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RESEARCH PAPER

Effect of limited irrigation and nitrogen levels on quality and oil yield of Indian mustard [*Brassica juncea* (L.)]

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Abstract **:** A field experiment was conducted for two consecutive *Rabi* season of 1999-2000 and 2000-2001 at Hisar to study the effect of limited irrigation and nitrogen levels on quality and oil yield of India mustard. The variety 'Laxmi' recorded higher oil yield over RH-9304 and also recorded significantly higher seed protein content and crude protein yield over RH-9304. Varieties did not differ significantly in respect of saturated and unsaturated fatty acid composition. Irrigation levels could not reach to the level of significance with regard to oil content, seed protein content and synthesis of fatty acids in Indian mustard. The increasing nitrogen levels decreased the oil content but increased concomitantly the oil yield upto 100 kg N ha^{-1} nitrogen levels failed to cause any significant change in quality of oil during both the years.

Key Words **:** Limited irrigation, Nitrogen, Quality, Oil yield, Indian mustard

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INTRODUCTION

The high yield of Indian mustard can be achieved by optimizing irrigation and fertilizer doses for realizing high yield from newly released varieties. Combinations of irrigation and fertility levels have complementary and supplementary relationships and thus, have a direct impact on water use, yield and quality of Indian mustard. Oil content and composition of oil relative to fatty acids and iodine value have certain relationship with agronomic practices. Keeping this relationship in view, the seed oil content, oil yield and quality parameters of Indian mustard varieties were studied under limited irrigation and varying level of nitrogen.

MATERIALS AND METHODS

Field experiments were conducted during winter season (November-March) of 1999-2000 and 2000-2001 at the Agronomy Research Farm of C.C.S. Haryana Agricultural University, Hisar. The main plot treatments comprised of two Indian mustard varieties *viz*., V_1-RH-9304, V_2-Laxmi and three irrigation levels *viz*., I_0- no post sowing irrigation, I_1-one irrigation (60mm) at flowering stage, I_2-one irrigation (60mm) at siliqua development stage and the sub-plot treatments comprised of six nitrogen levels *viz*., No.-no nitrogen application N_1-40 kg Nha^{-1}, N_2-60 kg Nha^{-1}, N_3-80 kg Nha^{-1}, N_4-100 kg Nha^{-1} and N_5-120 kg Nha^{-1}. The experiment was laid out in Split-plot design with 3 replications. The soil of the experimental site was sandy loam in texture with 172 and 168 kg ha available N, 16 and 14 kg ha available P and 381 and 371 kg ha^{-1} available K during 1999-2000 and 2000-2001, respectively. All nitrogen through urea and phosphorus in the form of single super phosphate were applied at the time of sowing. The crop was sown in rows 30 cm apart on 14th November 1999 and 15th November 2000, respectively. Post sowing irrigation were of 60mm depth, each given as per requirement of treatments. A rainfall of 19 mm in 1999-2000 and 15 mm in 2000-2001 was received during the crop growth period. The crop was harvested on 1 April 2000 and 3 April 2001, respectively. Oil percentage in seed was determined by nuclear magnetic resonance (MKIII A new port Analyzer). Oil

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yield kg ha^{-1} was worked out on the basis of oil percentage in seed and seed yield kg ha^{-1}. Protein content in seeds of each treatment was worked out by multiplying the nitrogen content in seeds with a conversion factor of 6.25 for oil seed *Brassica*. Crude protein yield kg ha^{-1} was worked out on the basis of protein percentage in seed and seed yield ha. The fatty acid profile of mustard seeds were determined as per method of A.O.A.C. (1988).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Effect of varieties:

The varieties did not bring about any significant difference in oil content of seed during both the years. However, V_2 (Laxmi) recorded significantly higher oil yield, protein content in seed and crude protein yield than V_1 (RH-9304) during both the years (Table 1).

Oil and protein yield is the resultant of seed yield and oil and protein (%), respectively. Sharma *et al*. (1997) reported variability among *Brassica* cultivars. In both the years, different varieties did not show any significant variation in the palmitic, stearic, oleic. linoleic, linolenic and euric acid concentration of Indian mustard (Table 2 and 3).

Effect of irrigation:

Irrigation levels had a tendency toward increase in oil and protein content of seed but variation was not significant when compared with non irrigated crop (Table 1). However, irrigation application (I_1 and I_2) significantly increased the oil yield and crude protein yield over no post sowing irrigation (I_0) during both the years. The increase in oil yield was due to favourable effect of irrigation and seed yield. Panda *et al.* (2000) observed that irrigation levels significantly influenced oil yield, whereas oil content of seed not affected appreciably.

Irrigation could not bring about significant variation in palmitic and stearic acid concentration during any of the year (Table 2). Application of irrigation (I_1 and I_2) resulted in significant increase in oleic acid concentration over no irrigation treatment (I_0) though I_1 and I_2 were at par during both the years (Table 3). However, irrigation had non-significant effect on the linoleic, linolenic acid concentration during 1999-2000 and 2000-2001, respectively. Such observations were also reported by Singh *et al*. (1995).

