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Assessment of growth and yield attributes of mustard under irrigation, nitrogen and mulch levels

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Abstract
A field experiment was conducted during *rabi* season of 2021-22 on loamy sand of Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, Gujarat to assess the impact of levels of irrigation and nitrogen with & without mulch on growth, yield attributes, yield, field water use efficiency and economics of mustard. The soil was normal in EC (0.112 dS/m), low in organic carbon (0.30%), available nitrogen (187.56 kg/ha), medium in available phosphorus (49.80 kg/ha), available potash (256.40 kg/ha) with slightly alkaline (7.6 pH) in reaction. The experiment was laid out in split plot design and replicated four times. Twelve treatment combinations consisting three levels of irrigation (0.6, 0.8 and 1.0 IW/CPE), two levels of nitrogen (75 and 100% RDN) with and without mustard straw mulch (2 and 0 t/ha) were embedded. The results indicated that significantly higher growth and yield parameters *viz*., plant height at harvest (195.6, 191.9 cm),dry matter accumulation at harvest (46.69, 49.26 g/plant), CGR, RGR, number of primary branches per plant (5.50, 5.58), number of siliquae per plant (277.0, 279.3), number of seeds per siliqua (13.50, 13.48), seed yield (2106, 1999 kg/ha) and stover yield (4783, 4765 kg/ha) with irrigation scheduled at 1.0 IW/CPE and 100% RDN with mustard straw mulch @ 2 tonne per ha, individually. Siliqua length, test weight and harvest index of mustard were not affected by irrigation and nitrogen levels with & without mulch. Higher FWUE was found with irrigation scheduled at 0.6 IW/CPE and 100% RDN with mulch. Total N, P and K uptake as well as available N, P_2O_5 and K_2O after harvest were found highest with higher level of inputs *i.e.*, irrigation, nitrogen and mulch. Maximum net return (₹ 107647/ha) and BCR (3.47) was secured with irrigation scheduled at 1.0 IW/CPE along with 100% RDN with mustard straw mulch @ 2 tonne per ha. Thus, it is concluded that mustard crop should be irrigated at 1.0 IW/CPE and fertilized with 75% RDN (three splits, *i.e.*, 50% as basal and 25% each after 25 and 55 DAS) along with 2 tonne per ha mustard straw mulch for securing higher yield in loamy sand soil.

Keywords: Irrigation, mustard, yield, mulch

Introduction
Indian mustard is an important oilseed crop of the Indian subcontinent and contributes more than 80% of the total rapeseed-mustard production of the country. The oil content of Indian mustard is varied between 30 to 45.7%. Among the nine edible oilseeds cultivated in India, rapeseed-mustard (*Brassica* spp.) contributes 28.6% in the total production of oilseeds. European Union is the leading producer of mustard seed in the world accounting for 35% of the world production followed by Canada (21%), China (22%) and India (11%) (GOI, 2018). In India, it is the second most important edible oilseed crop after groundnut sharing 27.8% in the India's oilseed economy.

The productivity of mustard in India (1511 kg/ha) is very low compared to world average yield. Indian mustard is particularly being deep rooted and able to utilize the soil moisture and nutrient from lower layers of the soil. Therefore, they are mostly grown under rainfed conditions at residual soil moisture on marginal and sub marginal land. However, crop under such conditions result in poor yield. Several agronomical manipulations are needed to harness the maximum yield potential depending on the climatic and resource management. Irrigation and fertility levels influence to a great extent of growth, yield attributes and yield (Bharati *et al.*, 2003) [4]. Mustard crop is generally grown on marginal lands with poor fertility status and therefore it suffers from nutrient stress. Among three primary nutrients (N, P and K) rapeseed and mustard being cruciferous crop, responds remarkably well to nitrogen fertilization mainly due to its exhaustive nature and deep rooting system. Presently, most of the farmers are using exhaustive high yielding varieties of mustard that lead to heavy withdrawal of nutrient from the soil and fertilizer consumption remained much below as compared to removal.

