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INFLUENCE OF PRE-SOWING SEED TREATMENT WITH NITRATE SALTS AND DIFFERENT SOWING DATES ON PERFORMANCE OF MUSTARD

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SUMMARY

Mustard *(Brassica juncea* L. Czern and Coss) seeds were soaked for 24 h either in solution of nitrate salts [($Mg(NO_3)_2$, $Ca(NO_3)_2$ and KNO_3)] or in distilled water and sown in field at three different dates of its cropping season. The parameters like plant height, number of leaves per plant, leaf area, leaf area index and net assimilation rate were found to increase with nitrate treatments in comparison to distilled water soaked and control (seeds directly sown in field without any prior treatment) sets. Among nitrates, $Mg(NO_3)_2$ showed better results followed by KNO_3 and $Ca(NO_3)_2$ treatments. The plants raised from first date of sowing showed maximum plant height and leaf area but the mean number of leaves per plant and leaf area index were highest in plants with second date of sowing. Net assimilation rate was found best in the plants of third date of sowing. However the plants raised from second date of sowing showed higher values for most of the parameters in comparison with others. Data regarding yield and yield attributes like pods plant^{-1}, pod weight plant^{-1}, pod length, seed pod^{-1}, seed plant^{-1} and test weight were increased in nitrate treated sets and in timely sown crops. However nitrate treatment to seeds showed an improvement in overcoming the late sown stress in mustard.

Key words: **Growth parameters, mustard, nitrate salts, seed treatment, sowing time.**

INTRODUCTION

Mustard crop has some production constraints, one of them being the late sowing of this crop in the field which happens generally due to late harvest of rice. However, the rate of germination and seedling vigour of mustard has been shown to be affected by temperature (Gangasaran and De 1979). Kumar (1986) suggested that sowing of mustard is proper when the maximum temperature is around 30^0 C. Therefore, early as well as delayed sowing both affect its vegetative growth which is the determinant factor of its yield (Choudhary and Thakuria 1994). On the other hand studies supported that soaking of seeds with various nitrate salts prior to sowing of maize, wheat, mustard and okra has a positive impact on their germination as well as on vegetative growth (Bose *et al* 1982, Bose and Misra 1992, Bose and Misra 1999, Bose and Pandey 2003). Present investigations were therefore, conducted to study the influence of pre-sowing seed treatment with nitrate salts and different sowing dates on performance of mustard.

MATERIALS AND METHODS

Bold and healthy seeds of mustard (*Brassica juncea* L. Czern & Coss var.Kranti)were surface sterilized with 0.1% of $HgCl_2$ for five minutes. These seeds were washed thoroughly and soaked either in distilled water (T_1) or in solutions of different nitrate salts (containing 15 mM of nitrate ion), i.e. $Mg(NO_3)_2$ (T_2), $Ca(NO_3)_2$

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(T_3) and KNO_3 (T_4) in pertidishes on filter papers for 24 h at a temperature of 18 ± 2^0C under normal light conditions. The unsoaked seeds (T_0) after proper washing served as control. Unsoaked seeds (T_0) and soaked seeds (T_1-T_4) were sown in the field. Seed rate for sowing was 6 kg/ ha at a row distance of 45 cm. The distance between the plants within the row was 10 cm and this was maintained by thinning after 15 days of sowing of the crop. NPK were applied @ 80, 60 and 40 kg/ ha in form of urea, single super phosphate and muriate of potash respectively at the time of first ploughing.

