Journal of Oilseed Brassica, 13 (1) : 22-25, January 2022

Productivity and profitability of rapeseed as influenced by irrigation depth and irrigation scheduling based on can-evaporimeter

Krishna Bharadwaj[1*] and K Pathak[2]

[1]*Department of Agronomy, Assam Agricultural University, Jorhat, Assam 785013, India*
[2]*Directorate of Research (Agri.), Assam Agricultural University, Jorhat, Assam 785013, India*
**Corresponding author: bharadwajkrishnaa@gmail.com*
(Received: 29 June 2021; Revised: 20 December 2021; Accepted: 23 December 2021)

Abstract

The effects of irrigation depth and irrigation scheduling on productivity and profitability of rapeseed was studied during *Rabi* 2018-19. Nine treatment combinations of three irrigation depths *viz*., 4 cm (I_1), 5 cm (I_2) and 6 cm (I_3) and three irrigation schedules *viz*., irrigation at 4 cm (D_1), 5 cm (D_2) and 6 cm (D_3) evaporation from a can-evaporimeter were laid out in factorial randomised block design with three replications. Irrigation of 6 cm depth recorded the highest values of growth parameters like plant height, total dry matter accumulation, leaf area index and yield attributing characters *viz*. number of branches per plant, number of siliquae per plant and number of seeds per siliqua which is, in turn, resulted in higher seed and stover yields as well. Similarly, irrigation scheduled at 4 cm evaporation from can-evaporimeter resulted in highest yield attributing characters, seed yield and stover yield. Among the different treatment combinations, irrigation of 6 cm depth scheduled at 4 cm evaporation (I_3D_1) recorded the maximum seed and stover yields, gross returns (Rs. 41510/ha), net returns (Rs. 14322/ha) and B:C ratio (1.53).

Keywords: *Can-evaporimeter, economics, irrigation depth, irrigation scheduling, rapeseed*

Introduction

India is one of the largest producers of edible oils in the world. The production and productivity of rapeseed-mustard increased from 0.76 million tonnes and 3.68 q/ha in 1951-52 to 8.32 million tonnes and 13.97 q/ha, respectively in 2017-18 (GOI, 2018). Water stress results in reduction of crop yield by affecting the uptake of water and plant nutrients. Flowering is the most sensitive stage for water stress (Ahmadi and Bahrani, 2009). Scheduling irrigation at right time increases irrigation water efficiency that helps to meet crop water demand during the peak water requirement stages, minimizing water losses and production cost. Alamin *et al.* (2019) reported an increase in seed yield with increasing irrigation frequency. The irrigation to a particular crop depends on the depletion of soil water which in turn depends on the evapotranspiration of the crop. The USDA Pan Evaporimeter based IW: CPE ratio is a very reliable method of irrigation scheduling to irrigate the crops. However, studies have shown that evaporation from one litre can has a high correlation with the evapotranspiration of a crop. Therefore, a small can-evaporimeter can be used to indicate the evaporation from crop fields. But, until now, limited research work has been conducted in this aspect particularly in North Eastern Region. Keeping these facts in background, the present investigation was conducted to study the effects of irrigation depth and irrigation scheduling based on can-evaporimeter on productivity and profitability of rapeseed.

Materials and Methods

A field experiment was conducted with rapeseed (toria) at Assam Agricultural University, Jorhat, Assam, India during 2018–19. Total nine treatment combinations of three irrigation depths *viz*., 4 cm (I_1), 5 cm (I_2) and 6 cm (I_3) and three irrigation schedules *viz*., irrigation at 4 cm (D_1), 5 cm (D_2) and 6 cm (D_3) evaporation from a can-evaporimeter were laid out in factorial randomised block design with three replications. The soil of the experimental site was sandy loam in texture, acidic in reaction (pH 5.2), medium in organic carbon (0.70%), low in alkaline $KMnO_4$ extractable N (243.7 kg/ha), medium in Brays-I P_2O_5 (24.9 kg/ha) and low in 1N ammonium acetate extractable K_2O (151.6 kg/ha). The climate of the area is sub-tropical, with an average annual rainfall of 1864.8 mm. The total amount of rainfall received during the crop growth period was 69.8 mm. The toria variety "TS 38" was sown on 15th October, 2018 and harvested on 16th January, 2019. Recommended dose of fertilizers at the rate of 60-40-40 as N-P_2O_5-K_2O kg/ha was applied to the crop. The full dose of P (250 kg/ha as SSP), 50% N (65.1 kg/ha as urea) and 50% K (33.4 kg/ha as MOP) were applied as basal, uniformly to all the plots, one day before sowing of the crop. The remaining 50% N and 50% K were applied 20 days after sowing. The required amount of borax @10 kg/ha in each plot was also applied along with the basal dose of fertilizer. The crop was irrigated as per the treatments using the evaporation data recorded from a field can-evaporimeter which was painted white and covered with 6/20 size mesh. An indicator pointer is fixed with can-evaporimeter at 1.5 cm below the brim. When the irrigation was given, the can-evaporimeter was filled up with water to pointer level and kept at crop height. Irrigation was scheduled when the water level of can-evaporimeter dropped to a predetermined level (Reddy and Reddi, 2010). The data were analyzed statistically and the mean differences among the treatment means were evaluated by the least significance difference (LSD) at 5% level of probability (Sarma, 2016). For economic analysis, all input costs including the cost for lease of land and interest on running capital were considered for computing the cost of production.

