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Research Article

# STUDIES ON PHYSIOLOGICAL TRAITS OF RAPESEED (BRASSICA RAPA VAR DICHOTOMA) UNDER CAN EVAPORIMETER BASED IRRIGATION MANAGEMENT

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A R T I C L E I N F O

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A B S T R A C T

An experiment was conducted to study the growth parameters of rapeseed (*Brassica rapa* var *dichotoma*) under Can evaporimeter based irrigation management at Assam Agricultural University, Jorhat in the *rabi* season of 2018-2019. The treatments consisted of three different irrigation depths *viz*., irrigation of 4 cm depth ($I_1$), irrigation of 5 cm depth ($I_2$) and irrigation of 6 cm depth ($I_3$) and three irrigation schedules *viz*., irrigation at 4 cm evaporation from Can evaporimeter ($D_1$), irrigation at 5 cm evaporation from Can evaporimeter ($D_2$) and irrigation at 6 cm evaporation from Can evaporimeter ($D_3$). The experiment was laid out in factorial randomized block design with three replications. The study revealed that irrigation of 6 cm depth ($I_3$) recorded the highest values for all physiological traits in terms of crop growth rate (CGR), relative growth rate (RGR), leaf area index (LAI) and specific leaf area (SLA). Similarly, in case of scheduling, application of irrigation at 4 cm evaporation from Can evaporimeter ($D_1$) resulted in higher values of CGR, RGR, LAI and SLA. The highest biological yield of 3156 and 3325 kg ha$^{-1}$ was recorded with 6 cm irrigation depth ($I_3$) among depth of irrigation and irrigation scheduled at 4 cm evaporation from Can evaporimeter among the irrigation schedules, respectively.



## INTRODUCTION

Oil seed is a crop which receives greater attention in our country next to cereals. The production and productivity of rapeseed is 8.32 million tons and 13.97 q/ha in 2017-18 (Pocket Book of Agriculture, 2018). Although there has been a significant increase in oilseed production since 1960s, the demand for oilseeds production is also increasing due to population increase. Improper water management is one of the major reasons for yield decline in rapeseed and mustard. Plant faces physiological changes including loss of cell turgor, closing of stomata and reduction in cell enlargement as well as leaf surface area due to water stress condition. All these abnormalities ultimately decrease photosynthesis and respiration and as a result overall production of crop is reduced. Hence there is a necessity for development of a suitable irrigation management practice to boost up the crop productivity.

Irrigation scheduling with Can evaporimeter at proper interval increases irrigation water efficiency. Studies have shown that evaporation from one litre Can have a high correlation with the evapotranspiration of a crop. In this method, a small Can is used to indicate the evaporation from crop fields. The Can is painted white and covered with 6/20 size mesh. An indicator pointer is fixed at 1.5 cm below the brim. When the irrigation is given, the can is filled up with water to pointer level and kept at crop height. Irrigation is scheduled when the water level of can falls to a predetermined level (Reddy and Reddi, 2010). This method is very simple, inexpensive and may provide accurate scheduling of irrigation to crops. However, until now, based on such information, no such research work has been conducted in this region. Hence, the present investigation was conducted to find out the influence of Can evaporimeter based irrigation management on growth of rapeseed.

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## MATERIALS AND METHODS

The experiment was conducted at ICR farm of Assam Agricultural University, Jorhat during *rabi* season of 2018-2019. The surface soil (0-20 cm)of the experimental site was sandy loam in texture (sand, silt and clay content of 74.2, 15.2 and 10.6%, respectively), acidic in reaction (pH 5.2), medium in organic carbon (0.70%), low in N (243.7kg/ha), medium in I - $P_2O_5$ (24.9kg/ha) and low in $K_2O$ (151.6kg/ha) with the soil field capacity, permanent wilting point and hydraulic conductivity of 22.5% w/w, 8.3 % w/w and 0.59 cm/hr, respectively. During the crop season 69.8 mm rainfall was received. The mean weekly maximum and minimum temperatures fluctuated between 22.5 to 28.7 $^0$C and 8.9 to 17.2 $^0$C, respectively. The mean weekly relative humidity varied from 92.7 to 100 per cent and 64.9 to 77.3 per cent in the morning and evening, respectively. The mean weekly bright sunshine hours ranged from 1.3 to 9.2 (hours/day) during the growing period of the crop.The experiment was laid out in factorial randomized block design with three replications. The treatments were a combination of irrigation depth and irrigation schedule based on Can evaporimeter. The irrigation depths included $I_1$: Irrigation of 4 cm depth, $I_2$: Irrigation of 5 cm depth and $I_3$: Irrigation of 6 cm depth. The irrigation schedules included $D_1$: Irrigation at 4 cm evaporation from Can evaporimeter, $D_2$: Irrigation at 5 cm evaporation from Can evaporimeter and $D_3$: Irrigation at 6 cm evaporation from Can evaporimeter.