The experiment was conducted in split plot design with three main plots representing the sowing date/time and five sub plots for soaked and non-soaked seeds. D_1, D_2 and D_3 represented 3 dates of sowing i.e. 14th October (early sown), and 3rd November (timely sown), and 23rd November (late sown) respectively. Experiment was carried out in two consecutive years, i.e. in 1996-97 and 1997-98. Since, the data for both years showed a similar trend, the data of 1997-98 is presented here. Observations regarding plant height, leaf number, leaf area (LA), leaf area index (LAI) and net assimilation rate (NAR) were determined at 40, 60, 80 and 100 days after sowing (DAS) as per requirement of the experiment .Crop was harvested at physiological maturity to determine the yield and yield attributes. The data have been analyzed statistically and analysis of variance for split plot design was worked out and significance was tested by 'F' test as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

Maximum plant height was noticed in the plants raised from D_1 treatment followed by D_3 and D_2 treatments at 40 DAS whereas at 60 DAS, D_3 showed highest value (Table 1). The plants raised from $Mg(NO_3)_2$ treatment showed maximum plant height among all the nitrate treatments, distilled water treatment and control one; the latter two treatments showed non significant differences. Data on leaf number plant^{-1} indicates that nitrate treatments improved the leafiness in timely (D_2) and late (D_3) sown crops at 60 DAS in comparison to control and distilled water treatments. However, among nitrate salts $Mg(NO_3)_2$ was found best in producing more number of leaves plant^{-1} (Table 1).

Table 1. Effect of pre-sowing soaking treatment to seeds with different nitrate salts (containing 15 mM of nitrate ion) and sowing time on plant height and leaf number plant^{-1} in mustard var. Kranti.

Treatment	Plant height (cm)			Leaf plant^{-1}		
	40 DAS*	60 DAS	Mean	40 DAS	60 DAS	Mean
D_1	16.06	142.70	79.38	5.80	18.60	12.20
D_2	13.34	136.57	74.95	5.53	26.73	16.13
D_3	16.15	143.17	79.66	4.80	20.67	12.78
T_0 (CONTROL)	11.12	125.46	68.29	4.78	19.89	12.38
T_1 (Distilled Water)	11.66	124.19	67.92	5.22	18.56	11.89
T_2 ($Mg(NO_3)_2$)	14.32	146.56	80.44	5.56	27.89	16.72
T_3 ($Ca(NO_3)_2$)	12.37	138.02	75.19	5.00	21.89	13.44
T_4 (KNO_3)	16.45	136.51	76.48	6.33	21.78	14.05
For D factor SE + and	6.02	3.35		0.69	1.40	
C.D. at 5%	NS	9.29		NS	3.90	
For T factor SE + and	9.24	2.24		0.70	0.91	
C.D. at 5%	NS	6.07		NS	1.89	

* DAS (Days after sowing)

D_1 = Early sown, D_2 = Timely sown, D_3 = Late sown

T_0 = Seeds were sown in field directly without any soaking treatment

T_1 – T_4 = Seeds soaked for 24 h either in distilled water or in nitrate salts and then sown in field.

The results of leaf area plant^{-1} (LA), leaf area index (LAI) and net assimilation rate (NAR) from 40 to 100 DAS are presented in Table 2 and 3. Mean data of LA in context to sowing times showed that it increased upto 60 DAS and then decreased sharply; maximum LA was noticed in D_1 followed by D_2 and D_3. At early phases of crop growth, $Mg(NO_3)_2$ showed better performance whereas, at later stages i.e., at maturity KNO_3 was found best among all in respect to LA followed by $Ca(NO_3)_2$. LAI also maintained the same trend as LA. The NAR, however, showed a different trend. D_3 treatment had highest NAR and all nitrate treatments were found better than distilled water and control one.

Table 4 represents various yield attributes of mustard. Pre-sowing soaking with nitrate salts was found to improve the number of pods plant^{-1}. Plants raised with distilled water soaked treatment (T_1) have more number of pods plant^{-1} in comparison to directly sown seeds in the field without any prior treatment (T_0). Among nitrates, KNO_3 represented highest values followed by $Mg(NO_3)_2$ and $Ca(NO_3)_2$ treatments. As far as date of sowing is concerned, maximum no. of pods plant^{-1} was attained by the plants raised from D_2 followed by D_3 and D_1. The same trend was observed with respect to pod weight plant^{-1}, pod length, no. of seed pod^{-1}, no. of seed plant^{-1} and test weight (Table 4).