Mulches checks soil erosion, reduces evaporation, increase infiltration, keeps down weeds, improves soil structure and eventually increases crop yields. Mulching plays an important role to increase yield of the crop especially in the arid and semi-arid regions as it may be proved beneficial by reducing water losses. Mulching has been advocated as an effective means for conserving soil moisture. It works as an insulating material against heat or cold and also as a surface barrier to check evaporation from soil surface. Application of organic mulch of paddy straw significantly increased growth parameters, yield and yield attributes and water use efficiency of mustard (Yadav *et al.,* 2010) [28].

Material and Methods

The field experiment was conducted during *rabi* season of 2021-22 on loamy sand of Agronomy Instructional Farm, C. P. College of Agriculture, S. D. Agricultural University, Sardarkrushinagar, Gujarat to assess the impact of levels of irrigation and nitrogen with & without mulchon growth, yield attributes, yield, field water use efficiency and economics of mustard. The soil was normal in EC (0.112 dS/m), low in organic carbon (0.30%), available nitrogen (187.56 kg/ha), medium in available phosphorus (49.80 kg/ha), available potash (256.40 kg/ha) with slightly alkaline (7.6 pH) in reaction. The experiment was laid out in split plot design and replicated four times. Twelve treatment combinations consisting three levels of irrigation (0.6, 0.8 and 1.0 IW/CPE), two levels of nitrogen (75 and 100% RDN) with and without mustard straw mulch (2 and 0 t/ha) were embedded. Mustard variety GDM 4 was selected for experimental purpose.

Results and Discussion

Crop growth rate

Effect of irrigation levels

A perusal of data presented in Table 2 revealed that various levels of irrigation exerted significant influence on crop growth rate. Significantly higher crop growth rate 1.81, 5.76, 8.84 and 6.65 g/m^2/day was recorded with treatment I_3 (1.0 IW/CPE) at 30, 60 and 90 DAS and at harvest, respectively, which remained statistically at par with treatment I_2 (0.8 IW/CPE) at 30 DAS. Treatment I_3 (1.0 IW/CPE) produced 15.28, 36.49, 54.81 and 50.45% higher crop growth rateover treatment I_1 (0.6 IW/CPE) at30, 60, 90 DAS and harvest, respectively.

This might be due to increment in irrigation improved the soil and this leads to improve the growth of mustard and development of fresh leaves. Development of the roots leads to better penetration of roots to spread into deeper layers of soil so that it can uptake more nutrients from soil cause more dry matter accumulation which results into better crop growth rate.The results are conformity with Digra *et al*. (2016) [9] and Barman *et al.* (2021) [2].

Effect of nitrogen levels with & without mulch

The data presented in Table 1 revealed that nitrogen levels with & without mulch did not exert significant influence on crop growth rate at 30 DAS. Whereas, N_4 (100% RDN with straw mulch) produced significantly higher crop growth rate 5.90, 9.13 and 7.56 g/m^2/day was recorded at 60,90 and harvest, respectively. Here, crop growth rate was significantly higher with treatment N_3 (100% RDN without mulch) over treatment N_1 (75% RDN without mulch). Treatment N_3produced 14.65, 22.04 and 35.12% more crop growth rate at 60 DAS, 90 DAS and at harvest over treatment N_1, respectively.

This might be due to increased nitrogen rate enhanced assimilation of photosynthates and thereby resulting in more dry matter accumulation. Overall improvement in growth under application of nitrogen could be ascribed to vital role of nitrogen improving both vegetative and reproductive growth which subsequently led to plant biomass.The results are conformity with Dongarkar *et al*. (2005) [10].

Treatment N_4 (100% RDN with straw mulch) increasing dry matter accumulation over treatment N_3 (100% RDN without mulch) except at 30 DAS. Treatment N_4 significantly increased 21.64, 29.87 and 43.45%higher crop growth rate at 60, 90 DAS and at harvest over treatment N_3, respectively. This might be due to mulch application improved soil moisture, nutrients and other growth factors that altoghether promoted growth and plant dry matter accumulation resulted in more crop growth rate.The results are conformity with the finding of Digra *et al.* (2016) [9] and Lal *et al.* (2017) [9].

