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Yield and economical parameters of mustard as influenced by nutrient management in different irrigation schedules

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Abstract

A field experiment was conducted at R.B.S. College, Bichpuri, Agra during the crop season of 2021-22 and 2022-23 to study the effect of irrigation schedules and nutrient management on yield and economics of Indian mustard (*Brassica juncea* var. RH-725). The experiment was carried out in split plot design with three replications. The treatments consisted of three schedules of irrigation in the main plots and four nutrient management practices in sub-plots. The results showed that, irrigated treatments show significantly higher yield parameters as compared to no irrigation treatment. And its trend under various irrigation scheduling were in increasing order as no irrigation < one irrigation at 35 DAS < two irrigations at 35 & 60 DAS. Application of NPKS at different levels (50, 75 and 100%) either alone or with foliar spray of thio urea recorded significantly higher yield parameters as compared to control treatment. Under different treatment combinations of Irrigation scheduling and nutrient management practices maximum gross return, net return and B: C ratio was observed with application of 100% NPKS with two irrigations at 35 and 60 DAS stages.

Keywords: Indian mustard, Irrigation schedules, thio urea, net return and B: C ratio

Introduction

Indian mustard [*Brassica juncea* (L.) Czern & Coss.] is an important *rabi* oilseed crop in north west part of India. The average yield (1145 kg ha⁻¹) is relatively low due to the improper fertilization and other agronomic practices in which irrigation schedules is one of them. The average productivity of mustard needs to be enhanced up to 2562 kg ha⁻¹ by 2030 for ensuring self sufficiency in edible oil (DRMR, 2011) ^[5]. To meet up the growing demand of oilseed, it is urgent to ensure its higher production. It is almost impossible to increase production by increasing area because of crop competitions. Therefore, production per unit area can be increased by adopting improved technology and inputs. Mustard can be raised well both under rainfed and irrigated conditions. Being more responsive to fertilizers, it gives better returns under irrigated conditions. The mustard crop is usually grown under arid and semi-arid conditions. Thus, irrigation plays a vital role in growth and yield of this crop in these regions (Piri *et al*, 2011) ^[9]. Mustard nutritionally very rich due to higher oil content which varies from 37.2 - 48.4 per cent. It's belonged to the family of Cruciferae which containing high amounts of glucosinolates and have a high sulfur demand (Rathore *et al*, 2015) ^[10]. Thiourea, a sulphahydral compound, is known to improve oilseeds productivity and its role as a drought ameliorant is well established under the sub-tropical regions. Its application in rapeseed-mustard affects oil, protein and glucosinolate concentration (Ghosh *et al*, 2000) ^[6]. Keeping in view the present study was carried out with different nutrient management practices in various irrigation schedules.

Materials and Methods

The field experiment was conducted at the Instructional Farm, *Raja Balwant Singh College*, Bichpuri, Agra, India (27° 17' 46" N, 77° 90' 33"E) during two *rabi* season of 2021-2022 and 2022-23. The soil texture of experimental field was sandy clay loam that contained 4.29 g kg⁻¹ organic carbon, 185.0 kg ha⁻¹ N, 16.3 kg ha⁻¹ available phosphorus, 232.4 kg ha⁻¹ available K

and 16.8 kg ha⁻¹ available S with pH 7.9. The experiment was laid out in split plot design consisting of twelve treatments combinations in which three irrigation schedules as main plot and four nutrient management as sub plot treatment with three replications. The crop was sown in the last week of October, using the variety RH-725 and harvested on second week of March. Seeding was done in the row spacing 40 cm and plant to plant spacing 10 cm apart. Urea, di-ammonium phosphate, muriate of potash and bentonite sulphur were used as a source of N, P, K and S, respectively. A standard dose for phosphorus (40 kg ha⁻¹), Potassium (20 kg ha⁻¹) Sulphur (30 kg ha⁻¹) and half of the recommended dose (40 kg ha⁻¹) of nitrogen were side dressed at the sowing time and remaining half nitrogen was top dressed at 35 DAS with first irrigation. Weeds were kept under control by manual weeding when needed. Thinning was done after two weeks of sowing to maintain plant to plant spacing of 10 cm. Yield parameters was recorded at harvest and seed, stover yield were calculated as per net plot area yield converted into per hacture with mutiplying factor and harvest index was computed with the ratio of economic yield to the total biological yield. Economical parameters were calculated by appropriate formula as per current market rates.

