

Effect of Irrigation and Nitrogen on Growth and Yield of Linseed (*Linum usitatissimum* L.)

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<http://dx.doi.org/10.22207/JPAM.11.2.35>

(Received: 16 December 2016; accepted: 20 January 2017)

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 effect of irrigation and nitrogen on linseed (*Linum usitatissimum* L.). Higher values of growth characters, yield attributes, seed and straw yield were recorded under irrigation level I₃ (0.8 IW:CPE ratio). Each successive increase in the level of N from 30 to 90 kg/ha significantly increased the growth characters, yield attributes, seed and straw yield. The WUE was recorded higher with I₁ treatment (0.4 IW:CPE ratio). Application of nitrogen @ 90 kg N ha⁻¹ in conjunction with irrigation at 0.8 IW:CPE ratio produced maximum seed yield (465 kg ha⁻¹).

Keywords: Linseed, Irrigation and Nitrogen.

Linseed (*Linum usitatissimum* L.) is popularly known as flax, alsii, jawas and ousahalu. It is *rabi* season annual herb belongs to family *Linaceae*. Linseed is one of the *rabi* oilseed crop of India. It is basically an industrial crop cultivated for its seeds and fibres. Its each and every part is endowed with commercial and medicinal importance. 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. The another major constraint limiting production of crop is poor fertility status

of soil and nitrogen is one of the universal deficient plant nutrients in Indian soils. 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, scarce and costly resources, must aim at achieving higher benefits from the cultivation of high yielding varieties, especially under limited resource conditions. Since research work on these aspects of linseed is very meager. 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 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

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of experimental field was loamy sand in texture, having low in organic carbon (0.41%) and nitrogen (242 kg ha⁻¹) and medium in phosphorus (32 kg ha⁻¹) and potash (263 kg ha⁻¹) with pH 7.5. The field capacity, wilting point and bulk density of experimental field were 14.59 %, 4.58 % and 1.36 g/cc, respectively with good drainage capacity. The treatments comprising four levels of irrigation (I₁: 0.4 IW:CPE ratio, I₂: 0.6 IW:CPE ratio, I₃: 0.8 IW:CPE ratio and I₄: Irrigation at critical growth stages (rosette, node elongation, flowering and capsules development stages) and three levels of nitrogen (30, 60 and 90 kg 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 each irrigation.

Calculated quantity of N was applied through urea in two splits. Entire quantity of P with a basal dose of 30 kg P₂O₅/ha through single super phosphate was applied at sowing. Linseed was sown on 23 October with seed rate of 10 kg ha⁻¹.

RESULTS AND DISCUSSION

Effect of irrigation

Treatment I₃ (0.8 IW:CPE ratio) recorded significantly higher plant height (63.13 cm), number of branches per plant (7.33), number of capsules/plant (68.58), test weight (6.68 g), seed yield (412 kg ha⁻¹) and straw yield (3524 kg ha⁻¹) (Table 1) and it was remained at par with treatment I₄ (Irrigation at critical growth stages i.e. rosette, node elongation, flowering and capsules

Table 1. Effect of irrigation and nitrogen on growth, yield attributes and yield of linseed

