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Research Paper

NPK content and uptake in Indian mustard (*Brassica juncea* L.) varieties as influenced by limited irrigation and nitrogen levels

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ABSTRACT

A field experiment was conducted during winter season of 1999-2000 and 2000-2001 to study the effect of limited irrigation and nitrogen levels on NPK content and their uptake by Indian mustard [*Brassica juncea* (L)] varieties. The variety 'Laxmi' recorded higher N,P and K per cent content and NPK uptake both in seed and stover. Application of irrigation increased N,P and K contents both in seed and stover but the difference were non significant. One irrigation applied at flowering stage recorded higher NPK uptake both in seed and stover over other irrigation levels during both the years. The increase in nitrogen levels increased significantly the nitrogen content both in seed and stover upto 60 kg Nha^{-1}. However, P and K content in seed and stover was not influenced during any of the year. The nitrogen application increased significantly the uptake of NPK by seed and stover upto 100 kg Nha^{-1}.

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Key words : NPK content, NPK uptake, Limited irrigation, Nitrogen levels

INTRODUCTION

With the increase in irrigation facilities and to fetch better prices of oilseeds, Raya or Indian mustard (*Brassica juncea* L.) is preferred over other crops of rapeseed-mustard group. It has also maximum production potential and established as more responsive to irrigation and fertilizer management by its other virtue *viz.,* profuse foliage, deep and extensive root system and comparatively better tolerance to low temperature, pest and disease hazards. The high yielding varieties of Indian mustard have been found to respond well to nitrogen but the information on the effect of nitrogen under limited water supply condition on NPK content and its uptake is meagre. Hence, present investigation was undertaken.

MATERIALS AND METHODS

A field experiment on Indian mustard varieties was conducted during rabi seasons of 1999-2000 and 2000 – 2001 at the Agronomy Research Farm of C.C.S.Haryana Agricultural University, Hisar. The experiment was laid out in a Split-plot design with three replications keeping two varieties of Indian mustard *viz.*, V_1-RH 9304, V_2-Laxmi and three irrigation levels *viz.*, I_0- no post sowing irrigation, I_1- one irrigation (60 mm) at flowering stage, I_2- one irrigation (60mm) at siliqua development stage in main plots and six nitrogen levels *viz.,* No-no nitrogen application, N_1-40 kg N ha^{-1}, N_2- 60 kg N ha^{-1}, N_3- 80 kg N ha^{-1}, N_4- 100 kg N ha^{-1} and N_5- 120 kg N ha^{-1} in sub-plots. The field trial was conducted on sandy loam soil with 172 and 168 $kgha^{-1}$ available N, 16 and 14 $kgha^{-1}$ available P,381 and 379 $kgha^{-1}$ available K during 1999-2000 and 2000-2001, respectively. Entire nitrogen as per treatment as urea and phosphorus in the form of SSP were applied at sowing. The crop was sown on 14 November 1999 and 15 November 2000 at a row spacing of 30 cm apart in the same field during both the years. Thinning was done 30 days after emergence to maintain plant to plant distance of 15 cm. A measured quality of water (60 cm depth) in each irrigation was applied as per requirement of treatments. The total rainfall received during the winter season of 1999-2000 and 2000-2001 was 19.0 and 15.0 mm, respectively,. The crop was harvested

on 1 April 2000 and 3 April 2001, respectively. The NP and K content in plant samplers (seed + stover) were determined following colorimetric method (Jackson, 1973), vanadmolybdo phosphoric acid yellow colour method (Jackson, 1973) and Flame Photometric method (Jackson, 1973), respectively and nutrients uptake was calculated.

RESULTS AND DISCUSSION

The results of the present study as well as relevant discussion have been presented under the following sub heads:

Effect of varieties*:*

Indian mustard varieties differed significantly with respect to nitrogen contents in seed during both the years and in stover during 1999-2000 (Table 1). The variety Laxmi (V_2) contained higher N,P and K per cent content both in seed and stover as compared to the variety RH-9304 (V_1). The uptake of nitrogen, phosphorus and potassium in seed and stover recorded significant variation amongst varieties. V_2 showed significantly higher NPK uptake in seed and stover over V_1 (Table 2). Significantly higher NPK uptake by seed and stover recorded in the V_2 than V_1 due to its higher N,P and K content in seed and stover as well as higher seed and stover yield. Similarly, V_2 recorded higher total NPK uptake than V_1 during both years (Table 3).

