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Quality of linseed (*Linum usitatissimum* L.) influenced by irrigation and level of nitrogen

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Abstract
An experiment was conducted during *rabi* season of the year 2013-14 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) to study the quality of linseed (*Linum usitatissimum* L.) influenced by irrigation and level of nitrogen. Higher values of quality parameters like oil content, protein content, nitrogen content in seed and available nitrogen in soil after harvest were recorded under application of irrigation at 0.8 IW: CPE. Each successive increase in the level of nitrogen from 30 to 90 kg N ha^{-1} significantly increased protein content, nitrogen content in seed and available nitrogen in soil after harvest. The oil content was recorded higher with application of nitrogen @ 30 kg N ha^{-1}.

Keywords: Linseed, Irrigation and Nitrogen

1. Introduction
Linseed (*Linum usitatissimum* L.) is popularly known as flax, alsi, jawas and ousahalu. It is *rabi* season annual herb belongs to family *Linaceae*. It is basically an industrial crop cultivated for its seeds as well as fibre, which is used for manufacture of linen. Seed is directly used for edible purpose. Seeds contain 33-47% oil, which used for paint, varnish, printing ink, soap and patent leather. Irrigation to this crop is mostly based on physiological growth stages and the latest approach of scheduling irrigation through irrigation water depth: cumulative pan evaporation (IW:CPE) ratio has not yet been amply tried in almost states of India. Therefore, it is important to compare the previous methods with the latest approach of scheduling irrigation to identify the most suitable frequency, time and depth of irrigation for higher yield of linseed. Lack of adoption of improved agronomic package of practices based on agro-climatic condition, is one of the major constraints behind this. Beside application of nitrogen and water, scare and costly resources, must aim at achieving higher benefits from the cultivation of high yielding varieties, especially under limited resource conditions. So that to obtain the necessary information regarding the optimum dose of nitrogen and suitable time of irrigation for linseed, present investigation was under taken to study the effect of irrigation and nitrogen on quality of linseed.

Materials and Methods
An experiment was conducted at college agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during *rabi* season of the year 2013-14. The soil of experimental field was loamy sand in texture, having low in organic carbon (0.41%), available nitrogen (242 kg ha^{-1}) and available phosphorus (32 kg ha^{-1}), medium in available potash (263 kg ha^{-1}) and pH (7.5). The treatments comprising four levels of irrigation (I_1: 0.4 IW:CPE ratio, I_2: 0.6 IW:CPE ratio, I_3: 0.8 IW:CPE ratio and I_4: Irrigation at critical growth stages (rosette, node elongation, flowering and capsules development stages) and three levels of nitrogen (30, 60 and 90 kg N ha^{-1}). The experiment was laid out in split plot design with four replications. Irrigation water of 50 mm (measured with the help of Parshall flume) was allowed to run in each plot at irrigation. Calculated quantity of N was applied through urea in two splits. Entire quantity of P with a basal dose of 30 kg P_2O_5/ha through single super phosphate was applied at sowing.

Results and Discussion
Effect of irrigation
Irrigation level influenced different quality parameter like oil content, protein content, nitrogen content in seed and soil nitrogen status after harvest. The magnitude of increase the oil content, protein content, N content in seed and soil nitrogen status after harvest in irrigation at 0.8

0.8 IW:CPE ratio was to the tune of 3.20, 8.03, 7.97 and 3.28 percent, respectively as compared to irrigation at 0.4 IW:CPE ratio. This might be due to more number of irrigation the availability of moisture for long period at root zone, which enhanced absorption of nutrients and that is reflected to improve the quality of linseed. The results are in agreement with Nimje (1991) [2], Reddaih *et al.* (1993) [4] and Singh *et al.* (1997) [6].

Table 1: Effect of irrigation and level of nitrogen on oil content, protein content, nitrogen content and uptake by seed of linseed and nitrogen status of soil after harvest.

Treatment	Oil content (%)	Protein content (%)	N content in seed (%)	N uptake by seed (kg ha^{-1})	N status of soil after harvest (kg ha^{-1})
Irrigation (I)					
I_1 - 0.4 IW:CPE ratio	39.70	18.79	3.01	10.75	225.66
I_2 - 0.6 IW:CPE ratio	40.43	19.50	3.12	12.07	226.67
I_3 - 0.8 IW:CPE ratio	40.97	20.76	3.32	13.46	233.92
I_4 - Irrigation at critical growth stages	40.49	20.30	3.25	12.80	233.08
S. Em. ±	0.27	0.37	0.06	0.26	6.84
C.D. at 5 %	0.85	1.20	0.19	0.83	NS
C.V. %	2.28	6.55	6.55	7.31	10.30
Nitrogen (N)					
N_1 - 30 kg ha^{-1}	40.73	19.35	3.10	11.30	215.62
N_2 - 60 kg ha^{-1}	40.67	19.65	3.14	12.21	225.31
N_3 - 90 kg ha^{-1}	39.80	20.52	3.28	13.29	248.57
S. Em. ±	0.21	0.26	0.04	0.23	5.58
C.D. at 5 %	0.62	0.75	0.12	0.67	16.28
Interaction effect (I X N)					
I X N	NS	NS	NS	NS	NS
C.V. %	2.11	5.15	5.15	7.50	9.71

Effect of nitrogen

Nitrogen level was significantly influenced on different quality parameter like oil content, protein content, nitrogen content in seed and soil nitrogen status after harvest. The magnitude of increase in protein content, N content in seed, N uptake by seed and available nitrogen in soil after harvest in application of 90 kg N ha^{-1} was to the tune of 6.04, 5.80, 17.61 and 15.28 percent, respectively as compared to application of 30 kg N ha^{-1}. This might be due to by increasing nitrogen level, significant build-up of available nitrogen status. This could be attributed to adequate supply of nitrogen to meet the crop demand. This is responsible for higher quality of seed and available nitrogen status in soil after harvest. While in case of oil content, the magnitude of decrease in oil content by application of 90 kg N ha^{-1} was to the tune of 2.28 percent as compared to application of 30 kg N ha^{-1}. These might be due to remarkably higher uptake of nitrogen by seed under higher levels of nitrogen which may responsible for lower oil content and higher protein content. Moreover there is a marked competition for photosynthetic between different metabolic sink in oilseed crops, hence increasing the level of nitrogen nutrition may enhance the protein content but lower the oil content. The findings of this investigation are in closed conformity of results obtained by Rafey *et al.* (1988) [3], Chourasia *et al.* (1992) [1], Vashishtha (1993) [7] and Singh *et al.* (1997) [6].

Interaction effects (I×N)

No interaction was found in case of quality of linseed and available nitrogen in soil after harvest.

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