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Influence of sulphur application on biochemical composition of sunflower (*Helianthus annus* L.) varieties grown in eastern Uttar Pradesh

KRISHAN LAL, BINDER SINGH[1], RAMAYAN SINGH[1], HIMANSHU DUBEY[1] AND J.P. SINGH[1]
Department of Biochemistry, N.D. Univ. of Agriculture and Tech., Kumarganj, Faizabad (U.P.)

Abstract

The field experiment was conducted during the rabi season of 2004-05 and 2005-06 to study the influence of different levels of sulphur (0,20,40 and 60 kg S ha^{-1}) and date of sowing (D_1 early and D_2 late sowing) on the yield and biochemical composition of sunflower varieties viz. Teza-555 and NFSH-36. The yield, protein content, oil content and amino acids (viz. methionine and cystine) were recorded maximum in Teza-555 (V_1) variety. The effect of sulphur (0, 20, 40, 60 kg S ha^{-1}) on yield, protein content, oil content and amino acid (viz. methionine and cystine) were found in increasing trends. Maximum yield (12.98 q ha^{-1}), protein content (41.48 %), oil content (41.18 %), methionine (1.93 %) and cystine (1.40 %) were obtained at (60 kg S ha^{-1}) level of sulphur. The yield (12.48 q ha^{-1}) and oil content (40.24 %) were recorded maximum in early (D_1) date of sowing.

Key words: Oil content, Protein, Methionine, Cystine, Iodine value, Sunflower

Introduction

Sunflower popularly known as "Suryamukhi" is a familiar oil seed crop in India. Since, the sunflower seed contain 45-50 per cent good quality oil and high amount of quality protein in cake. It has good scope in Indian agriculture. It hardly needs to emphasize that vegetable fats play an important and essential role in the human diet and in the industries throughout the world. The oil contain 64 % linoleic acid, 20-50 % oleic acid, 40-44% protein in cake along with sufficient amount of vitamin A, D and E the important constituents for human health. Because of high linoleic acid 64 % it has got anticholes terol property as a result of which it has become a boon to the heart patient. It is also very useful in reducing the incidence of atherosclerosis, a deadly circulatory disease in man. Rate of sulphur increasing the oil content in oil crop seeds is well known. Sulphur is an integral constituent of sulphur containing amino acids (viz. methionine cystine and cysteine) which are building units of protein. It is also an important constituent of the vitamins which increase the activity of enzyme popinase and ATPase. In the synthesis of essential oils, sulphur is also required by plant. Date of sowing has been proved to be the single most important variable characteristics affecting the yield and quality attributes of sunflower. Early as well as late sowing crops give poor yield and quality. The delay sowing causes early maturity of crop result the drastic reduction on the yield. Keeping this in view, the present study was conducted to know the influence of sulphur application on biochemical composition of sunflower seeds.

Materials and methods

Field experiment was conducted during rabi season 2004-05 at Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.) during the rabi season of 2004-05 and 2005-06 with two varieties of sunflower viz. Teza-555 (V_1) NFSH-36 (V_2) four levels of sulphur (0, 20, 40, 60 kg S ha^{-1}) and two sowing date (D_1 early and D_2 late) were grown in split plot design comprising 16 treatment. In each replication sulphur was applied by basal dressing through gypsum. On the basis of yield per plant, the total yield (q ha^{-1}) was worked out. Protein content was determined in cake of sunflower seeds by Lowry's method using BSA as standard protein. Oil content in seed was extracted by conventional soxhlet method (A.O.A.C., 1970). Methionine content was analyzed by the method described by Horn *et al.* (1946) and cystine content was estimated by the method of Leach (1966). The iodine value was analyzed by Hart and Fisher (1971).

Results and Discussion

The data regarding seed yield of sunflower as

[1]Department of agricultural chemistry & soil science, R.B.S. college, bichpuri Agra

influenced by different varieties and level of sulphur have been presented in Table 1. Maximum seed yield was noticed in Teza 555 (12.30 q ha^{-1}) followed by NFSH-36 (11.46 q ha^{-1}). The highest yield (12.98 q ha^{-1}) was recorded by the application of 60 kg S ha^{-1} while lowest yield was obtained in control treatment. Seed yield significantly increased with increasing level of sulphur nutrition, which is mainly due to enhance rate of photosynthesis and carbohydrate metabolism. Sulphur augment photosynthate translocation from source to sink. The result of this parameter are in accordance with the result of Gangwar & Permeswaran (1966).