Results and Discussion

Effect of Irrigation scheduling on yield parameters

It is clear from results that irrigated treatments show significantly higher yield **parameters** as compared to no irrigation treatment and its trend under various irrigation scheduling were in increasing order as no irrigation < one irrigations < two irrigations. Seed yield of mustard was found in the range of 1137.2 to 1937.5 under different irrigation treatments. maximum seed yield (1902.5 kg ha⁻¹) was observed with treatment of two irrigations at 35 and 60 DAS which was 16.58 and 67.30 per cent significantly higher as compared to one irrigation at 35 DAS and no irrigation treatments, respectively. Treatment of one irrigation also recorded 43.50 per cent significantly higher seed yield as compared to no irrigation treatment. Minimum seed yield (1137.2 kg ha⁻¹) was noted with no irrigation treatment. The significant improvement in the mustard seed yield might be the cumulative effect of significant improvement in the value of yield attributes like number of siliquae per plant, number of seeds/siliqua and test weight. Bharati and Prasad (2002) ^[3] and Piri *et al.* (2019) ^[8] also reported an increase in seed yield of mustard due to irrigation. Simillar trend was also noted in staver and biological yield of mustard. Maximum harvest index (28.94%) was observed with two irrigations at 35 and 60 DAS which was significantly higher as compared to one irrigation at 35 DAS and no irrigation treatments. Availability of more moisture to plants might have resulted in the production of more photosynthates which might have helped in the translocation of more photosynthates to seeds and increased harvest index. These results were in conformity with those of Piri *et al.* (2011) ^[9].

Effect of nutrient management on yield parameters

Application of NPKS at different levels (50, 75 and 100%) either alone or with foliar spray of thio urea recorded significantly higher yield parameters (Table-1) as compared to control treatment. Seed yield ranged from 1243.5 to 1746.7 kg

ha⁻¹ under different nutrient management treatments. maximum seed yield (1746.7 kg ha⁻¹) was noted with 100% NPKS treatment which was closely followed (1692.2 kg ha⁻¹) by 75% NPKS + 1% foliar spray of thio urea and both the treatments show significantly higher seed yield as compared to control and 50% NPKS + 1% foliar spray of thio urea at flowering stage treatments. Similar trend was also noted in staver and biological yield of mustard. The higher yield with 100% NPKS or 75% NPKS + thio urea application may be attributed to higher yield components like siliquae/plant, and test weight that improved with the application of sulphur through thio in this crop. Increase in seed yield with an increase in the rate of NPKS application has also been reported by Bhagat and Soni (2000) ^[2]. Maximum harvest index (26.93%) was noted with 100% NPKS treatment followed (26.74%) by 75% NPKS + 1% foliar spray of thio urea and (26.37%) with 50% NPKS + 1% foliar spray of thio urea at flowering stage treatments all these treatments show significantly higher harvest index as compared to control. The higher harvest index with increasing rate of nutrient application may be due to higher increase in seed yield. These results were in conformity with those of Ali *et al.* (1996) ^[1].

Interaction effect of irrigation scheduling and nutrient management on seed yield (Table -2) was found to be significant which is clearly indicated that the under each irrigation schedule, application of 100% NPKS resulted higher seed yield over 50% NPKS + 1% foliar spray of thio urea and control treatments but was statistically at par with 75% NPKS + 1% foliar spray of thio urea at flowering stage. Similarly, under each nutrient management practice, two irrigations at 35 and 60 DAS produced higher seed yield as compared to other irrigation schedule. Thus, the crop sown with two irrigations at 35 and 60 DAS and 100% NPKS produced significantly maximum seed yield (2191.7 kg ha⁻¹) over rest of the other treatment combinations except treatment combination of two irrigations at 35 and 60 DAS and 75% NPKS + 1% foliar spray of thio urea at flowering stage. This is attributed to improved nutritional environment in the rhizosphere as well as in the plant system leading to higher nutrients translocation in plant parts along with irrigation water so that availability of moisture in rhizosphere which solubilized the nutrients and ultimately the plants exploited more nutrients from soil through their root proliferation (Lakpale *et al.* 2007) ^[7] and finally the yield attributes and yield parameters.

Effect of Irrigation scheduling and nutrient management on economics

Under different Irrigation scheduling maximum gross return, net return and B: C ratio was observed with Two irrigations at 35 and 60 DAS followed by one irrigation at 35 DAS stage. Under different nutrient management practices maximum gross return, net return and B: C ratio was observed with 100% NPKS followed by 75% NPKS + 1% foliar spray of thio urea at flowering stage. Similarly, Under different treatment combinations of Irrigation scheduling and nutrient management practices maximum gross return, net return and B: C ratio was observed with application of 100% NPKS with two irrigations at 35 and 60 DAS stages. This may be attributed to higher economical yield in this treatment combination. Similar findings are reported by Dashora *et al.* (2014) ^[4].