Irrigation to the crop was applied as per respective treatment.

The amount of irrigation water was measured as follows:

q = a x d. where, q = quantity of water needed ($m^3$), a =area to be irrigated (12 $m^2$), d = depth of water (6 cm).The sowing was done manually by placing the seeds (Variety TS 38) in the furrows of 4 to 5 cm depth opened at 30 cm apart with seed rate @ 10 kg/ha and plant to plant spacing was maintaining at 5 to 7 cm on 15$^{th}$ October, 2018 and harvested on 16$^{th}$ January, 2019. Five representative sample plants were selected randomly from individual plot and respective physiological traits of those tagged plants were measured accordingly.

The Crop growth rate represents dry weight gained by a unit area of crop in a given time. It was calculated using formula of Watson (1952) and expressed as mg/$m^2$/day.

$$CGR = \frac{W_2 - W_1}{(t_2 - t_1)S}$$

The relative growth rate of crops at time instant (T) is defined as the increase of plant material per unit of crop growth weight per unit time. It is expressed in mg/g/day (Watson, 1952).

$$RGR = \frac{\log_e W_2 - \log_e W_1}{(t_2 - t_1)S}$$

Where, $W_1$ and $W_2$ are plant dry weight at time $t_1$ and $t_2$, respectively, S is land area over which dry matter was recorded.

The leaf area index was calculated by dividing the leaf area per plant by land area occupied by the plant.

$$LAI = \frac{\text{Leaf area/plant}\,(cm^2)}{\text{Land area/plant}\,(cm^2)}$$

Specific leaf area is the ratio of leaf area to leaf mass. It is a measure of relative spread of leaf.

$$SLA = \frac{\text{Leaf area}}{\text{Leaf dry weight}}$$

Two border rows on either side of the plot and 50 cm row length from both the ends of the rows were discarded. The plants from the net plot were pulled out by hand, tied into bundles separately for individual plot and were carried to thrashing floor. After 4 days of drying threshing was done by trampling with foot for individual plots. Then the Biological yield were measured in kg/plot and convert to q/ha.

The data were analyzed statistically using standard procedure (Gomez and Gomez 1984). Fisher's least significant difference was used to test the significance of differences at five percent probability level.

## RESULT AND DISCUSSION

### *Crop Growth Rate (CGR)*

Growth in terms of crop growth rate was influenced at all the irrigation levels. Application of irrigation of 6 cm depth ($I_3$) recorded the highest CGR followed by irrigation of 5 cm depth ($I_2$). Scheduling irrigation at 4 cm evaporation from Can evaporimeter ($D_1$) recorded the highest CGR followed by irrigation at 5 cm evaporation from Can evaporimeter ($D_2$). The lowest CGR was found under irrigation at 6 cm evaporation from Can evaporimeter ($D_3$). Fig. 1(a)

The better growth under these treatments ($I_3$ and $D_1$) might be attributed to adequate soil moisture availability to rapeseed crop had in comparison with less irrigation either in depth or in frequency. Further, it is understood that it increased photosynthetic surface and biomass accumulation by the crop under irrigated condition. Ansar (2013) and Singh (2014) *et al.* also observed improvement in overall growth of rapeseed with irrigation.

### *Relative Growth Rate (RGR)*

Irrigation of 6 cm depth (I3) recorded the highest RGR at all the crop growth stages. It was followed by irrigation of 5cm ($I_2$) depth. Among the irrigation schedule, application of irrigation at 4cm evaporation from Can evaporimeter($D_1$) recorded the highest value of RGR at all the stages of growth followed by 5m evaporation ($D_2$) (figure:1.b).