Effect of nitrogen:

The oil content of Indian mustard seed decreased significantly with the increasing levels of nitrogen application during both the years. However, oil yield, protein content and

Table 1 : Effect of limited irrigation and nitrogen levels on seed oil content, oil yield, seed protein content and protein yield of Indian mustard

Treatments	Seed oil content (%)		Oil yield (kgha^{-1})		Seed protein content (%)		Crude protein yield (kgha^{-1})	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Varieties								
V_1	39.31	39.20	561.00	535.00	18.31	17.44	261.00	238.00
V_2	39.15	39.02	589.00	556.00	18.69	18.44	281.00	263.00
S.E ±	0.23	0.19	5.00	4.00	0.09	0.14	4.00	5.00
C.D. (P=0.05)	NS	NS	17.00	15.00	0.28	0.46	15.00	17.00
Irrigation schedule								
I_0	39.12	38.80	507.00	482.00	18.38	17.88	238.00	220.00
I_1	39.36	39.41	640.00	607.00	18.63	18.00	303.00	277.00
I_2	39.21	39.12	579.00	550.00	18.50	17.94	273.00	252.00
S.E ±	0.34	0.29	13.00	14.00	0.06	0.05	5.00	4.00
C.D. (P=0.05)	NS	NS	42.00	45.00	NS	NS	17.00	13.00
Nitrogen levels								
N_0-No nitrogen	38.12	38.10	398.00	387.00	16.44	15.69	171.00	159.00
N_1-40 kg Nha^{-1}	40.25	40.12	533.00	506.00	17.69	17.13	234.00	216.00
N_2-60 kg Nha^{-1}	39.43	39.33	580.00	551.00	18.63	17.94	274.00	251.00
N_3-80 kg Nha^{-1}	39.31	39.16	621.00	586.00	19.31	18.69	305.00	280.00
N_4-100 kg Nha^{-1}	39.19	39.05	656.00	619.00	19.38	19.06	325.00	320.00
N_5-120 kg Nha^{-1}	39.08	38.88	666.00	626.00	19.44	19.06	331.00	307.00
S.E ±	0.02	0.03	7.00	5.00	0.04	0.11	3.00	4.00
C.D. (P=0.05)	0.06	0.08	21.00	17.00	0.12	0.36	12.00	13.00

NS=Non-significant

Table 2 : Effect of limited irrigation and nitrogen levels on saturated fatty acid composition of Indian mustard

Treatments	Palmitic acid (%)		Stearic acid (%)	
	1999-2000	2000-2001	1999-2000	2000-2001
Varieties				
V_1	2.75	2.69	0.95	0.91
V_2	2.43	2.41	1.03	1.05
S.E ±	0.04	0.05	0.03	0.02
C.D (P=0.05)	NS	NS	NS	NS
Irrigation schedule				
I_0	2.52	2.49	0.92	0.95
I_1	2.66	2.59	1.09	1.00
I_2	2.59	2.57	0.96	0.99
S.E ±	0.04	0.03	0.03	0.4
C.D (P=0.05)	NS	NS	NS	NS
Nitrogen levels				
N_0-No nitrogen	2.35	2.31	0.89	0.91
N_1-40 kg Nha^{-1}	2.43	2.41	0.92	0.93
N_2-60 kg Nha^{-1}	2.50	2.46	0.96	0.95
N_3-80 kg Nha^{-1}	2.61	2.57	1.02	0.98
N_4-100 kg Nha^{-1}	2.75	2.73	1.06	1.02
N_5-120 kg Nha^{-1}	2.87	2.84	1.11	1.06
S.E ±	0.05	0.06	0.02	0.04
C.D (P=0.05)	NS	NS	NS	NS

NS=Non-significant

Table 3 : Effect of limited irrigation and nitrogen levels on unsaturated fatty acid composition of Indian mustard

Treatments	Oleic acid (%		Linoleic acid (%)		Linolenic acid (%)		Euric acid (%)	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Varieties								
V_1	10.68	10.78	12.17	12.18	8.57	8.59	50.49	50.68
V_2	11.46	11.28	13.83	13.72	8.89	8.79	49.65	49.62
S.E ±	0.04	0.05	0.06	0.04	0.04	0.03	0.13	0.12
C.D (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS
Irrigation schedule								
I_0	10.57	10.52	12.64	12.57	8.61	8.57	48.86	49.18
I_1	11.55	11.45	13.25	13.23	8.81	8.77	50.75	50.71
I_2	11.15	11.12	13.11	13.05	8.77	8.73	50.60	50.56
S.E ±	0.17	0.18	0.08	0.06	0.03	0.04	0.12	0.11
C.D (P=0.05)	0.52	0.55	NS	NS	NS	NS	NS	NS
Nitrogen levels								
N_0-No nitrogen	10.05	10.03	13.34	13.29	8.48	8.45	49.65	49.86
N_1-40 kg Nha^{-1}	11.08	11.09	13.14	13.11	8.72	8.69	49.86	49.96
N_2-60 kg Nha^{-1}	11.19	11.14	13.04	12.98	8.29	8.73	50.07	50.11
N_3-80 kg Nha^{-1}	11.30	11.22	12.94	12.86	8.77	8.26	50.17	50.20
N_4-100 kg Nha^{-1}	11.42	11.31	12.83	12.75	8.92	8.87	50.29	50.32
N_5-120 kg Nha^{-1}	11.51	11.38	12.71	12.69	9.19	9.14	50.41	50.43
S.E ±	0.06	0.04	0.09	0.05	0.03	0.04	0.17	0.15
C.D (P=0.05)	NS	NS	NS	NS	NS	NS	0.52	0.45

NS=Non-significant

protein yield increased significantly with the successive increase in nitrogen levels up to N_4 level (100 kg N ha^{-1}) whereas N_4 and N_5 levels were at par during both the years (Table 1).

The decrease in oil content with increase in nitrogen levels in due to utilization of carbohydrates in protein synthesis, whereas oil yield increased due to the depressing effect of nitrogen levels on oil content since a negative correlation exists between oil and protein contents. Similar results have been reported by Sharma *et al*. (1997). Varying nitrogen levels failed to cause any significant change in the Palmitic, stearic, oleic, linoleic and linolenic acid concentration during both the years (Table 2 and 3). However, nitrogen levels increased euric acid up to N_1 level, the N_1, N_2 N_3, N_4 and N_5 levels being at par, were significantly superior over no nitrogen application (No).

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