Relative growth rate

Effect of irrigation levels

A perusal of data presented in Table 2 revealed that various levels of irrigation exerted significant influence on relative growth rate except at harvest. Significantly higher relative growth rate 0.0188, 0.0206 and 0.0111 g/g/day was recorded with I_1 (1.0 IW/CPE) at 30, 60 and 90 DAS, respectively. Which remained at par with treatment I_2 (0.8 IW/CPE) at 30, 60 and 90 DAS. Treatment I_3 (1.0 IW/CPE) produced 13.25, 9.57 and 12.12% higher relative growth rate than I_1 (0.6 IW/CPE) at30, 60 and 90 DAS, respectively.

This might be due to increment in irrigation improved the availability of moisture and nutrients which leads to improve dry matter accumulation of plant which results into better relative growth rate.The results are conformity with Digra *et al*. (2016) [9].

Effect of nitrogen levels with & without mulch

The data presented in Table 2 revealed that nitrogen levels with & without mulch did not exert significant influence on RGR at 30 DAS. Whereas, N4 (100% RDN with straw mulch) produced significantly higher relative growth rate of 0.0213, 0.0114 and 0.054 g/g/day was recorded at 60, 90 DAS and at harvest, respectively.

Relative growth rate at 60, 90 DAS and at harvest was significantly higher with treatment N_3 (100% RDN without mulch) over treatment N_1 (75% RDN without mulch).This might be also due to favourable influence of nitrogen on cell division and cell elongation, which could have produced more crop growth and higher dry matter with increased relative growth rate.These results are in conformity with the findings of Dongarkar *et al*. (2005) [10].

Treatment N_4 (100% RDN with straw mulch) significantly increased relative growth rate at 60, 90 DAS and at harvest over treatment N_3(100% RDN without mulch).This might be due to fact that application of mulch improved soil moisture, nutrients and dry matter resulted in more relative growth rate. Decreasing relative growth rate at harvest is due to several reasons *viz.* increasing in non-photosynthetic biomass and shading of leaves. The results are conformity with the finding of Digra *et al.* (2016) [9] and Lal *et al.* (2017) [17].

Yield and yield attributes

Effect of irrigation levels

A perusal of data presented in Table 3 revealed that various irrigation levels exerted significant influence on number of primary branches per plant. Treatment I_3 (1.0 IW/CPE) recorded significantly higher number of primary branches per plant (5.50) which remained at par with the treatment I_2 (0.8 IW/CPE). The lowest number of primary branches per plant (4.70) were recorded with treatment I_1 (0.6 IW/CPE). Treatment I_3 (1.0 IW/CPE) produced 4.96 and 17.02% more primary branches per plant over I_2 (0.8 IW/CPE) and I_1 (0.6 IW/CPE), respectively.

Increase in number of primary branches per plant of mustard might be due to the better moisture availability which favoured the development of branches by the way of maintaining a better moisture regime. The results are conformity with the finding of Yadav (2005) [27], Kashved *el al.* (2010) [13], Parmar *et al.* (2016) [18] and Devedee *et al.* (2019) [8].

Effect of nitrogen levels with & without mulch

The data presented in Table 3 revealed that various nitrogen levels with & without mulch exerted significant influence on primary branches per plant. Significantly higher primary branches per plant (5.58) was recorded with treatment N_4 (100% RDN with straw mulch), while lowest primary branches per plant (4.75) was recorded with treatment N_1 (75% RDN without mulch).