Effect of irrigation:

Application of irrigation increased N, P and K contents both in seed and stover but the difference were not significant (Table 1) and resulted in their increased uptake both in seed as well as stover with the different levels of irrigation. One irrigation applied at flowering stage (I_1) recorded significantly higher N,P and K uptake both in seed and stover over other irrigation levels during both the years (Table 2). The contents of these major nutrients and their uptake were lowest in I_0. Total uptake (seed + stover) also revealed similar results. This can be explained possibly because the moisture stress may increase soil strength, decrease root growth and its prolification thereby decreasing the absorption of N,P and K. Stress condition may also decrease the ability of unit plant root surfaces to absorb N,P and K affecting the metabolic activity of the plants. Soil water movement probably accounts for a much

Table 1: Effect of limited irrigation and nitrogen levels on nitrogen (N) , phosphorous (P) and potassium (K) content of seed and stover of Indian mustard varieties

Treatments	Nitrogen content (%)				Phosphorus content (%)				Potassium content (%)			
	Seed		Stover		Seed		Stover		Seed		Stover	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Varieties												
V_1	2.93	2.79	0.68	0.69	0.55	0.45	0.17	0.16	0.59	0.60	1.59	1.61
V_2	2.99	2.95	0.76	0.71	0.57	0.53	0.21	1.18	0.67	0.62	1.75	1.65
S.E ±	0.01	0.04	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.03	0.04	0.02
C.D. (P=0.05)	0.03	0.13	0.06	NS	NS	0.06	0.03	NS	0.06	NS	0.14	NS
Irrigation schedule :												
I_0	2.94	2.86	0.70	0.68	0.54	0.47	0.17	0.14	0.60	0.60	1.64	1.59
I_1	2.98	2.88	0.74	0.71	0.58	0.51	0.21	0.20	0.68	0.62	1.71	1.66
I_2	2.96	2.87	0.72	0.71	0.58	0.49	0.19	0.17	0.61	0.61	1.66	1.64
S.E.±	0.03	0.03	0.01	0.02	0.02	0.03	0.03	0.02	0.03	0.02	0.04	0.03
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nitrogen levels												
N_0	2.63	2.51	0.67	0.65	0.51	0.40	0.12	0.10	0.62	0.59	1.60	1.58
N_1	2.83	2.74	0.69	0.67	0.54	0.43	0.16	0.13	0.61	0.60	1.65	1.61
N_2	2.98	2.87	0.72	0.69	0.56	0.47	0.19	0.15	0.62	0.60	1.67	1.62
N_3	3.09	2.99	0.73	0.70	0.57	0.49	0.20	0.19	0.63	0.61	1.69	1.63
N_4	3.10	3.05	0.75	0.74	0.60	0.58	0.22	0.21	0.64	0.63	1.71	1.66
N_5	3.11	3.05	0.75	0.74	0.60	0.60	0.22	0.21	0.64	0.64	1.72	1.67
S.E.±	0.03	0.05	0.01	0.02	0.02	0.03	0.03	0.03	0.05	0.03	0.06	0.05
C.D. (P=0.05)	0.12	0.16	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Details of treatments are given under materials and methods, NS- Non-significant

Table 2: Effect of limited irrigation and nitrogen levels on nitrogen, phosphorus and potassium uptake by seed and stover of Indian mustard varieties