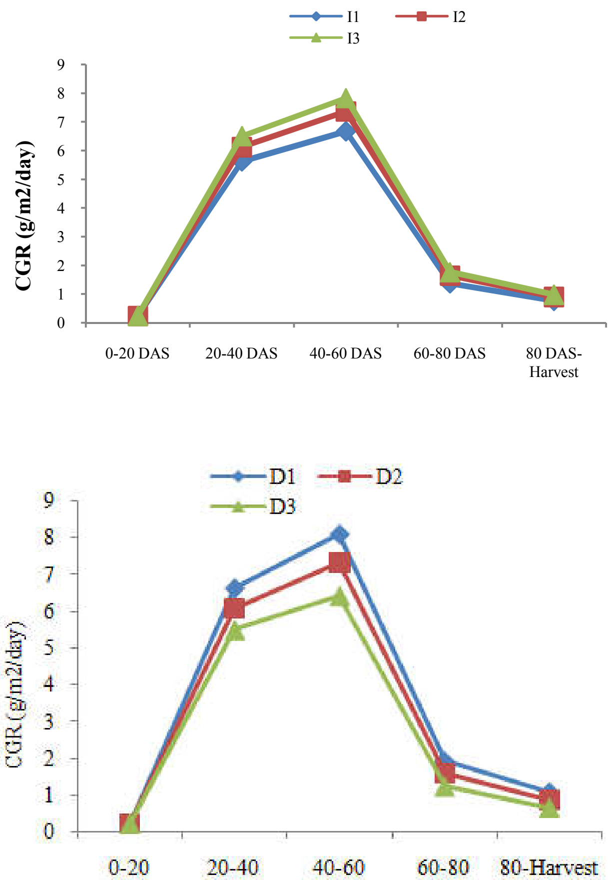
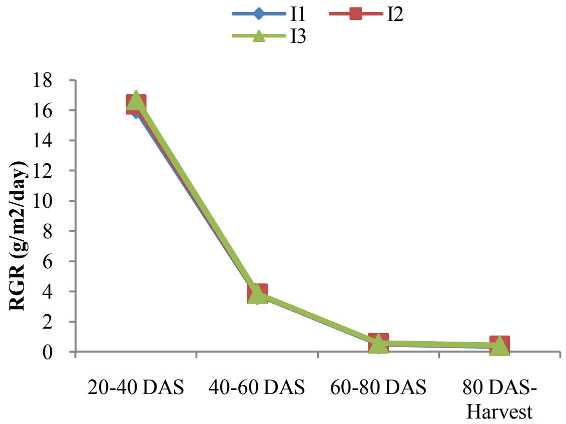



**Fig 1(a)** Effect of irrigation depth and irrigation schedule based on Can evaporimeter on Crop Growth Rate (CGR) of rapeseed



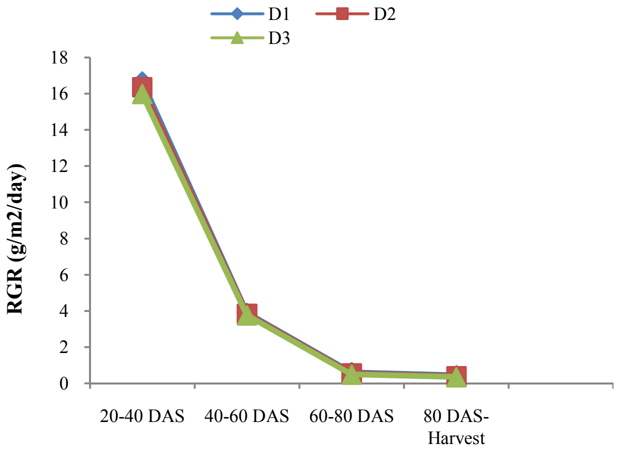




**Fig 1(b)** Effect of irrigation depth and irrigation schedule based on Can evaporimeter on Relative Growth Rate(RGR) of rapeseed

An optimum moisture regime is very important for the balanced metabolic activities of the plants, which in turn, results in increased growth of the plants. In the present study, successive increase in irrigation levels had significant positive effect on relative growth rate. This might be attributed to plant growth viz. cell division and elongation required a comparatively higher moisture supply from the soil. Piri *et al.* (2011) and Sonowal (2012) also observed enhancement in relative growth of rapeseed with balanced irrigation scheduling.Positive effects of irrigation on growth of rapeseed had also been reported by Deka *et al.* (2018).