Number of primary branches per plant was significantly 6.94% higher with treatment N_3 (100% RDN without mulch) over treatment N_1 (75% RDN without mulch). This might be due to fact that increasing doses of nitrogen had pronounced effect on number of primary branches of mustard which might be due to nitrogen is the essential constituent of chlorophyll molecules. This made the plants more photo synthetically efficient for higher assimilate and dry matter production. Branching is related with the formation and development of auxiliary or lateral buds, which physiologically is the function of tissue differentiation, multiplication and development which led to higher accumulation and translocation in plant might have improved vegetative growth and ultimately increased primary branches per plant in mustard. These results are in conformity with the finding of Dongarkar *et al.* (2005) [10], Kumar and Kumar (2007) [16], Singh and Singh (2012) [23] and Keerthi *et al*. (2017) [14].

Treatment N_4 (100% RDN with straw mulch) significantly increased 9.84% more primary branches per plant over treatment N_3 (100% RDN without mulch). It may be attributed to enriched crop nutritional environment and conservation of soil moisture *etc.* which might have resulted in more synthesis of photosynthates, increased crop biomass production and as a result, higher branching ability. The results is in conformity with with the finding of Yadav (2005) [27], Kashved *et al.* (2010) [13] and Roy (2019) [20].

Number of siliquae per plant

Effect of irrigation levels

A perusal of data presented in Table 4 revealed that various irrigation levels significantly influenced number of siliquae per plant. Treatment I_3 (1.0 IW/CPE) recorded significantly higher number of siliquae per plant (277.0) and it remained statistically at par with treatment I_2 (0.8 IW/CPE).Lowest number of siliquae per plant (239.1) recorded with treatment I_1 (0.6 IW/CPE). The magnitude of increase in number of siliquae per plant under treatment I_3 (1.0 IW/CPE) was to extent of 15.85% over treatment I_1 (0.6 IW/CPE).

Increase in number of siliquae per plant of mustard with increase in irrigation might be due to increasing rates of growth and development of the plants and also ensured a higher availability of nutrients which produced more numbers of branches and cumulated in a better sink development that led to increase in number of siliquae per plant. The findings conformity with Chaudhari *et al.* (2016) [6], Pawar *et al.* (2016) [19] and Jat *et al.* (2017) [12].

Effect of nitrogen levels with & without mulch

The data presented in Table 5revealed that different nitrogen levels with & without mulch exerted significant influence on siliquae per plant. Significantly higher number of siliquae per plant (279.3) was recorded withN_4 (100% RDN with straw mulch), while least number of siliquae per plant (260.9) was recorded with N_1 (75% RDN without mulch).

An appraisal of data presented in Table 4 showed that treatment N_3 (100% RDN without mulch) produced 6.76% higher number of siliquae per plant as compared to treatment N_1 (75% RDN without mulch). Increased number of siliquae per plant might be due to the fact that application of higher level of nitrogen improved availability of nitrogen in adequate quantity coinciding with physiological needs of crop, which might have accelerated crop growth and enhanced photosynthetic activity. The increased availability of photosynthates might have increased number of flowers and their fertilization resulted in higher number of siliquae per plant. This findings corroborated by Dawson *et al.* (2009) [7], Kishore *et al.* (2014) [15], Singh and Kumar (2014) [22], Jat *et al.* (2018) [11] and Yadav and Dhanai (2018) [26].

Treatment N_4 (100% RDN with straw mulch) produced 9.83% higher number of siliquae per plant as compared to treatment N_3 (100% RDN without mulch). This might be due to application of mulch improves availability of nutrients, suppression of weeds, moderation of hydrothermal temperature and better availability of moisture, which created a favourable growing conditions for the crop, increased branching and boosted siliquae formation in the branches. This findings corroborated by Yadav *et al.* (2005) [27], Lal *et al.* (2017) [9] and Kumar *et al.* (2018) [29].

Number of seeds per siliqua

Effect of irrigation levels

A perusal of data presented in Table 4 revealed that various irrigation levels had significant effect on number of seeds per siliqua. Treatment I_3 (1.0 IW/CPE) recorded significantly higher number of seeds per siliqua (13.50) while, least number of seeds per siliqua (11.96) recorded with treatment I_1 (0.6 IW/CPE). Here, I_3 (1.0 IW/CPE) produced 23.17% more seeds per siliqua over treatment I_1(0.6 IW/CPE).

