Effect of irrigation level and nitrogen levels on economics, quality and water productivity of Garden cress (*Lepidium sativum* L.)

ABSTRACT: A field experiment was conducted at krishi vigyan kendra, Sawaimadhopur, Rajasthan in two consecutive years of 2018-19 and 2019-20 on "Effect of irrigation level and nitrogen levels on economics, quality and water productivity of chandrasur (*L. sativum*)". The highest economics net return was found with three irrigations [25, 50 & 75 days after sowing (DAS)] I_3 (57517 Rs ha^{-1}) which was at par with I_2 with two irrigations (25 & 50 DAS) in the pooled data of both years. Highest benefit-cost (B/C) ratio was also found under three irrigations (25, 50 & 75 DAS) I_3 (2.60) which was at par with (I_2) two irrigations (25 & 50 DAS) in the pooled data of both years. Highest net return and B/C ratio was found with application of 80 Kg N ha^{-1} (57628 Rs ha^{-1}) and (2.65) which was at par with 60 Kg N ha^{-1}. In terms of oil yield Kg ha^{-1} highest oil yield was found with (I_2) two irrigations (25 & 50 DAS) and 60 Kg N ha^{-1}. Water productivity (kg m^{-3}) was found lowest in the treatment (25, 50 & 75DAS) (I_3) and 80 Kg N ha^{-1} which was at par with (I_2) two irrigations (25 & 50 DAS) and 60 Kg N ha^{-1}.

Key Words: Garden cress, Irrigation level, *Lepidium sativum*, Nitrogen levels, Oil yield, water productivity..

INTRODUCTION

The "chandrasur" *Lepidium sativum* L., Brassicaceae) is also known with the common name "Garden cress". It is an annual herbaceous plant native of Asia and north Africa, but distributed ……. It is very nutritious which can use as green leafy vegetables as salad purpose. It can also use to increase traditionally height of childrens and milk in lactating women. It is used to treat liver diseases and infectious diseases, as immune system enhancer, antibacterial, etc. (Amin, 2005). Due to its properties it can be used as insect repellent and to treat insect bites. In India it is cultivated mostly Madhya Pradesh, Rajasthan, Uttar Pradesh. etc. In Rajasthan it is cultivated as fodder for animals. Chandrasur is a crop withlow water requirements.. However, irrigation scheduling at specific time is very important for the maximum yield of crop.

Fertilization is very important for the mostly agricultural crop production. When we applied in injudiciously is can make loss and pollution of water also. Excessive application losses results in emission of green house gases nitrogen oxides. (Güler, 2004).

Nitrogen fertilization plays a very important role in structural and yield component of the plants. In plants many enzymatic activities and chlorophyll and other structural components depends upon nitrogen. Chandrasuris considered a species of high nitrate accumulating (Cavarianni *et al*., 2008). Vegetable plants require high amount of nitrogen because its vegetation period is short (Maynard *et al*., 1976). That's why there is a need to find out proper irrigation schedule and nitrogen level for the chandrasur for zone III B of Rajasthan.

MATERIALS AND METHODS

The study was conducted at the agronomic farm of Krishi Vigyan Kendra, Sawai madhopur, Agriculture University, Kota. The soil of experimental site was sandy loam soil, moderately fertile, low in available organic carbon 0.30 %, low in available nitrogen 243 kg ha^{-1}, medium in available phosphorus 20.52 kg ha^{-1}, and high in available potash 279 kg ha^{-1}. Sawai madhopur consist in Zone III-B of Rajasthan (Flood Prone Eastern Plain) and Zone-V of Rajasthan (Sub Humid South- Eastern Plain) of Rajasthan. In the zone III-B the mean annual rainfall is 623 mm. Thechandrasur sowing was done in the second week of October during both the years. The experiment was laid out in split plot design in which three treatments of irrigation levels were done [(1) one irrigation at 25 days after sowing (DAS) (I_1), (2) two irrigations at 25 & 50 DAS) (I_2), (3)three irrigations (25, 50 & 75 DAS) (I_3)] and were placed in main plot. Four nitrogen levels (20kg N ha^{-1}, 40kg N ha^{-1}, 60kg N ha^{-1}, 80kg N ha^{-1}) were placed in sub plots. Sowing was done at spacing of 30×10 cm and 6 kg ha^{-1} seed rate was used during experiment. Main irrigation channel was 1.5 m wide and sub irrigation channel was 1.0 m wide. Different nitrogen levels were applied through urea in two split doses first basal application and second after first irrigation 25 DAS. Full dose of phosphorus was applied as basal in the form of SSP. For irrigation was used rain water. Net return and benefit-cost ratio (B/C ratio) was calculated after the harvesting of crop on the basis of following formula:

