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

ABSTRACT: A field experiment was conducted at krishi vigyan kendra, Sawaimadhopur, Rajasthan in two consecutive years of 2018-19 and 20129-20 on "Effect of irrigation level and nitrogen levels on economics, quality and water productivity of chandrasur (*L. sativum*)". In terms of The highest economics highest net return was found within 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 the 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 the 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 cCress, Irrigation level, *Lepidium sativum*, Nitrogen levels, Oil yYield, water productivity., Irrigation level, Nitrogen levels.

INTRODUCTION:

The "chandrasurGarden cress" (*Lepidium sSativum* L., Brassicaceae) is also known with the common nameas "Garden cressChandrasur" and it belongs to family: Brassicacace. It is an annual herbaceous plant which is native tof Aasia and north Africa, but distributed ……. It is very nutritious and medicinal values 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 iscan used to treat liver diseases and infectious diseases, to use as immune system enhancer, antibacterial, etc. (Amin, 2005). Due to its fumigant properties it can also be used asto treat insect repellent and to treatin the form of insect bites also. It can also use to increase traditionally height of childrens and milk in lactating women. In India it is cultivated mostly M.P., Rajasthan, U.P. etc. In Rajasthan it is cultivated as fodder for grazing purpose for animals. Sowing method of Cehandrasur is a crop withwas broadcasting and it is low water requirements.ring crop. However, But 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

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The highest economics net return and benefit-cost ratio were found under three irrigations (25, 50 and 75 days after sowing) with values of 57517 Rs ha1 and 2.60 respectively, but they were at par with two irrigations (25 and 50 days after sowing) in the pooled data for both years.
Similar results were obtained with application of 80 Kg N ha (57628 Rs ha1) and (2.65) for the highest net return and benefit-cost ratio respectfully.
Whereas the highest oil yield was found with two irrigations (25 and 50 DAS) and 60 Kg N ha1. The highest water productivity was also found with two irrigations (25 and 50 DAS) and 60 Kg N ha1, which was at par with three irrigations and 80 Kg N ha1.
Based on the results we conclude the best economic, quality and water productivity are achieved using two irrigations and applying 60 Kg N ha-1.

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Although, the excessive use of chemical fertilization is injurious for the environment, producing losses and polluted conditions in the air and water space (Güler, 2004)

upon nitrogen. ChandrasurGarden cress is considered as 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, Ssawai 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 mMean annual rainfall iwas 623 mm. The chandrasur sowing was done in the second week of October during both the years. TheDesign of experiment was laid out in sSplit plot design in which three treatments of iIrrigation levels were done [((One(1) one irrigation at 25 days after sowing (DAS) (I_1), (2) tTwo iIrrigations (at 25 & 50 DAS) (I_2), (3)& Tthree irrigations (25, 50 & 75 DAS) (I_3))] and were placed in main plot. andFour 4 level of 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 level of nitrogen levels were applied through urea in two split doses first basal application and second after first irrigation 25 DAS. Full dDose of phosphorus was applied as basal in the form of SSP. ForSource of iIrrigation 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 Aagriculture Uuniversity, 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 Ggomez 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})

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Data presented in Ttable -1 revealed that the highest yield was obtained with tThree irrigations (25, 50 & 75 DAS) ($I_{3)}$ 353.91 kg ha^{-1} which was at par with two iIrrigation (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}. TWith increasing the numbero of irrigations the oil content in chandrasurgarden cress will increases significantly up to a certain level. but I_3 and I_2 found at par with each other. Similar results was found by (Khalil and El-Noemani, *et al.*, 2012) explained that by increasing the irrigation interval the oil percentage of chandrasurgarden cress will increased to its maximum values. The result of this study also stated that with increasing level of nitrogen the oil yield in seeds of chandrasurgarden cress was also increases. These results are in agreement with those establishingof who stated that fertilization increases the fatty acid presence, percentages and ratio theof fatty acids ratio in canola seed oil (Gao *et al*., 2010;) (Mohamed *et al.*, 2020).

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It is clear that a major number of irrigations increase the chandrasur oil content, but it will increases significantly up to a certain level.

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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 Ttable 1 ~~eminated~~ that during both ~~the~~ 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 confo~~i~~rmity with Shivran *et al.*~~,~~ (2018) who reported that ~~with~~ increasing no. of irrigations up to three consumptionve use of water was also increases. Increased no. of irrigation would trend~~s~~ to higher consumptionve use of water due to higher seed yield.

Table 1 shows~~represented~~ 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 Ttable ~~-~~2 show~~determined~~ 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 %. ~~With higher no of irrigations nitrogen content in grains was also found higher.~~ This might be due to adequate moisture content helps to increase the nutrient content and uptake in plants. The~~i~~se 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~~in~~ 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 highest ~~no3~~ content was found in application of highest amount of nitrogen 150 kg ha^{-1}.

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

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RThe results in Ttable 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 level of 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. Plant can uptake higher nutrient content with higher amount of nutrient content. (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

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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 Ttable-3 elaborated that in pooled data of both the years highest Net return (Rs ha-1) and B/C ratio wereas found with tThree irrigations (25, 50 & 75 DAS) (I^3) 57517 Rs ha^{-1} and 2.60 during both the years.which 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 wereas 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**

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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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The present investigation was conducted during Rabi 2018-19 and 2019-20. Results revealed that application of two irrigations (25 & 50 DAS) and 60 Kg N ha^{-1} gives higher net return, benefit-cost ratio, and water productivity.

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