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Growth, Seed Yield and Oil Content Response of Canola (*Brassica napus* L.) to Varying Levels of Sulphur

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ABSTRACT

Studies were carried out to assess the influence of different levels of sulphur fertilization (0, 25, 50, 75, 100, 125 & 150 kg ha^{-1}). The experiment was laid out in randomized complete block design with three replications and a net plot size of 1.8m x 5m. Data on various growth and yield parameters of canola were recorded using the standard procedures. The results revealed that the highest seed yield (3725 kg ha^{-1}) was obtained in T_4 with 100 kg ha^{-1} S which was however, at par with treatment where 125 kg S ha^{-1} was applied. While minimum seed yield (2870 kg ha^{-1}) was recorded in case of control i.e. with no S. Oil content progressively increased with increase of S level with highest (45.10%) with a S level of 150 kg ha^{-1}. But a perusal of economic analysis showed that T_4 i.e. application of 100 kg ha^{-1} would be more economical than all other treatments.

Key Words: Canola; Oil contents; *Brassica napus* L.; Sulphur; Fertilizer

INTRODUCTION

Edible oil is one of the basic requirement of our daily diet. Pakistan is suffering from acute deficiency in edible oil because of its increased consumption. The domestic edible oil production from all sources has grown @ 2.56% annually over the last decades while the annual consumption rate has increased by 9%. During 2001-02 the total consumption was 2.0 million tons and the local production was 0.582 million tons which was 29% of the domestic consumption while the remaining 71% was met through imports (Anonymous, 2002).

The non-true oilseed crops like cotton, maize, etc. are contributing upto 73% towards the national edible oil production in the country. Whereas, the conventional oilseeds (rapeseed and mustards) rank second and contribute about 18-20% in the domestic edible oil production. Rapeseed and mustard, the conventional oil seed crops, impose health concerns because of the presence of erucic acid and glucosinolate contents.

Introduction of canola (*Brassica napus* L) in Pakistan has shown success at many places. It is low in erucic acid and glucosinolate and hence is a suitable cooking oil. During 2001-02 area under canola was 118000 acres with an oil seed production of 59000 tonnes. (Anonymous, 2002). Canola oil has a lower level of saturated fats (only 6%) than any other edible vegetable oil and also has a high proportion of unsaturated fat containing a favorable mix of both mono- and polyunsaturated fats. Canola has the potential to bridge up the gap between the domestic demand and supply due to its higher oil and protein contents i.e. 42-45 and 20-23%, respectively.

Among many agronomic factors responsible for low yield, imbalanced and injudicious use of fertilizers also limits the crop production. Sulphur has been reported to influence productivity of oil seeds (Singh *et al*., 1999). Similarly, Biswas *et al.* (1995) reported that application of S fertilizer increased the seed yield of gobhi sarson cv.ISN-706. Keeping this in view the present studies were carried out to assess the response of canola crop to different levels of sulphur.

MATERIALS AND METHODS

Studies on the influence of different S levels on the growth, seed yield and oil contents of canola cv. ZAFAR-2000 were conducted at the Agronomic Research Area; University of Agriculture Faisalabad during 2002-2003. The experiment comprised of the following treatments as 0 ,25, 50,75,100,125 and150 kg ha^{-1} S.

The experiment was laid out in randomized complete block design (RCBD) with three replications and a net plot size of 1.8m x 5m. The crop was sown in the Ist week of October using seed rate of 5 kg ha^{-1} in 30 cm apart rows with a single row hand drill. Soil samples were taken before sowing of crop to a depth of 30 cm for physico-chemical analysis. Nitrogen and phosphorous @ 90-60 kg ha^{-1}, respectively, were applied to all plots. Urea, diammonium phosphate and potassium sulphate were used as a source of N, P and S. All P, S and 1/2 N was side drilled at the time of sowing and remaining 1/2 N was top-dressed at early flowering stage.

