rs. /ha the significantly economic gain Net return Rs. per hectare were recorded with the application of sulphur @ 30 Kg/ha (18059) followed by sulphur @ 45 Kg/ha (18078) where as significantly lowest were observed under treatments sulphur control (16455 Rs./ha)

The two year pooled data estimate interaction Table (1) so as received economic gain net return Rs. per hectare due to interactive effect of both elements at stage. At initial ranged from 17646 to 18228 Rs/ha however the combination of Zn @ 7.5 Kg/ha + sulphur@ 30 Kg/ha recorded second highest received economic gain net return Rs. per hectare (18059 Rs/ha).

Benefit : Cost Ratio (B:C Ratio)

The ~~two~~ two-years pooled data economic gain benefit cost ratio significantly due two application of sulphur received from 1.30 to 1.65 Rs./ha the significantly economic gain benefit cost ratio were recorded with application of sulphur @ 30 Kg/ha (1.40) the followed by sulphur @ 45 Kg/ha (1.63) were as significantly lowest were observed under treatments sulphur control (1.17 Rs./ha)

The two year pooled data estimate interaction table (1) so as received economic gain benefit cost ratio due to interactive effect of both elements. At initial ranged from 1.30 to 1.65 however the combination of Zn @ 7.5 Kg/ha + sulphur@ 30 Kg/ha recorded second highest received economic gain benefit cost ratio is (1.58).

CONCLUSION

The crop of linseed (*Linum usitatissimum*) had been an important crop for industrial oil in India. It is mainly grown under rainfed situations with lesser inputs, thus the average yield is poor. Research efforts have been made to increase its productivity. As a result, improved varieties were developed and agronomic packages of practices ~~ware~~ were standardized for different areas of linseed growing. Among

such practices, proper nutrition of crop is most important. In this respect, linseed growers may be made up to this very dose. The grain productivity was 10.52 q ha^{-1} with ~~the~~ a net return of up to Rs. 77305 ha^{-1} with the application of S level treatments Application of Zn level treatments was not found economical up to a desirable extent. Among the S and Zn level treatments performed the best with the highest grain productivity up to 19.84 q ha^{-1}, net return up to Rs. 77360 ha^{-1}. Treatment interactions were found to be non-significant in ~~case of~~ grain yield – However, the combined application of S and Zn level treatments with dual further raised all these parameters synergistically according to their combined role. Economy in the uses of phosphatic fertilizers may be done with application S and Zn level treatments. The total availability of nutrients i.e. nitrogen, phosphorus and potassium per hectare were also increased in all these treatments with suggests that soil must be recouped every year with NPK nutrients with a minimum level on soil test values and the nature of the crop to be grown. This would maintain the nutrient~~s~~ balance in the soil to ensure sustainable crop production per unit area.