This might be due to application of irrigation ensured the better moisture and nutrient availability with a better translocation of photosynthates from source to sink which led to more number of seeds per siliqua. Least number of seeds per siliqua might have been experienced due to moisture stress condition at various stages of mustard. Similar results found by Devedee *et al.* (2019) [8], Singh *et al.* (2019) [25], Barrick *et al.* (2020) [3] and Barman *et al.* (2020) [2].

Effect of nitrogen levels with & without mulch

The data presented in Table 4 revealed that application of nitrogen with mustard straw mulch gave significantly higher seeds per siliqua (13.48)with treatment N_4 (100% RDN with straw mulch), while lowest seeds per siliqua (10.84) was recorded with treatment N_1 (75% RDN without straw mulch).

Treatment N_3 (100% RDN without mulch) produced 10.79% more number of siliquae per plant as compared to treatment N_1 (75% RDN without mulch). It might be due to nitrogen cause significant improvement in overall growth and development of the mustard crop expressed in terms of plant height and number of branches per plant by virtue of increased photosynthetic efficiency. Thus, greater availability of photosynthates and nutrients to develop reproductive structures seems to have resulted in increased number of seeds per siliqua. The present findings are within the close proximity of Dawson *et al.* (2009) [7], Singh and Singh (2012) [23], Kishore *et al.* (2014) [15], Singh and Kumar (2014) and Yadav and Dhanai (2018) [22].

Treatment N_4 (100% RDN with straw mulch) produced 12.23% higher number of siliquae per plant as compared to treatment N_3 (100% RDN without mulch). This might be due to fact that application of mulch might have resulted in greater availability of photosynthates, metabolites and nutrients supply due to better plant height and more primary branches which was found to be beneficial for production of healthy and more seeds per siliqua in mustard. Similar results found by Digra *et al.* (2016) [9], Lal *et al.* (2017) [17] and Roy (2019) [20].

Length of siliqua

Effect of irrigation levels

A perusal of data presented in Table 5 revealed that various irrigation levels did not exert significant influence on length of siliqua of mustard. Treatment I_3 (1.0 IW/CPE) recorded maximum length of siliqua (5.34 cm) and minimum length of siliqua (4.90 cm) was observed with treatment I_1 (0.6 IW/CPE).

Effect of nitrogen levels with & without mulch

Effect of nitrogen levels with & without mulch on length of siliqua found non-significant. Maximum length of siliqua (5.42 cm) of mustard was recorded with treatment N_4 (100% RDN with straw mulch), while lowest length of siliqua (4.78 cm) was recorded with treatment N_1 (75% RDN without mulch).

Test weight (g)

Effect of irrigation levels

A perusal of data presented in Table 5 revealed that various irrigation levels did not exert any significant influence on test weight of mustard. Treatment I_3 (1.0 IW/CPE) recorded maximum test weight (5.44 g), while minimum test weight (4.83 g) recorded with treatment I_1 (0.6 IW/CPE).

Effect of nitrogen levels with & without mulch

Effect of nitrogen levels with & without mulch on test weight recorded non-significant. Maximum test weight (5.47 g) of mustard was recorded with treatment N_4 (100% RDN with straw mulch), while lowest test weight (4.87 g) was recorded with treatment N_1 (75% RDN without straw mulch).

Total nutrients uptake

Effect of irrigation levels

The data revealed that increased in the levels of irrigation significantly increased the total N, P and K uptake by mustard. Significantly higher total N, P and K uptake (118.60, 14.54 and 82.21 kg/ha, respectively) by mustard was recorded by the application of I_3 (1.0 IW/CPE). The lowest total N, Pand Kuptake (81.00, 10.35 and 60.87 kg/ha, respectively) was recorded by the treatment I_1 (0.6 IW/CPE).