Treatments	Plant height (cm)	Number of branches plant ⁻¹	Number of capsules plant ⁻¹	Test weight (g)	Seed yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	WUE (Kg ha ⁻¹ mm ⁻¹)
Irrigation (I)							
I ₁ - 0.4 IW:CPE ratio	55.36	5.33	55.00	6.01	362	2886	1.79
I ₂ - 0.6 IW:CPE ratio	59.86	6.42	56.75	6.18	372	3222	1.49
I ₃ - 0.8 IW:CPE ratio	63.13	7.33	68.58	6.68	412	3524	1.33
I ₄ - Irrigation at critical growth stages	63.05	7.03	66.50	6.48	388	3364	1.32
S. Em. ±	0.96	0.26	1.92	0.14	7	121	0.02
C.D. at 5 %	3.08	0.82	6.15	0.47	24	386	0.06
C.V. %	5.53	13.58	12.87	7.97	6.67	12.85	4.11
Nitrogen (N)							
N ₁ - 30 kg ha ⁻¹	55.71	6.06	56.44	6.24	365	3082	1.46
N ₂ - 60 kg ha ⁻¹	61.64	6.19	61.19	6.38	384	3235	1.48
N ₃ - 90 kg ha ⁻¹	63.40	7.34	67.50	6.52	401	3431	1.49
S. Em. ±	0.52	0.21	1.99	0.12	5.03	93	0.02
C.D. at 5 %	1.50	0.61	5.80	NS	15	272	NS
C.V. %	3.42	12.79	10.79	7.73	5.25	11.47	4.03

Table 2. Interaction effects of irrigation and nitrogen on seed yield of linseed

I	Seed yield (kg ha ⁻¹)		
	N ₁	N ₂	N ₃
I ₁	357	363	364
I ₂	358	380	376
I ₃	371	400	465
I ₄	374	393	398
S. Em. ±		11	
C.D. at 5%		32	

development stages). This treatment significantly superior as compared to treatment 0.4 and 0.6 IW:CPE ratio for above-mentioned characters. This might be due to increase in number of irrigations applied at shorter intervals and total consumptive use of water. These situation avoided soil moisture stress and it provided very favourable conditions for soil moisture and nutrients availability to the plants and ultimately higher yield attributes and seed yield. The soil moisture stress created with the irrigation schedule with 0.4 IW:CPE at most

critical growth stage of flowering was responsible for decreasing the growth characters and yield attributes, ultimately resulting in the reduction of seed and straw yield. Water use efficiency decreased with increased in water supply. The results corroborate the findings of Tiwari *et al.* (1988), Reddaih *et al.* (1993), Dutta *et al.* (1995) and Singh *et al.* (1997).

Effect of nitrogen

Each successive increase in the level of N from 30 to 90 kg ha⁻¹ significantly increased the plant height, number of branches per plant, capsules/plant, test weight, seed and straw yield. The highest plant height (63.40 cm), number of branches per plant (7.34), number of capsules/plant (67.50), seed yield (401 kg ha⁻¹) and straw yield (3431 kg ha⁻¹) were recorded under the treatment N₃ (90 kg N ha⁻¹). Nitrogen levels unable to exert significant differences in test weight of linseed. The increase in the level of N was responsible for increased number of leaves/plant and leaf-area index, causing higher photosynthesis and assimilation rate and metabolic activity and cell-division, which were responsible for the significant increase in the growth characters, yield attributes and ultimately the seed and straw yields. The results of the present investigation confirm the findings of Singh and Verma (1999), Kushwaha (2006) and Choudhary *et al.* (2010) in linseed crop.

Interaction effects (I×N)

Interaction effect between irrigation scheduling and nitrogen levels was found significant with respect to seed yield of linseed (Table 2). Significantly the highest (465 kg ha⁻¹) seed yield was noted in treatment combination I₃N₃ (0.8 IW:CPE ratio + 90 kg N ha⁻¹). Whereas, significantly the lowest (357 kg ha⁻¹) seed yield was observed in treatment combination I₁N₁ (0.4 IW: CPE ratio + 30 kg N ha⁻¹). The reason might be due to increase in yield attributed to more vigorous crop growth and higher order of yield attributes

under frequent irrigation with adequate supply of nitrogen as the atmosphere had high demand of evapo-transpiration and nutrient during crop period and this results in increased seed yield. The findings of this investigation are in closed conformity of results obtained by Reddaih *et al.* (1993).

CONCLUSION

From the above results, it can be concluded that for securing higher seed yield of linseed, it is advisable to irrigate the crop at 0.8 IW:CPE ratio in conjunction with 90 kg N ha⁻¹.

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