Results and Discussion

The study revealed that irrigation to rapeseed caused significant variations in the growth characters *viz*., plant height, total dry matter accumulation and leaf area index (Table 1). Application of 6 cm depth of irrigation (I_3) recorded significantly higher total dry matter than irrigation of 4 cm (I_1) and 5 cm (I_2) depths. The better growth under this treatment might be attributed to adequate soil moisture supply to the crop in comparison to lesser depth of irrigation. Moaveni *et al*. (2010) and Lal *et al.* (2013) also observed improvement in overall growth of rapeseed with the application of irrigation. Plant height and total dry matter was found to be the highest in frequent application of irrigation *i.e.,* irrigation at 4 cm evaporation (D_1). This might due to availability of moisture at all the critical growth stages of rapeseed. Corroborative findings have also been reported by Tahir *et al.* (2007). The interaction effect between irrigation depth and irrigation scheduling on dry matter accumulation was found to be significant. Irrigation of 6 cm depth at 4 cm evaporation recorded the highest dry matter accumulation. Adequate and timely supply of irrigation water might have ensured cell turgidity and consequently higher meristematic activity leading to more foliage development, greater photosynthetic rate, higher nutrient uptake and better dry matter of plant. Similar results were reported by Jat *et al*. (2018) and Choudhary *et al*. (2021). Irrigation depth of 6 cm (I_3) and irrigation scheduling at 4 cm evaporation (D_1) recorded significantly higher leaf area index (LAI). Irrigation of 6 cm depth (I_3) recorded the highest number of siliquae per plant and application of irrigation at 4 cm evaporation (D_1) resulted in the highest number of siliquae per plant and number of seeds per siliqua (Table 1). It could be inferred that these treatments maintained favourable soil moisture condition for better growth and development, partitioning of photosynthates and dry matter to seed. Similar results were also reported by Lakra *et al*. (2018) and Choudhary *et al*. (2021).

In case of seed and stover yields, application of 6 cm irrigation depth (I_3) recorded the highest values among all the depth of irrigation water applied. 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. Deka *et al*. (2018) also reported similar

Table 1: Effect of irrigation depth and irrigation scheduling on growth, yield attributes, seed yield and stover yield of rapeseed

Treatment	Plant height (cm)	Dry matter (g/m^2)	Leaf area index	Branches per plant	Siliquae per plant	Seeds per siliqua	Test weight (g)	Seed yield (kg/ha)	Stover yield (kg/ha)
Irrigation Depth (I)									
4 cm	90	293	0.62	4.8	67	9.2	3.44	958	1808
5 cm	96	325	0.64	5.2	73	9.4	3.45	1042	1942
6 cm	101	347	0.70	5.2	77	9.6	3.46	1104	2052
SEm±	2	6	0.01	0.2	1	0.2	0.06	21	39
LSD (p=0.05)	8	19	0.04	NS	4	NS	NS	63	117
Evaporation based irrigation schedule (D)									
4 cm	103	361	0.69	5.3	82	9.9	3.48	1173	2152
5 cm	95	322	0.64	5.2	71	9.3	3.43	1016	1916
6 cm	89	282	0.62	4.7	64	9.0	3.43	915	1734
SEm±	2	6	0.01	0.2	1	0.2	0.06	21	39
LSD (p=0.05)	8	19	0.04	NS	4	0.6	NS	63	117
Interaction (I×D)		NS	S	NS	NS	NS	NS	NS	S S

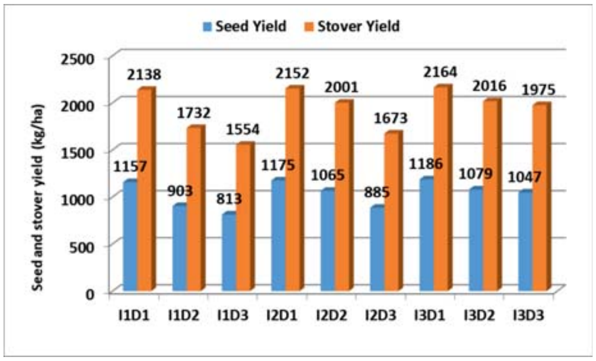

Fig. 1: Interaction effect irrigation depth and irrigation scheduling on seed and stover yield of rapeseed

observations. Scheduling irrigations at 4 cm evaporation (D_1) produced highest seed and stover yields. Frequent irrigation increased the total green surface of the plant and by alleviating the water stress through irrigation allowed the production of more flowers and siliqua per plant. Under frequent irrigation, the plant got adequate moisture and nutrients to produce highest number of siliquae. This finding was similar with the results of Yadav *et al.* (2018) and Langadi *et al.* (2021). The interaction effect between irrigation depth and irrigation scheduling on seed and stover yields of rapeseed was found to be significant (Fig.1). Irrigation of 6 cm depth at 4 cm evaporation (I_3D_1) recorded the highest seed and stover yields of 1186 kg/ha and 2164 kg/ha, respectively. Adequate supply of moisture in soil due to more depth and frequent irrigation schedule under this treatment combination might have helped in proper utilization of plant nutrients resulting in proper plant growth and production of more siliquae. Similar results were also reported by Verma *et al.* (2014).