Net return = Gross return-Cost of Cultivation

B/C ratio = Net return / Cost of cultivation

Oil content (kg ha^{-1}) was analysed in laboratory of Agriculture University, Kota.

Water productivity was measured by following formula:

Water Productivity (kg m^{-3})= Grain yield (kg ha^{-1})/ total water applied (m^{-3})

The statistical calculation were done by as per analysis of variance described by Gomez and Gomez 1984 to analysis the test of significant of treatments. Gomez, K. A. and Gomez A. A. 1984.

RESULTS AND DISCUSSION

Oil yield (Kg ha^{-1})

Data presented in Table 1 revealed that the highest yield was obtained with three irrigations (25, 50 & 75 DAS) ($I_{3)}$ 353.91 kg ha^{-1} which was at par with two irrigation (25 & 50 DAS) (I_2). Application of 80 kg N ha^{-1} found highest Oil yield 344.20 kg ha^{-1} which was found statistically at par with 60 kg N ha^{-1}328.92 kg ha^{-1}. With increasing the number of irrigations the oil content in chandrasur will increases significantly up to a certain level. Similar results was found by (Khalil and El-Noemani, 2012) explained that by increasing the irrigation interval the oil

percentage of chandrasur will increased to its maximum values. The result of this study also stated that increasing level of nitrogen the oil yield in seeds of chandrasuralso increase. These results are in agreement with those establishingthat fertilization increases the fatty acid presence, percentages and the fatty-acids ratio in canola seed oil (Gao *et al.*, 2010; Mohamed *et al*., 2020).

Table 1: Effect of Irrigation and Nitrogen levels on Oil yield (Kg ha^{-1}) and Water productivity (kg m^{-3}) of Chandrasur (*Lepidium sativum*).

Treatments	Oil yield (Kg ha^{-1})			Water productivity (kg m^{-3})		
Irrigation levels	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**
Irrigation (One at 25 DAS) (I_1)	**263.53**	**271.83**	**267.68**	**2.49**	**2.57**	**2.53**
two Irrigation (25 & 50 DAS) (I_2)	**320.77**	**324.92**	**322.85**	**1.41**	**1.53**	**1.47**
Three irrigation (25, 50 & 75 DAS) ($I_{3)}$	**351.82**	**355.99**	**353.91**	**1.06**	**1.07**	**1.06**
SEm±	**10.23**	**9.14**	**6.86**	**0.09**	**0.08**	**0.06**
CD (P=0.05)	**35.40**	**31.63**	**21.14**	**0.33**	**0.29**	**0.20**
Nitrogen levels						
20kg N ha^{-1} (N_1)	**280.42**	**290.48**	**285.45**	**1.50**	**1.58**	**1.54**
40 kg N ha^{-1} (N_2)	**299.42**	**301.93**	**300.68**	**1.56**	**1.66**	**1.61**
60 kg N ha^{-1} (N_3)	**327.75**	**330.10**	**328.92**	**1.73**	**1.75**	**1.74**
80 kg N ha^{-1} (N_4)	**340.57**	**347.83**	**344.20**	**1.83**	**1.90**	**1.86**
SEm±	**6.66**	**8.10**	**5.24**	**0.06**	**0.06**	**0.04**
CD (P=0.05)	**19.33**	**23.51**	**14.87**	**0.16**	**0.17**	**0.11**

Water productivity (kg m^{-3})

The results presented in Table 1 that during both years the highest water productivity (kg m^{-3}) was found with three irrigations (25, 50 & 75 DAS) (I_3) 1.06 kg m^{-3} which was at par with two Irrigation (25 & 50 DAS) (I_2) 1.47 kg m^{-3}**.** Same trend was found during each year. These results are in close conformity with Shivran *et al*. (2018) who reported thatincreasing no. of irrigations up to three consumptionof water was also increases. Increased no. of irrigation would trend to higher consumption of water due to higher seed yield.

