

STUDIES ON THE EFFECT OF NITROGEN FERTILIZER TOGETHER WITH LIME ON SUNFLOWER SEED OIL CULTIVATED IN WEST BENGAL (EASTERN INDIA)

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INTRODUCTION

In eastern India there exists a vast tract of land in the western belt of West Bengal and adjoining areas of Bihar and Orissa, where the lands are relatively arid, undulated and typically lateritic in nature. Though Sunflower is a recent introduction in fertile alluvial tracts of this state, attempts are also being made to establish its cultivation in lateritic soils, to combat the shortage of oil production in India.

For the improvement of crop production in lateritic soil, earlier investigators (1,2) pointed out about the beneficial effects of judicious fertilization with lime pretreatment. Lime together with N, P & K treatment increased protein and fat content of different agricultural crops (3,4). Nitrogen fertilization on a P & K background increases the linoleic acid content in Sunflower seed oil (5,6).

In the present experiment, effects of different levels of nitrogen fertilization in acid lateritic soil, with and without lime pretreatment on the composition of sunflower seed, oil and cake have been carried out in *Kharif* season (June to September) in West Bengal.

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EXPERIMENTAL

Cultivation of sunflower

The experiment was set up in a statistically laidout replicated plots in typically lateritic upland soils (pH 5.6) of Midnapore district of West Bengal. Sunflower variety Ec 68414 was raised in *Kharif* season (June to September, 1975).

Ammonium sulphate as nitrogenous fertilizer in different levels e.g. 0, 20, 40, 60 and 80 kg N per hectare (100 kg $(\text{NH}_4)_2\text{SO}_4 = 20$ kg N) was applied according to statistical randomised design, one set in lime dress plots (pH 6.8) and the other in without liming. The ammonium fertilizer was applied in split doses, one at basal and other at 30 days after sowing and at 60 days after sowing. A general dressing with 60 kg P_2O_5 and 180 kg K_2O per hectare was also given at the time of final land preparation.

The crop was harvested and the samples were collected for laboratory analysis.

Analysis of seed and oil

I) Oil content: The oil content was determined by the usual Soxhlet extraction method using petroleum ether (40-60° C) as solvent.

II) Fatty acid composition: About 20-25 mg of oil was methylated with 0.5 (N) potassium methoxide according to Luddy *et al* (7) and the fatty acid composition was determined by gasliquid Chromatography on DEGS column.

Analysis of oil cake

Protein: Nitrogen was determined by micro-Kjeldahi method (8) from 0.05 g of cake. The percentage of protein was obtained by multiplying the percent of nitrogen with 6.25.

RESULTS AND DISCUSSION

The results of the present experiment exhibit a number of encouraging features on the development and popularisation of Sunflower cultivation.

TABLE 1

Effect of nitrogen fertilizers with and without lime on seed yield (kg/ha) and test weight (g) of Sunflower.

Nitrogen levels (kg/ha)	Seed yield (kg/ha) ^a		Test weight (g) ^a 1000 seeds weight	
	With lime	Without lime	With lime	Without lime
0	343.3	287.9	30.2	25.4
20	565.3	369.8	31.5	28.6
40	828.3	496.6	34.2	31.7
60	931.3	601.6	37.5	36.3
80	957.6	770.8	38.5	37.1
Mean	725.2	505.3	34.4	31.8

^a Mean of four replicate samples

TABLE 2

Effect of nitrogen fertilizers with and without lime on oil content of seed and protein content of undecorticated Sunflower cake

Nitrogen levels (kg/ha)	Oil content ^a (% wt.)		Nitrogen as protein (% wt.)	
	With lime	Without lime	With lime	Without lime
0	37.7	34.5	18.6	16.8
20	38.4	36.8	19.5	17.5
40	39.2	37.4	19.7	17.8
60	39.8	38.7	21.2	20.4
80	39.5	37.2	23.8	21.1
Mean	38.9	36.7	20.6	18.7

^a Mean of four replicate samples

Increased amount of nitrogen fertilization has resulted into higher seed yield in kg/ha (Table I) in Sunflower irrespective of soil reaction, but the effects were more pronounced in lime treated soil. The yield increased significantly up to 60 kg nitrogen/ha but the yield showed very little increase with increase in nitrogen level from 60 kg to 80 kg/ha in both plots. The yield response under lime soil in general surpassed the yield obtained under original soil by about 44%. The response to added levels of nitrogen in lime dressed soil

may be accounted for the greater uptake of nutrients than original soil (9). The increased yield with the higher levels of nitrogen may be attributed to greater uptake and subsequent assimilation of nitrogen and its translocation leading to increased accumulation of assimilates in the grains and thereby having a maximum expression of the yield contributing characters.