This might be due to fact that increased application of irrigation increased nutrient uptake by seed and stover of mustard which results into higher total N, P and K uptake by mustard. The results are conformity with the finding of Bhatt and Kushwaha (2019) [5] and Singh *et al.* (2021) [24].

Effect of nitrogen levels with & without mulch

Application of nitrogen with mulch significantly increased the total N, P and K uptake by mustard. Significantly higher N, Pand K uptake (116.21, 14.20 and 80.27 kg/ha, respectively) was recorded with the application of 100% RDN with straw mulch. The lowest N, P and K uptake (82.27, 10.98 and 63.60 kg/ha respectively) was recorded by the application 75% RDN without straw mulch.

This might be due to fact that increased application of nitrogen with mulch increased nutrient uptake by seed and stover of mustard which results into higher total N, P and K uptake by mustard. This result was confirmed with the findings of Singh *et al*. (2010) [30] and Singh *et al*. (2012) [23].

Table 1: Effect of irrigation and nitrogen with & without mulch on periodical crop growth rate of mustard

Treatments		Crop growth rate ($g/m^2/day$)			
		30 DAS	60 DAS	90 DAS	At harvest
A.	**Irrigation levels**				
	I_1: 0.6 IW/CPE	1.57	4.22	5.71	4.42
	I_2: 0.8 IW/CPE	1.75	5.01	7.43	5.96
	I_3: 1.0 IW/CPE	1.81	5.76	8.84	6.65
	S.Em. ±	0.04	0.14	0.29	0.16
	C.D. at 5%	0.13	0.49	0.99	0.55
	C.V.%	8.93	11.36	15.57	11.11
B.	**Nitrogen levels with & without mulch**				
	N_1:75% RDN without mulch	1.68	4.23	5.76	3.90
	N_2:75% RDN with straw mulch	1.67	5.02	7.39	5.98
	N_3:100% RDN without mulch	1.76	4.85	7.03	5.27
	N_4: 100% RDN with straw mulch	1.73	5.90	9.13	7.56
	S.Em. ±	0.04	0.18	0.35	0.14
	C.D. at 5%	NS	0.51	1.00	0.40
Interaction					

S.Em. ±	0.07	0.30	0.60	0.24
C.D. at 5%	NS	NS	NS	NS
C.V.%	8.47	12.20	16.34	8.52

Table 2: Effect of irrigation and nitrogen with & without mulch on periodical relative growth rate of mustard

Treatments		Relative growth rate (g/g/day)			
		30 DAS	60 DAS	90 DAS	At harvest
A.	**Irrigation levels**				
	I_1: 0.6 IW/CPE	0.0166	0.0188	0.0099	0.0047
	I_2: 0.8 IW/CPE	0.0183	0.0195	0.0107	0.0050
	I_3: 1.0 IW/CPE	0.0188	0.0206	0.0111	0.0050
	S.Em. ±	0.0004	0.0004	0.0003	0.0001
	C.D. at 5%	0.0013	0.0013	0.0009	NS
	C.V.%	8.17	7.46	10.17	7.31
B.	**Nitrogen levels with & without mulch**				
	N_1:75% RDN without mulch	0.0176	0.0182	0.0098	0.0042
	N_2:75% RDN with straw mulch	0.0176	0.0200	0.0106	0.0051
	N_3:100% RDN without mulch	0.0182	0.0190	0.0104	0.0048
	N_4: 100% RDN with straw mulch	0.0182	0.0213	0.0114	0.0054
	S.Em. ±	0.0004	0.0004	0.0003	0.0002
	C.D. at 5%	NS	0.0012	0.0010	0.0005
Interaction					
S.Em. ±		0.0007	0.0007	0.0006	0.0003
C.D. at 5%		NS	NS	NS	NS
C.V.%		7.74	7.30	11.19	12.09

Table 3: Effect of irrigation and nitrogen levels with & without mulch on number of primary branches per plant of mustard