The results of the present investigation are well correlated with the finding, reported by Bose and Mishra (2001). They showed that $Mg(NO_3)_2$ when given as soaking treatment to seeds prior to sowing of mustard improved plant height, leaf number, amino acid and chlorophyll contents of leaves. Allen and Morgan (1972) suggested that more leafiness is a determinant factor for higher productivity in mustard crop .The same has been observed in the present finding too where no. of leaves plant^{-1} was found directly correlated with the seed yield plant^{-1} in nitrate treated sets in all the three sowing dates (Table 1 and 4) over control. Nitrate treated sets improved the LA, LAI and NAR efficiently under late sowing conditions (Table 2 and 3).These results support the reports of various workers that nitrogen/nitrate salts when supplied to the soil increased leaf number, photosynthetically active leaf area, dry matter accumulation, CGR, RGR, NAR etc in mustard

Table 2. Effect of pre-sowing soaking treatment to seeds with different nitrate salts (containing 15 mM of nitrate ion) and sowing time on leaf area (LA) and leaf area index (LAI) in mustard var. Kranti.

Treatment	Leaf area (cm^2) plant^{-1}					Leaf area index plant^{-1}				
	40 DAS*	60 DAS	80 DAS	100 DAS	Mean	40 DAS	60 DAS	80 DAS	100 DAS	Mean
D_1	427.83	863.75	653.95	77.56	505.77	1.45	2.88	2.18	0.26	1.69
D_2	630.02	747.49	446.02	6.49	457.5	2.09	2.49	1.45	0.02	1.76
D_3	428.78	550.18	194.00	6.04	294.7	1.39	1.88	0.65	0.02	0.98
T_0 (CONTROL)	375.87	496.17	254.55	5.34	282.98	1.17	1.65	0.78	0.02	0.90
T_1 (Distilled Water)	494.30	581.58	332.02	8.51	354.10	1.45	1.94	1.11	0.03	1.13
T_2 (Mg $(NO_3)_2$)	595.89	972.06	562.00	20.32	537.56	2.07	3.24	1.87	0.07	1.81
T_3 ($Ca(NO_3)_2$)	503.81	781.71	440.05	51.41	444.48	1.74	2.60	1.47	0.17	1.49
T_4 (KNO_3)	507.85	770.85	567.49	64.58	477.69	1.77	2.57	1.89	0.21	1.61
For D factor SE + and	53.02	15.28	13.96	0.72		0.12	0.85	1.01	0.00	
C.D. at 5%	147.17	42.41	38.76	2.01		0.32	0.14	0.03	0.01	
For T factor SE + and	47.29	13.24	16.01	1.31		0.10	0.04	0.30	0.00	
C.D. at 5%	97.60	27.37	33.04	2.71		0.21	0.09	0.07	0.01	

* DAS (Days after sowing)

D_1 = Early sown, D_2 = Timely sown, D_3 = Late sown

T_0 = Seeds were sown in field directly without any soaking treatment.

$T_1 - T_4$ = Seeds soaked for 24 h either in distilled water or in nitrate salts and then sown in field.

Table 3. Effect of pre-sowing soaking treatment to seeds with different nitrate salts (containing 15 mM of nitrate ion) and sowing time on net assimilation rate (NAR) in mustard var Kranti.

Treatment	Net assimilation rate (mg /cm^2/day)				
	20-40 DAS*	40-60 DAS	60-80 DAS	80-100 DAS	Mean
D_1	0.87	0.95	1.14	3.52	1.620
D_2	0.93	0.91	1.73	5.50	2.267
D_3	1.06	0.78	0.84	11.43	3.527
T_0 (CONTROL)	0.88	1.11	1.53	5.26	2.195
T_1 (Distilled Water)	0.89	0.85	1.43	5.88	2.265
T_2 (Mg $(NO_3)_2$)	0.95	0.75	1.05	6.62	2.342
T_3 (Ca $(NO_3)_2$)	1.01	0.83	1.08	9.30	3.055
T_4 (KNO_3)	1.03	0.86	1.09	7.05	2.575
For D factor SE + and	0.05	0.06	0.10	0.14	
C.D. at 5%	NS	NS	0.27	0.38	
For T factor SE + and	0.06	0.05	0.12	0.64	
C.D. at 5%	NS	0.10	0.25	1.33	