Table 1: Influence of sulphur on yield and quality parameters of sunflower oil (Average data of two years)

Treatments	Yield (q/ha)	Oil (%)	Iodine value
Variety			
Teza 555 (V_1)	12.30	40.26	124.89
NFSH-36 (V_2)	11.46	39.12	125.43
Sem±	0.14	0.31	0.025
CD P=0.05	0.40	0.90	0.077
Sulphur level (kg ha^{-1})			
0	10.62	37.58	126.93
20	11.79	39.40	126.79
40	12.47	40.88	124.73
60	12.98	41.18	124.11
Sem±	0.20	0.43	0.079
CD P=0.05	0.57	1.22	0.238
Sowing date			
Early (D_1)	12.28	40.24	124.77
Late (D_2)	11.45	39.13	125.59
Sem±	0.14	0.13	0.344
CD P=0.05	0.40	0.90	NS

The protein content in cake varied from 40.46% to 41.23 %. Maximum protein content (41.23 %) was recorded in Teza-555 followed by NFSH-36 40.46 %. The protein content due to level of sulphur was obtained 40.61% to 41.48% by the application of 60 kg S ha^{-1} which was significantly differed over control but at par with 40 kg S ha^{-1}. The increasing level of sulphur was helpful in biosynthesis of sulphur containing amino acid into high quality of protein Chopra & Kunwar (1966). Sulphur provide disulphide (-S-S) bonds which form cross linkage of two peptide chain and this help in the formation of protein (Allaway & Thompson, 1966). The findings of present investigation were in agreement with the result of Gangwar & Permeswarn (1976).

The methionine content in cake ranged from 1.54% to 1.65% Maximum methionine content (1.65 %) was noticed in Teza-555 followed by NFSH-36. The methionine content due to effect of sulphur level ranged from 1.11% to 1.93 %. Highest methionine content was observed by application of 60 kg S ha^{-1} followed by 20 kg S ha^{-1}. The methionine content varied significantly by various level of sulphur, while the interaction effect between the treatments was found non-significant methionine contents, sulphur helps in the biosynthesis of this amino acid. The findings of present investigation are in accordance with Hari Shanker and Yadav (1977), Kocking *et al.* (1987).

The amino acid cystine in the cake of sunflower was found between 1.27% to1.29 %. Highest content of this amino acid was observed in Teza-555 followed by NFSH-36. Cystine content due to effect of sulphur level ranged from 1.15% to 1.40 %. Highest cystine content was observed by the application of 60 kg S ha^{-1} and it varied significantly with various treatments. This amino acid contains sulphur which leads to proper synthesis of sulphur containing amino acid. The findings of present investigation are in accordance with Hari Shanker and Yadav (1977).

Table 2: Effect of sulphur application on protein and amino acid content of sunflower cake(Average data of two years).

Treatments	Protein %	Methionine %	Cystine %
Variety			
Teza 555 (V_1)	41.23	1.65	1.29
NFSH-36 (V_2)	40.46	1.54	1.27
Sem±	0.05	0.02	0.02
CD P=0.05	0.14	0.06	0.05 (NS)
Sulphur level (kg ha^{-1})			
0	40.61	1.11	1.15
20	41.11	1.54	1.23
40	41.38	1.79	1.32
60	41.48	1.93	1.40
Sem±	0.05	0.03	0.02
CD P=0.05	0.13	0.08	0.06
Sowing date			
Early (D_1)	41.32	1.61	1.29
Late (D_2)	41.21	1.58	1.26
Sem±	0.14	0.02	0.02
CD P=0.05	NS	NS	NS

The oil content in sunflower varieties was observed in the range of 39.12% and 40.26 %. Maximum oil content (40.26 %) was observed in Teza-555 followed by NFSH-36(39.12). The oil content varied significantly among themselves. Effect of sulphur level influence the oil content ranged from 37.58% to 41.18 %. Maximum oil content was observed by application of 60 kg S ha^{-1} which was statistically significant over control but at par with 40

kg S ha^{-1} sulphur level. The increase in oil content due to sulphur nutrition created favourable nutritional environment for the production of metabolites responsible for oil biosynthesis in plants. Sulphur helps in conversion of carbohydrate into oil (Chopra and Kanwar, 1966). In the fatty acid biosynthesis, acetyl Co A is converted into malonyl Co A. In this conversion an enzyme acetic thiokinase is involved. The activity of this enzyme depends upon sulphur supply more ever acetyl Co A it self contains sulphur and sulphydryl group. This may be the reason for increase in oil content of sunflower with sulphur application. The findings of present investigation are in accordance with Gangwar and Parmeswaran (1976), Harishanker and Yadav (1977), Channel (1979) Singh & Sahu (1986).

Iodine value of oil varied from 124.89 to 125.43. Maximum iodine value 125.43 was found in NFSH-36 followed by Teza 555 variety. Iodine value due to effect of sulphur level was found between 124.11 to 126.93. Highest iodine value was recorded in control treatment followed by 20, 40 and 60 kg s ha^{-1} sulphur doses. The variation in the iodine value was observed in different varieties may be due to its genetical characters. Sulphur application significantly reduced the iodine value of oil. Similar findings has been reported by Hari Shanker & Yadav (1977). A significant change in iodine value sunflower oil with sulphur application was also observed by Channel (1979) interaction of sulphur and variety significantly reduced iodine value in various treatments.

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