Successive increase in nitrogen fertilization results into corresponding increase in test weight of Sunflower seeds. (Table 1). Here also the effect of lime is pronounced. These results are in agreement to be explained by previous observations (9). Decrease in test weight under lower nitrogen rates may be accounted for lesser accumulation of carbohydrates (10).

Increasing levels of nitrogen application upto 60 kg/ha exhibited corresponding higher oil recovery in lime pretreated soil over control in summer season (Table 2). Further addition by 20 kg/ha showed a decrease in oil content in both plots. This is suggestive of the fact that liming must have reinforced the effectiveness of nitrogen fertilizer on oil production of Sunflower seeds. Increasing oil content in seeds upto 60 kg/ha may be due to well matured filled seeds with proportionate constituent of carbohydrates and fats. The inhibiting effect of higher nitrogen (80 kg/ha) on oil content in Sunflower seeds is probably due to relatively more protein in cake (Table 2). Due to lower oil content, the higher seed yield at 80 kg nitrogen level in lime treated soil has negligible contribution to total oil yield (in kg/ha) obtained from 80 kg nitrogen application.

The fatty acid composition of Sunflower oil was affected by growing season and nitrogen fertilization and the proportion of linoleic acid was found to be 20-25%, in the *Kharif* grown crop (11), while in this experiment linoleic acid varied from 30.5% to 40.2% (Table 3). Oil from lime treated seeds contained more linoleic acid. The mechanism of this effect of lime on linoleic acid content is not clearly known. However, one possible explanation may be due to effective use of fertilizer in acid soil, in presence of lime which helps the conversion of oleic acid to linoleic acid (12). The second explanation may be due to higher oil content in lime treated seeds which has a positive relation with linoleic acid content in the oil (13). It is interesting to note that the amount of saturated fatty acid remained more or less fixed and conversion of oleic acid had taken place to increase the linoleic acid, content. The composition of major fatty acids of oil from original acid soil is in close agreement to that of groundnut oil and may be used as a substitute for the same. For high linoleic acid oils, pretreatment with lime would be effective.

TABLE 3

Effect of nitrogen fertilizers with and without lime on fatty acids composition of sunflower seedoil cultivated in West Bengal

Nitrogen levels (kg/ha)	Fatty acid composition (% wt.) ^a							
	With lime				Without lime			
	C16:0	C18:0	C18:1	C18:2	C16:0	C18:0	C18:1	C18:2
0	5.8	4.0	55.7	34.4	6.1	3.8	59.6	30.5
20	6.1	3.6	55.6	34.7	6.3	4.5	56.4	32.8
40	5.8	4.8	53.6	36.4	6.4	4.8	54.2	34.5
60	5.8	3.9	50.4	39.8	6.1	3.5	54.0	36.9
80	6.5	3.8	49.5	40.2	5.0	3.5	57.6	33.8

a Mean of four replicate samples

Application of varying levels of nitrogen has manifested its effectiveness on protein content (Table 2) in undecorticated Sunflower cake. Increased levels of nitrogen from 0 to 80 kg/ha resulted into corresponding higher protein content in a constantly linear trend. This significant response may be accounted for reasons stated earlier as also by increased nitrogen uptake by plants in lime treated soil (14,15). Although protein content increased with increase in nitrogen dose, experiment with higher nitrogen level than 80 kg/ha was not studied. As it was found that even with 80 kg/ha nitrogen application, the total oil content showed some declining tendency and since the main object was to get maximum oil yield rather than the protein content in seed.

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