* DAS (Days after sowing)
D_1 = Early sown, D_2 = Timely sown, D_3 = Late sown
T_0 = Seeds were sown in field directly without any soaking treatment.
$T_1 - T_4$ = Seeds soaked for 24 h either in distilled water or in nitrate salts and then sown in field.

Table 4. Effect of pre-sowing soaking treatment to seeds with different nitrate salts (containing 15 mM of nitrate ion) and sowing time on number of pods plant^{-1}(A), pods weight g plant $^{-1}$ (B), pod length (cm) (C), number of seeds pod^{-1} (D), number of seeds plant^{-1}(E) and test weight (g) (F) in mustard var. Kranti.

Treatment	PARAMETERS					
	A	B	C	D	E	F
D_1	265.93	22.32	4.95	14.52	2727.69	4.29
D_2	472.07	34.93	5.55	15.03	3064.25	4.89
D_3	272.60	24.59	4.99	13.43	3654.05	2.92
T_0 (Control)	227.89	23.23	4.83	13.33	2752.65	3.68
T_1 (Distilled Water)	294.44	24.39	4.95	13.63	2804.51	3.70
T_2	380.44	29.94	5.39	15.07	3538.21	4.26
T_3	342.67	28.74	5.19	14.54	3108.13	4.13
T_4	383.55	30.17	5.46	15.16	3539.82	4.40
For D factor SE ±	1.45	0.21	0.09	0.06	38.73	0.03
and C.D. at 5%	4.02	0.95	0.24	0.18	107.50	0.09
For T factor SE ±	1.43	0.16	0.11	0.07	34.72	0.04
and C.D. at 5%	2.95	0.34	0.24	0.14	71.67	0.09

D_1 = Early sown, D_2 = Timely sown, D_3 = Late sown
T_0 = Seeds were sown in field directly without any soaking treatment
$T_1 - T_4$ = Seeds were sown in field after 24 h soaking treatment either in distilled water or in nitrate salts

(Ogunlela1989, Padmani *et al*.1994 and Singh *et al*.1992). Bose and Mishra (1999 and 2001) reported that $Mg(NO_3)_2$ salt treatment to seeds prior to sowing improved a number of parameters of germination and post-germination phases of plant growth in *Brassica juncea L.* varieties. It has been also found that during soaking of seeds in $Mg(NO_3)_2$ solution the cations Mg^{+2} and anions NO_3^{-1} influxed in the seeds and showed their carry over effects during vegetative growth period and consequently the yield was improved (Bose and Mishra 1999 and Bose and Pandey 2003). In the present investigation same might have happened where the cations like K^{+1}, Mg^{+2} and Ca^{+2} were influxed along with anion NO_3^{-1} during soaking of seeds which in turn showed their carry over effects in later stages of growth (Table 1, 2 and 3). Further, it has also been suggested that NO_3 is not only a nutrient, but it also act as a signal for intiating various metabolic process (Tischener 2000) even while subjected as seed treatment (Bose and Pandey 2003). However, the present investigation concludes that nitrate seed treatment for a brief period (24 h) may improve the yield not only in timely (D_2) sown seeds but also it has the capacity to over come the late sowing stress in mustard by improving its yield in late sown (D_3) condition. Reports also showed that delay in sowing of mustard is a cause for reduction in yield (Choudhury and Thakuria 1994, Reddy and Kumar 1997) resulting from a decease in vegetative growth. Therefore, this type of pre-sowing soaking treatment to seeds with nitrate salts may be beneficial for the improvement of yield in late sown mustard crop.

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