Table 1 shows that the highest water productivity was found with application of 80 kg N ha^{-1} 1.86 kg m^{-3} which was significantly higher over 20 kg N ha^{-1} and 40 kg N ha^{-1} .The results confirm the findings of Pradhan *et al.* (2013) who reported the water productivity significantly increases with the level of Nitrogen. The higher water productivity was due to higher grain yield with efficient utilization of water per drop of water. Similarly Tadayon *et al*. (2012) reported that highest water productivity was obtained with application of 100 Kg N ha^{-1} which was significantly higher over 0 and 50 kg N ha^{-1}**.**

Nitrogen content in grains (%)

The results presented in Table 2 show that highest content of nitrogen in grains was found under three irrigations (25,50 & 75 DAS) (I3), 1.42% which was significantly higher over one irrigations (25 DAS) and at par with two irrigation (I2) (25 & 50 DAS) 1.37 %. This might be due to adequate moisture content helps to increase the nutrient content and uptake in plants. These results are in close conformity with Umale *et al*. (2015).

In terms of application of nitrogen fertilization highest nitrogen content in grains was found with application of 80 kg N ha^{-1} which was at par with 60 kg N ha^{-1} and significantly higher over 20 & 40 Kg N ha^{-1}. These results are in close conformity with Inne *et al*. (2021) who stated that the highestcontent was found in application of highest amount of nitrogen 150 kg ha^{-1}.

Nitrogen uptake in grains (Kg ha^{-1})

Results in Table 2 represented that highest nitrogen uptake in grains (kg ha-1) was found in three irrigations (25, 50 & 75 DAS) (I^3) 22.71 kg ha^{-1} which was at par with two irrigations (25 & 50 DAS) (I^2) 20.18 kg ha^{-1} and significantly higher over one Irrigation (25 DAS). Razmjoo *et al.* (2008) reported that scarcity of water is the main factor in low yield and productivity of medicinal plants. Deficiency of moisture induces many different physiological and metabolic responses like stomata closure, decrease in growth and photosynthesis. This might also leads to decrease in nutrient uptake and finally affects yield of crops. These results are in close conformity with Jibrin *et al*. (2008).

In different nitrogen levels the highest nitrogen uptake 23.67 kg ha^{-1} was found with application of 80 kg N ha^{-1} which was significantly higher over 20 and 40 kg N ha^{-1} and at par with 60 kg N ha^{-1} (20.62 kg ha^{-1}). These results are closely related to those reported by Raghuvanshi et al. (2018) who stated that with higher nitrogen fertilization uptake of nitrogen by seed and strover

was also increases in mustard [*Brassica juncea* (L.) Czern.]. At higher levels of fertilizers assures higher accessibility of nutrient in adequate amount for the plant to uptake. (Nayak *et al*., 2020).

Table 2: Effect of Irrigation and Nitrogen levels on Nitrogen content in grains and Nitrogen uptake in grains (kg ha^{-1}) in Chandrasur (*Lepidium sativum*).