Table 1: Yield parameters of mustard as influenced by nutrient management in various irrigation schedules (Pooled data of two years)

Treatment	Yield parameters (kg ha ⁻¹)			Harvest index (%)
	Seed	Stover	Biological	
Main Treatments - Irrigation scheduling (I)				
I ₀ : No irrigation	1137.2	3732.2	4869.4	23.30
I ₁ : One irrigation (At 35 DAS)	1631.9	4513.3	6145.1	26.50
I ₂ : Two irrigations (At 35 and 60 DAS)	1902.5	4642.0	6544.5	28.94
S.E m.±	17.4	36.4	51.1	0.15
C.D. (5%)	56.9	118.8	166.6	0.49
Sub-plot treatment - Nutrient management (F)				
F ₁ : Control	1243.5	3695.6	4939.1	24.95
F ₂ : 50% NPKS+ foliar spray of Thio urea (1%) at flowering stage	1546.4	4266.3	5812.6	26.37
F ₃ : 75% NPKS+ foliar spray of Thio urea (1%) at flowering stage	1692.2	4566.2	6258.4	26.74
F ₄ : 100% NPKS	1746.7	4655.3	6401.9	26.93
S.E m.±	23.8	48.3	63.3	0.27
C.D. (5%)	67.7	137.4	180.1	0.76
Interaction (I x F)	S*	S*	S*	NS

Table 2: Interaction effect of irrigation scheduling and nutrient management on seed yield of mustard

Nutrient management	Irrigation scheduling (I)			
	I ₀ : No irrigation	I ₁ : One irrigation at 35 DAS	I ₂ : Two irrigations at 35 & 60 DAS	F- Mean
F ₁ : Control	927.2	1326.7	1476.7	1243.5
F ₂ : 50% NPKS + Thio urea (1%)	1160.8	1646.7	1831.7	1546.4
F ₃ : 75% NPKS + Thio urea (1%)	1214.2	1752.5	2110.0	1692.2
F ₄ : 100% NPKS	1246.7	1801.7	2191.7	1746.7
I - Mean	1137.2	1631.9	1902.5	
	F within I (F x I)		I within F (I x F)	
S.E m.±	33.65		37.90	
C.D. (5%)	95.75		111.51	

Table 3: Economical parameters in mustard as influenced by nutrient management in various irrigation schedules

Treatments	Cost of cultivation (Rs./ha)			Return (Rs./ha)		B:C ratio
	Common	Treatment	Total	Gross	Net	
Main - plot treatments: Irrigation scheduling (I)						
I0	23650	0	23650	73014	49364	3.09
I1	23650	2000	25650	102670	77020	4.00
I2	23650	4000	27650	118145	90495	4.27
Sub- plot treatments: Nutrient management (F)						
F1	23650	0	23650	78875	55225	3.34
F2	23650	3240	26890	97264	70374	3.62
F3	23650	4260	27910	106179	78269	3.80
F4	23650	4080	27730	109453	81723	3.95
Interaction						
I0F1	23650	0	23650	60022	36372	2.54
I0F2	23650	3240	26890	74422	47532	2.77
I0F3	23650	4260	27910	77593	49683	2.78
I0F4	23650	4080	27730	80023	52293	2.89
I1F1	23650	2000	25650	84014	58364	3.28
I1F2	23650	5240	28890	103574	74684	3.59
I1F3	23650	6260	29910	110330	80420	3.69
I1F4	23650	6080	29730	112760	83030	3.79
I2F1	23650	4000	27650	92594	64944	3.35
I2F2	23650	7240	30890	113796	82906	3.68
I2F3	23650	8260	31910	130618	98708	4.09
I2F4	23650	8080	31730	135577	103847	4.27

Conclusion

From the results obtained under present study indicate that irrigated treatments show significantly higher yield and economical parameters as compared to no irrigation treatment and its trend under various irrigation scheduling were in increasing order as no irrigation < one irrigations < two irrigations. Application of NPKS at different levels (50, 75 and 100%) either alone or with foliar spray of thio urea recorded significantly higher yield parameters as compared to control

treatment. Thus the crop sown with two irrigations at 35 and 60 DAS with either 100% NPKS or 75% NPKS + 1% foliar spray of thio urea at flowering stage produced higher seed yield and achieved more economical in alluvial soil of agra district of uttar pradesh.

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