### *Leaf area index*

The effect of different irrigation depth on leaf area index was significant at at 40 and 60 DAS and recorded significantly higher LAI than irrigation of 4 cm depth ($I_1$). The increase in the depth of irrigations had a significant positive effect on LAI. Positive effects of irrigation on growth of rapeseed had also been reported by Das (2015) and Deka *et al.* (2018). Leaf area index (LAI) was found to be highest in irrigation scheduling at 4 cm evaporation from Can evaporimeter ($D_1$) and the parameters were lowest in irrigation scheduling at 6 cm evaporation from Can evaporimeter ($D_3$). In case of more frequent irrigation application ($D_1$), the plant could get adequate moisture to produce better growth in terms of LAI. (Table.1). This might be due to the fact that in case of more frequent irrigation application ($D_1$), the plant could get adequate moisture to produce better LAI.

**Table 1** Effect of different irrigation depths and irrigation schedules on LAI, SLA and biological yield of rapeseed

| Treatment | Leaf Area Index(LAI) | | | Specific Leaf Area (SLA) ($cm^2g^{-1}$) | | | Biological yield ($qha^{-1}$) |
|---|---|---|---|---|---|---|---|
| | 20DAS | 40DAS | 60DAS | 20DAS | 40DAS | 60DAS | |
| **Irrigation Depth(I)** | | | | | | | |
| $I_1$: 4 cm | 0.20 | 1.58 | 0.62 | 458.0 | 375.4 | 249.9 | 2766 |
| $I_2$: 5 cm | 0.21 | 1.98 | 0.64 | 462.1 | 386.7 | 257.2 | 2984 |
| $I_3$: 6 cm | 0.22 | 2.12 | 0.70 | 465.7 | 405.2 | 271.4 | 3156 |
| SEm ± | 0.01 | 0.09 | 0.01 | 9.4 | 7.8 | 4.3 | 60 |
| $CD_{0.05}$ | NS | 0.28 | 0.04 | NS | 23.3 | 12.9 | 180 |
| **Irrigation schedule based on evaporation (D)** | | | | | | | |
| $D_1$: 4 cm | 0.21 | 2.09 | 0.69 | 463.2 | 403.1 | 268.7 | 3325 |
| $D_2$: 5 cm | 0.21 | 1.85 | 0.64 | 462.9 | 390.9 | 259.4 | 2932 |
| $D_3$: 6 cm | 0.21 | 1.74 | 0.62 | 459.7 | 373.2 | 250.5 | 2649 |
| SEm ± | 0.01 | 0.09 | 0.01 | 9.4 | 7.8 | 4.3 | 60 |
| $CD_{0.05}$ | NS | 0.28 | 0.04 | NS | 0.15 | 0.21 | 180 |

### *Specific Leaf Area*

Application of 6 cm irrigation depth ($I_3$) recorded significantly higher SLA than both 5 cm ($I_2$) and 4 cm ($I_1$) depth both at 40 and 60 DAS except being at par with 5 cm depth ($I_2$) at 40 DAS. The lowest SLA was recorded at 4 cm depth of irrigation ($I_1$) at all the growth stages. Frequent application of irrigation i.e. irrigation scheduled at 4 cm evaporation from can evaporimeter ($D_1$) recorded the highest SLA at 40 and 60 DAS (Table 1.) Corroborative findings have also been reported by Tahir *et al.* (2007).

### *Biological yield*

A well maintained crop optimally supplied with water assimilates greater dry matter and translocate larger proportion at maturity. In the present study, application of 6 cm depth of irrigation ($I_3$) and application of frequent irrigations at 4cm evaporation from can evaporimeter produced higher values of biological yield than other treatments . Application of 6 cm dept of irrigation ($I_3$) produced 5.60 and 14.10 per cent higher biological yield than 5 cm irrigation (I2) and 4 cm irrigation depth ($I_1$), respectively. Among the irrigation schedules based on Can evaporimeter, irrigation scheduled at 4 cm evaporation from Can evaporimeter($D_1$) registered 13.40 and 25.30 per cent more biological yield than in 5 cm and 6 cm evaporation based irrigation schedule, respectively (Table 1) Higher yield due to application of irrigations contributed various yield components that influenced the yield accordingly. Irrigation had significant effects on growth characters as well as yield of rapeseed was well documented by MdAlamin *et al.* (2019).

## CONCLUSION

From the present field experimental studies, it may be concluded that application of 6 cm irrigation depth should be applied based on 4 cm evaporation from Can evaporimeter for achieving higher growth and biological yield.

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