Treatments		Number of primary branches per plant
A.	**Irrigation levels**	
	I_1: 0.6 IW/CPE	4.70
	I_2: 0.8 IW/CPE	5.24
	I_3: 1.0 IW/CPE	5.50
	S.Em. ±	0.17
	C.D. at 5%	0.58
	C.V.%	13.08
B.	**Nitrogen levels with & without mulch**	
	N_1:75% RDN without mulch	4.75
	N_2:75% RDN with straw mulch	5.18
	N_3:100% RDN without mulch	5.08
	N_4: 100% RDN with straw mulch	5.58
	S.Em. ±	0.13
	C.D. at 5%	0.37
Interaction		
S.Em. ±		0.22
C.D. at 5%		NS

Table 4: Effect of irrigation and nitrogen levels with & without mulch on number of siliquae per plant and number of seeds per siliqua of mustard

Treatments		Number of siliquae per plant	Number of seeds per siliqua
A.	**Irrigation levels**		
	I_1: 0.6 IW/CPE	239.1	10.96
	I_2: 0.8 IW/CPE	258.4	11.98
	I_3: 1.0 IW/CPE	277.0	13.50
	S.Em. ±	5.92	0.34
	C.D. at 5%	20.49	1.18
	C.V.%	9.17	11.19
B.	**Nitrogen levels with & without mulch**		
	N_1:75% RDN without mulch	238.2	10.84
	N_2:75% RDN with straw mulch	260.9	12.26
	N_3:100% RDN without mulch	254.3	12.01
	N_4: 100% RDN with straw mulch	279.3	13.48
	S.Em. ±	6.10	0.32
	C.D. at 5%	17.70	0.92
Interaction			
S.Em. ±		10.57	0.55

C.D. at 5%	NS	NS
C.V.%	8.19	9.00

Table 5: Effect of irrigation and nitrogen with & without mulch on length of siliqua and test weight of mustard

	Treatments	Length of siliqua (cm)	Test weight (g)
A.	**Irrigation levels**		
	I_1: 0.6 IW/CPE	4.90	4.83
	I_2: 0.8 IW/CPE	5.00	5.25
	I_3: 1.0 IW/CPE	5.34	5.44
	S.Em. ±	0.15	0.14
	C.D. at 5%	NS	NS
	C.V.%	11.45	10.69
B.	**Nitrogen levels with & without mulch**		
	N_1:75% RDN without mulch	4.78	4.87
	N_2:75% RDN with straw mulch	5.08	5.18
	N_3:100% RDN without mulch	5.04	5.17
	N_4: 100% RDN with straw mulch	5.42	5.47
	S.Em. ±	0.16	0.15
	C.D. at 5%	NS	NS
Interaction			
S.Em. ±		0.27	0.26
C.D. at 5%		NS	NS

Table 6: Effect of irrigation and nitrogen levels with & without mulch on N, P and K uptake by seed of mustard

Treatments		Nutrient uptake by seed (kg/ha)		
		N	**P**	**K**
A.	**Irrigation levels**			
	I_1: 0.6 IW/CPE	34.66	4.92	11.13
	I_2: 0.8 IW/CPE	44.75	6.15	13.87
	I_3: 1.0 IW/CPE	54.80	7.36	15.71
	S.Em. ±	1.66	0.18	0.42
	C.D. at 5%	5.75	0.64	1.46
	C.V.%	14.84	11.99	12.42
B.	**Nitrogen levels with & without mulch**			
	N_1:75% RDN without mulch	35.99	5.55	12.09
	N_2:75% RDN with straw mulch	46.30	6.05	13.84
	N_3:100% RDN without mulch	43.87	5.93	13.31
	N_4: 100% RDN with straw mulch	52.80	7.04	15.03
	S.Em. ±	1.68	0.23	0.45
	C.D. at 5%	4.89	0.65	1.32
Interaction				
S.Em. ±		2.92	0.39	0.78
C.D. at 5%		NS	NS	NS
C.V.%		13.05	12.72	11.57

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