Treatments	Nitrogen uptake ($kgha^{-1}$)				Phosphorus uptake ($kgha^{-1}$)				Potassium uptake ($kgha^{-1}$)			
	Seed		Stover		Seed		Stover		Seed		Stover	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Varieties												
V1	41.84	38.06	22.51	22.05	7.85	6.14	5.63	5.12	8.43	8.18	52.63	51.46
V2	44.97	42.07	26.58	23.88	8.57	7.56	7.35	6.06	10.08	8.84	61.22	55.51
S.E. ±	0.66	1.16	1.18	0.46	0.20	0.43	0.43	0.29	0.45	0.21	1.28	0.98
C.D.(P=0.05)	2.14	3.76	3.81	1.49	0.65	1.39	1.37	0.92	1.35	0.64	4.15	3.14
Irrigation schedule :												
I_0	38.13	35.49	21.09	20.32	7.00	5.83	5.12	4.18	7.78	7.45	49.41	47.51
I_1	48.43	44.32	27.17	24.95	9.43	7.85	7.71	7.03	11.65	9.54	62.79	58.33
I_2	43.69	40.32	24.67	23.70	8.27	6.88	6.51	5.67	9.00	8.57	56.89	54.74
S.E. ±	0.98	0.99	0.68	0.35	0.30	0.22	0.22	0.39	0.33	0.32	1.05	0.43
C.D.(P=0.05)	3.17	3.22	2.18	1.13	0.98	0.68	0.72	1.25	0.98	0.95	3.15	1.29
Nitrogen levels												
N_0	27.43	25.50	18.77	18.04	5.32	4.06	3.36	2.78	6.47	5.99	44.83	43.86
N_1	37.49	34.55	21.51	20.05	7.16	5.42	4.99	3.89	8.08	7.57	51.43	48.17
N_2	43.34	40.18	24.21	22.45	8.24	6.58	6.39	4.88	9.12	8.40	65.15	52.71
N_3	48.29	44.76	26.08	24.17	9.00	7.34	7.14	6.56	9.95	9.13	60.38	56.28
N_4	51.43	48.37	28.23	2645	10.05	9.20	8.28	7.51	10.72	9.99	64.36	59.33
N_5	52.49	49.11	28.55	29.87	10.22	9.66	8.37	7.63	10.91	10.30	56.48	60.64
S.E. ±	0.51	0.51	0.35	0.29	0.17	0.22	0.16	0.11	0.15	0.13	0.39	0.46
C.D.(P=0.05)	1.65	1.63	1.12	0.96	0.55	0.72	0.52	0.33	0.45	0.41	1.17	1.39

Details of treatments are given under materials and methods

Table 3: Effect of limited irrigation and nitrogen levels on total (seed+stover), nitrogen, phosphorous and potassium uptake by Indian mustard varieties

Treatments	Total N uptake ($kgha^{-1}$)		Total P uptake ($kgha^{-1}$)		Total K uptake ($kgha^{-1}$)	
	1999-2000	2000-2001	1999-2000	2000-2001	1999-2000	2000-2001
Varieties						
V_1	64.35	60.11	13.48	11.26	61.06	59.64
V_2	71.55	65.95	15.92	13.62	71.30	64.35
S.E. ±	1.18	0.86	0.52	0.54	1.12	0.67
C.D.(P=0.05)	3.81	2.76	1.69	1.73	3.62	2.17
Irrigation schedule :						
I_0	59.22	55.81	12.12	10.01	57.19	54.96
I_1	75.60	69.27	17.14	14.88	73.84	67.87
I_2	68.36	64.02	14.78	12.55	65.89	63.31
S.E. ±	1.29	1.28	0.59	0.61	1.05	0.98
C.D.(P=0.05)	4.17	4.13	1.91	1.96	3.17	2.95
Nitrogen levels						
N_0	46.20	43.54	8.68	6.84	51.30	49.85
N_1	59.01	54.60	12.15	9.31	59.51	55.74
N_2	67.55	62.63	14.63	11.46	65.27	61.11
N_3	74.37	68.93	16.14	13.90	70.32	65.41
N_4	79.66	74.82	18.33	16.71	75.08	69.32
N_5	81.04	75.98	18.59	17.29	76.39	70.94
S.E. ±	0.78	0.55	0.33	0.35	0.49	0.56
C.D.(P=0.05)	2.52	1.78	1.05	1.13	1.47	1.69

Details of treatments are given under materials and methods

greater transfer of N,P and K through mass to the root surface than by diffusion. Almost similar results were also reported by Reddy and Sinha (1989) and Narang and Gill (1991).

Effect of nitrogen:

The nitrogen content in seed was significantly influenced by application of nitrogen only up to N_2 level during both the years. However, nitrogen concentration in stover was not influenced significantly by nitrogen application in either of the years (Table 1). Increase in nitrogen content in seed with increase in levels of nitrogen might be due to more availability of nutrients under higher rates of fertility which increased its absorption and improved concentration of nutrients in plants. Nitrogen levels failed to cause any significant change in the phosphorus and potassium content of seed and stover during both the years (Table 1). Similarly, the nitrogen application increased significantly the uptake of NPK both by seed and stover (Table2). This might be explained with the fact that crop under fertilized environments accumulated more of these nutrients in seed and stover in one hand and simultaneously improved their respective production remarkably on the other hand, which in combination resulted higher total uptakes of these nutrients (Table 3) by the crops. This showed that production of seed and stover biomass is the prime governing factor of nutrient uptake of Indian mustard. The results are in consonance with those of Singh *et al.* (1996) and Shukla and Kumar (1977).

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