Data were recorded on number of plants (m^{-2}) , plant height at maturity (cm), number of pods per plant, number of seeds per pod, 1000-seed weight (g), biological yield (kg ha^{-1}), seed yield (kg ha^{-1}), harvest index %, oil contents %, protein %, economic analysis, following standard procedures.

Data collected were analyzed statistically by using the Fisher's analysis of variance technique and LSD at 5% probability was used to compare the differences among treatments' means (Steel *et al.,* 1997).

RESULTS AND DISCUSSION

Number of plants m^{-2}. Data (Table I) showed that sulphur application did not affect the number of plants m^{-2} significantly. However, the comparison of treatment's means showed that the number of plants m^{-2} ranged between 23-25. These results confirm the findings of Nazir (1998) who also reported non-significant difference in plant population per square meter as influenced by different rates of fertilizers.

Plant height (cm). Plant height of canola was highly significantly affected by S application (Table I). Maximum plant height (212.0 cm) was recorded with the application of 150 kg ha^{-1} S. Minimum plant height (185.6cm) was observed in case of control treatment. These findings are comparable with Tomer *et al.* (1997) who reported that plant height, number of branches increased significantly with the increasing levels of sulphur fertilizers.

Number of pods plant^{-1}. (Table I) exhibited that different S levels had highly significant effect on the number of pods per plant. Maximum number of pods plant^{-1} (684.7) were recorded where 100 kg S ha^{-1} was applied. The minimum numbers of pods plant^{-1} (603.3) was produced in control. These results are in accordance with the findings of the early workers, Singh and Gangasaran (1987) who also reported higher number of pods plant^{-1} when 30 kg S ha^{-1} was applied as compared to the treatment where no S was applied.

Number of seeds pod^{-1}. Significant differences were recorded in number of seeds pod^{-1} among various sulphur rates (Table I). Maximum number of seeds pod^{-1} (24.67) were produced where 100 kg S ha^{-1} was applied. However it was statistically at par where 75 kg S ha^{-1} and 125 kg S ha^{-1} were applied. Minimum number of seeds pod^{-1} was produced in control treatment. These results are quite in line with the early research work done by Ali *et al.* (1996) who reported maximum number of seeds pod^{-1} (31.19) at 30 kg S ha^{-1} against the lower rates of S application and control.

1000-Seed weight (g). The maximum 1000-seed weight (3.65 g) was recorded where 100 kg S ha^{-1}was applied. It was followed by T_5 (125kg S ha^{-1}) treatment i.e. 3.60g. Minimum 1000-seed weight (3.29 g) was produced by application of 25 kg S ha^{-1} which was at par with control. Generally, 1000-seed weight increased with application of increasing fertilizer levels. The results are supported by Singh and Gangasaran (1987), Trividi and Singh (1999) who reported that increased levels of sulphur produced the highest 1000-seed weight.

Biological yield (kg ha^{-1}). Data (Table I) indicated that effects of sulphur were highly significant on the biological yield. The application of 150 kg S ha^{-1} gave the maximum biological yield 24340 kg, followed by (125 kg S ha^{-1}) which produced 21690 kg ha^{-1} of biological yield. The minimum biological yield (17460 kg) was recorded in control treatment. These results are in line with the findings of Khandkar *et al.* (1991) who reported that biological yield was maximum with increasing rates of sulphur levels.

Seed yield (kg ha^{-1}). Data (Table I) revealed that different levels of sulphur showed significant effect on seed yield. The maximum seed yield (3725 kg ha^{-1}) was recorded with the applcation of 100 kg S ha^{-1} which was statistically at par with seed yield (3375 kg ha^{1}) obtained with the application of 125 kg S ha^{-1}. The minimum seed yield was obtained in control treatment which produced 2870 kg ha^{-1} of seed yield. These results are in accordance with the early research workers working on rapeseed (Ahmed *et al*., 1998) who also reported maximum seed yield at 100 kg S ha^{-1}.

Harvest index (%). The maximum harvest index value (18.95) was obtained with the application of 100 kg S ha^{-1}. The minimum harvest index value (13.05) was obtained where 150 kg S ha^{-1} was applied. These results are in line with the findings of Ali *et al.* (1996) who also reported the progressive increase in the value of harvest index when the rate of applied S increased gradually.