Treatments	**Nitrogen content in grains (%)**			**Nitorgen uptake in grains (kg ha^{-1})**		
Irrigation levels	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**
Irrigation (One at 25 DAS) (I_1)	1.23	1.31	1.27	15.44	17.00	16.22
two Irrigation (25 & 50 DAS) (I_2)	1.33	1.41	1.37	18.72	21.64	20.18
Three irrigation (25, 50 & 75 DAS) ($I_{3)}$	1.37	1.47	1.42	21.84	23.58	22.71
SEm±	0.02	0.02	0.02	0.63	0.52	0.41
CD (P=0.05)	0.07	0.08	0.05	2.20	1.78	1.26
Nitrogen levels						
20kg N ha^{-1} (N_1)	1.18	1.26	1.22	15.32	17.28	16.30
40 kg N ha^{-1} (N_2)	1.28	1.36	1.32	17.10	19.34	18.22
60 kg N ha^{-1} (N_3)	1.34	1.43	1.38	19.71	21.53	20.62
80 kg N ha^{-1} (N_4)	1.44	1.54	1.49	22.53	24.82	23.67
SEm±	0.04	0.04	0.03	0.72	0.83	0.55
CD (P=0.05)	0.10	0.11	0.07	2.09	2.40	1.55

Net return (Rs ha^{-1})

Data presented in Table3 elaborated that in pooled data of both the years highest Net return (Rs ha-1) and B/C ratio were found with three irrigations (25, 50 & 75 DAS) (I^3) 57517 Rs ha^{-1} and

2.60which was at par with two irrigations (25 & 50 DAS) (I^2) 51699 Rs ha^{-1} and 2.38 respectively.

In terms of application of different nitrogen levels the highest net return and B/C ratio were found with application of 80 Kg N ha^{-1} (57628 Rs ha^{-1} and 2.65) which was at par with 60 kg N ha^{-1} (52932 Rs ha^{-1} and 2.46) and significantly higher over 20 & 40 Kg N ha^{-1}.

Highest net return and B/C ratio was obtained with two irrigation and 60 kg N ha^{-1}. This might be due to highest seed yield and optimum use of nutrient applied through fertilization. With two irrigations (25 & 50 DAS) availability of moisture was sufficient to crop growth and it gave higher yield which was at par with three irrigations. Availability of moisture also helps to enhance the accessibility and uptake of nutrient by the plants. Ultimate results was higher yield. These results are in close conformity with (Saraswathi *et al*., 2014;Choudhary *et al*., 2022).

Table 3: Effect of Irrigation and Nitrogen levels on Net returns (Rs ha^{-1}) and B/C ratio of chandrasur (*Lepidium sativum*).

Treatments	**Net return (Rs ha^{-1})**			**B/C ratio**		
Irrigation levels	**2018-19**	**2019-20**	**Pooled**	**2018-19**	**2019-20**	**Pooled**
Irrigation (One at 25 DAS) (I_1)	**42713**	**43657**	**43185**	**2.17**	**2.11**	**2.14**
two Irrigation (25 & 50 DAS) (I_2)	**49272**	**54125**	**51699**	**2.33**	**2.44**	**2.38**
Three irrigation (25, 50 & 75 DAS) (I_3)	**57547**	**57487**	**57517**	**2.66**	**2.54**	**2.60**
SEm±	**2621**	**2213**	**2341**	**0.13**	**0.10**	**0.12**
CD (P=0.05)	**9069**	**7657**	**9357**	**0.45**	**0.36**	**0.41**
Nitrogen levels						
20kg N ha^{-1} (N_1)	**43910**	**46575**	**45242**	**2.14**	**2.16**	**2.15**
40 kg N ha^{-1} (N_2)	**45970**	**48826**	**47398**	**2.21**	**2.24**	**2.23**
60 kg N ha^{-1} (N_3)	**52613**	**53251**	**52932**	**2.51**	**2.42**	**2.46**
80 kg N ha^{-1} (N_4)	**56882**	**58375**	**57628**	**2.68**	**2.63**	**2.65**

SEm±	**2212**	**2023**	**2176**	**0.11**	**0.09**	**0.07**
CD (P=0.05)	**6419**	**5872**	**6745**	**0.31**	**0.27**	**0.20**

Conclusion

On the basis of the results emanated from present investigation conducted during Rabi 2018-19 and 2019-20, Based on two year study, results revealed that application of two irrigations (25 & 50 DAS) with application of 60 Kg N ha^{-1} gives higher net return, BC ratio. Higher water productivity. was also found under two irrigations and application of 60 kg N ha^{-1}.

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