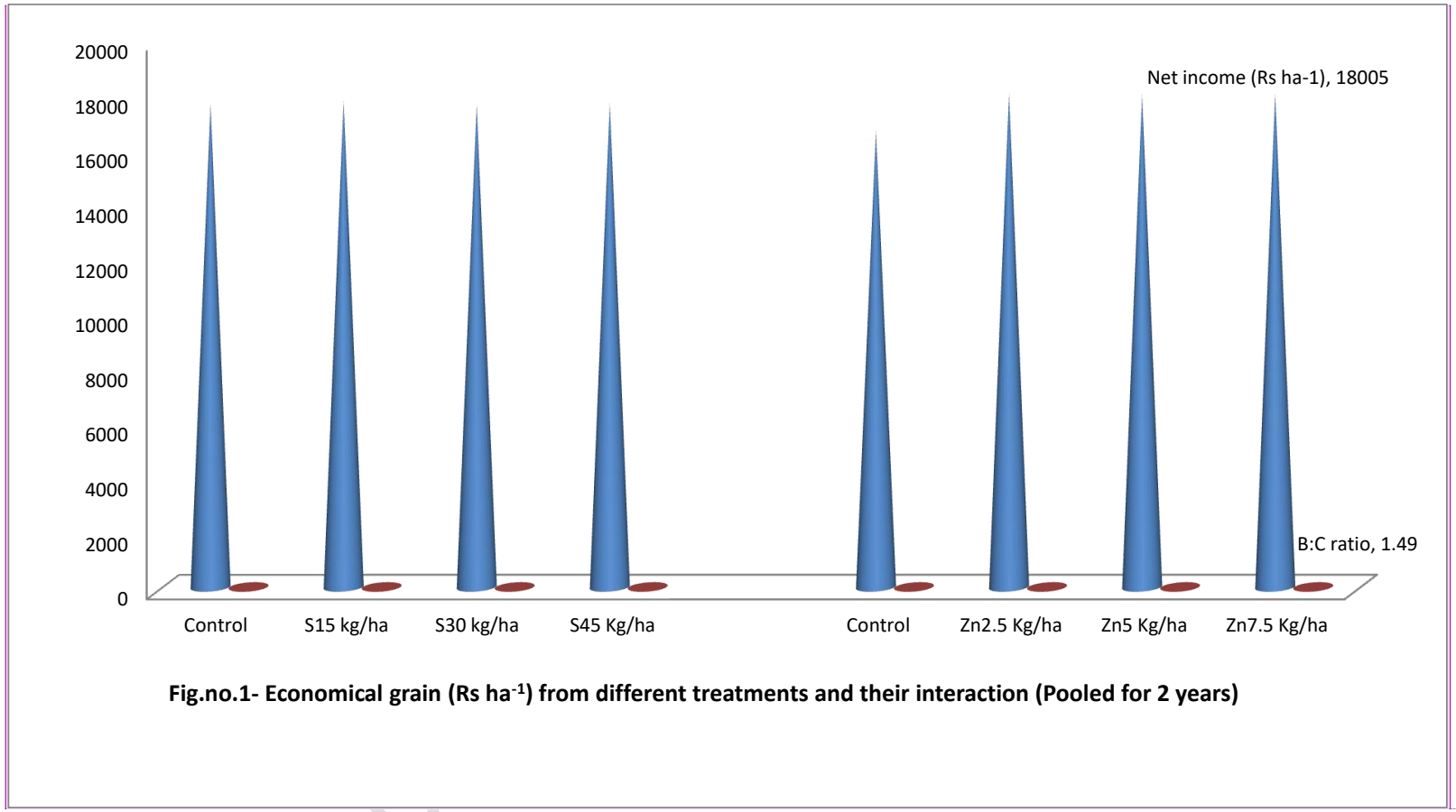

Fig.no.1- Economical grain (Rs ha^{-1}) from different treatments and their interaction (Pooled for 2 years)

Comment [K6]: Please add Error Bar in treatments

References

Chandel, S.R.S. (1991). A Handbook of Agricultural Statistics. Achal Prakashan Mandir, 117/574 Pandu Nagar, Kanpur. pp 1-213.

Deshmukh, M.R., Duhoon, S.S. and Alok Jyotishi, (2010). Effect of sources and levels of sulphur on seed yield, oil content and economics of sesame (Sesamum indicum L.) in Kymore plateau zone of Madhya Pradesh (India). Journal of Oilseeds Research 27(1) : 34 – 35

Elizabeth W. Murph Patricia E. Criner, and Brucy C. Gray Comparisons of methods for calculating retentions of nutrients in cooked foods Journal of Agricultural and Food Chemistry 1975, 23, 6, 1153-1157

Jimo, H., and R., Singh (2017). Effect of sources and doses of Sulphur on yield attributes, yield and quality of Linseed (*Linum usitatissimum* L.). *Journal of Pharmacognosy and Phytochemistry*, 6(**4**): 613-615.

Khare, J.P., Sharma, R.S. and Soni, N.K. (1996). Effect of sulphur and antitranspirants on yield attributed, yield and nutrient uptake in rainfed linseed (Linum usitatisssimum L.). Journal of oilseeds Research 13 (2) : 182-186.

P. K. Singh and Pankaj Chopra (2018) Double purpose linseed: a viable option for doubling farmers' income in the north-western Himalayan region Indian Farming 68(01): 49–54; January 2018

Panse, U.G. and Sukhatme, P.V. (1957). Factorial Experiments. Statistical Methods for Agriculture Workers, I.C.A.R., New Delhi. Pp. 166-174.

Sarawagi, S. K., Singh, A. P. and Purohit, K. K. (2005). Effect of phosphorus on nodulation, uptake and economics of soybean varieties in Vertisols. Ann. Pl. Soil Res. 7(2) : 165-168.