Oil content (%). Data (Table I) showed significant effect of S applications on oil content of canola. The maximum oil contents (45.10%) were produced in treatment receiving 150 kg ha^{-1} which was followed by T_5 (125 kg S ha^{-1}) producing 44.22 %.The minimum oil contents (42.36%) were produced in control. The increase in oil contents was due to the reason that S is an important component of many fatty acids and is required for the synthesis of other metabolites including coenzyme A,vitamin B, Biotin, Lipoic acid and sulpholipids. This results in the increase in the seed oil

Table I. Production efficiency of Canola (*Brassica napus* L) as affected by different S levels

Treatments S Kgha^{-1}	No. of plant m^{-2}	Plant Height	No. of pods/ plant	No. of seeds pod^{-1}	1000-seed weight (g)	Biological yield (Kgha^{-1})	Seed yield (Kgha^{-1})	Harvest Index	Seed oil content (%)	Protein content (%)
T_0 (0 kg)	25.66	185.6e	603.3e	19.63c	3.340b	17460c	2870c	16.46ab	42.36c	19.12e
T_1 (25 kg)	23.66	193.8d	612.7e	20.33bc	3.290b	17460c	3174bc	18.33ab	43.08bc	20.82d
T_2 (50 kg)	23.33	196.7d	631.3d	22.50ab	3.460ab	18250c	3187bc	17.39ab	42.19c	21.39cd
T_3 (75 kg)	24.00	203.2c	649.0cd	22.83a	3.443ab	19580bc	3267b	16.69ab	42.47c	21.79bcd
T_4 (100 kg)	25.33	205.9bc	684.7a	24.67a	3.647a	19840bc	3725a	18.95a	43.19bc	22.54abc
T_5 (125 kg)	23.66	207.0b	676.0ab	23.33a	3.607a	21960ab	3375ab	15.39bc	44.22ab	22.67ab
T_6 (150 kg)	24.66	212.0a	664.3bc	22.40ab	3.430ab	24340a	3169bc	13.05c	45.10a	23.00a

Any two means not sharing a letter in common differ significantly at 5% probability level.

Table II. Economic analysis

Treatments S kgha^{-1}	(Net Income (Rs. ha^{-1})
T_0	50365.51
T_1	54223.15
T_2	51692.4
T_3	50650.46
T_4	57980.14
T_5	47171.14
T_6	40203.84

contents at higher sulphur levels. These results are quite in line with those of Majumdar and Pingoliya (2000) who also reported the increase in oil contents (39.02%) with increasing the S level upto 60 kg ha^{-1} in *Brassica juncea*.

Protein (%). Data (Table I) showed that maximum protein contents (23.00%) were produced by where 150 kg S ha^{-1} was applied. It was followed by 22.67 % with the application of 125 kg S ha^{-1}. 100 kg S ha^{-1} gave 22.54%. However these three treatments were statistically at par with each other. The minimum Protein contents (19.12%) were produced by control treatment. The continuous increase in protein was due to the reason that S is required for the synthesis of S containing amino acids like cystein, cystine and methionine which are essenial components of protein. These results are in agreement with Mohapatra and Jee (1992), Zhao *et al*. (1993) and Dubey *et al*. (1994) who reported that the increasing rates of nitrogen and sulphur levels produced maximum protein contents.

Economic analysis. Maximum net benefit (Rs. 57980.14 ha^{-1}) was obtained with the application of 100 kg S ha^{-1} (Table II). It is evident from the table that there was reasonable increase in net return in T_4 treatment over control and also a significant increase in other treatments except where 125 and 150 kg S ha^{-1} was applied. Minimum net income was observed where 150 kg S ha^{-1} fertilizer was applied.

CONCLUSION

Production efficiency of Canola crop can be enhanced when fertilized @ 100 kg S ha^{-1}, with recommended application of N & P under agro-ecological conditions of Faisalabad.

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