Table 2: Effect of irrigation depth and irrigation scheduling on monetary return of rapeseed

Treatment	Gross returns (Rs./ha)	Net returns (Rs./ha)	B:C ratio
I_1D_1	40495	13907	1.52
I_1D_2	31605	5417	1.21
I_1D_3	28455	2267	1.09
I_2D_1	41125	14237	1.53
I_2D_2	37275	10887	1.41
I_2D_3	30975	4587	1.17
I_3D_1	41510	14322	1.53
I_3D_2	37765	11177	1.42
I_3D_3	36645	10057	1.38

The practicability and usefulness of a treatment is judged ultimately in terms of net returns. The data on economic analysis of the treatment combination of rapeseed suggested that the highest gross returns of 41510/ha, net returns of 14322/ha and B:C ratio of 1.53 were obtained by application of 6 cm depth of irrigation at 4 cm evaporation (I_3D_1). The increase in net returns and B:C ratio might be due to positive effect of irrigation on growth and yield attributes which have finally resulted in higher seed and stover yields. Collateral findings have been reported by Jat *et al.* (2018) and Lakra (2018).

Thus, it can be concluded that application of 6 cm depth of irrigation at 4 cm evaporation from can-evaporimeter was found to register the highest productivity and profitability in rapeseed.

References

Ahmadi M and Bahrani MJ. 2009. Yield and yield components of rapeseed as influenced by water stress at different growth stages and nitrogen levels. *Am Eurasian J Agric Environ Sci* **5**: 755-761.

Alamin M, Monir M, Fatima S, Nahar K and Ahamed KU. 2019. Effect of sowing time and irrigation frequency on growth and yield of Mustard (*B. napus*). *Int J Adv Agric Sci*. **4**: 01-11.

Choudhary RL, Langadi AK, Jat RS, Anupama, Singh HV, Meena MD, Dotaniya ML, Meena MK, Premi OP and Rai PK. 2021. Mitigating the moisture stress in Indian mustard (*B. juncea*) through polymer. *J Oilseed Brassica* **12**: 21–27.

Deka P, Pathak K, Begum M, Sarma A and Dutta PK. 2018. Seed yield and nutrient uptake in late sown toria as influenced by different irrigation and fertilizer levels. *Agric Sci Digest* **38**: 127-130.

GOI: Agricultural statistics at a glance. 2018. Agricultural Statistics Division: Department of Agriculture & Cooperative, Ministry of Agriculture, Government of India, New Delhi, p. 139-140.

Jat AL, Rathore BS, Desai AG and Shah SK. 2018. Production potential, water productivity and economic feasibility of Indian mustard (*B. juncea*) under deficit and adequate irrigation scheduling with hydrogel. *Indian J Agric Sci* **88**: 212–215.

Lakra RK, Alam P and Nayar A. 2018. Effect of sowing time and crop geometry on productivity of mustard (B. *juncea* l.) under irrigated condition of Jharkhand. *Int J Curr Microbiol Appl Sci* **7**: 777-781.

Lal B, Hossain MS, Alam MB and Ripon MA. 2013. Effect of irrigation and sowing method on yield and yield attributes of mustard. *Rajshahi Univ J Life Earth Agric Sci* **41**: 65-70.

Langadi AK, Choudhary RL, Jat RS, Singh HV, Dotaniya ML, Meena MK, Premi OP and Rai PK. 2021. Effect of superabsorbent polymer on drought Mitigation, and enhancing productivity and profitability of Indian mustard (*B. juncea*). *J Oilseeds Res* **38**: 179–186.

Moaveni P, Ebrahimi A and Farahani HA. 2010. Physiological growth indices in winter rapeseed (*B. napus*) cultivars as affected by drought stress at Iran. *J Cereals Oilseeds* **1**: 11-16.

Reddy TY and Reddi GHS. 2010. Principles of agronomy, fourth revised edition, Kalyani Publishers, New Delhi.

Sarma A. 2016. Agricultural statistics for field and laboratory experimentation. Kalyani Publishers, New Delhi.

Tahir M, Ali A, Nadeem MA, Tanveer A and Sabir QM. 2007. Performance of canola (*B. napus*) under different irrigation levels. *Pak J Bot* **39**: 739-746.

Verma HK, Singh MM, Singh MK and Santosh K. 2014. Response of Indian mustard (*B. juncea*) varieties to irrigation for better growth, yield and quality of mustard crop. *Int J Agric Sci* **10**: 426-429.

Yadav A, Singh AK, Chaudhari R and Mishra AK. 2018. Effect of planting geometry on growth and yield of mustard (*B. juncea)* varieties. *J Pharmacogn Phytochem* **7**: 2624-2627.