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Performance of rapeseed (*Brassica campestris L. Prain*) towords irrigation and mulch in new alluvial zone of West Bengal

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ABSTRACT

A field experiment was conducted to study the effect of levels of irrigation and mulch on growth attributes, yield attributes, yields, water use and water use efficiency of rapeseed during rabi season of 2014-15 at Regional Research Station, Gayeshpur, Nadia, West Bengal. The experiment was conducted with 12 treatment combinations (4 Irrigation levels considered as main plot and 3 levels of mulch as sub plot) in a split plot design replicated thrice. The study revealed that both irrigation and mulch levels significantly influenced growth attributes, yield attributes, seed yield and oil yield. Highest value were exhibited when irrigation applied at 1W:CPE ratio of 1.0 in combination with full row straw mulching. The highest total water use (388.78mm) and minimum WUE (3.06 kgha^{-1} mm^{-1}) and the lowest total water use (89.57mm) and maximum WUE (6.31 kg ha^{-1}mm^{-1}) were recorded under I_4M_1 and I_1 Mo treatment combination respectively.

Keywords: Irrigation, rapeseed, water use efficiency, yield

Oilseeds and oils have assumed an importance of their own in the economy of the country. India accounts for 12-15 per cent of world's oilseed area, 7-8 per cent of oilseed output, 6-7 per cent of vegetable oil consumption (Hegde, 2009). Among the oilseed crops, rapeseed-mustered group ranks next to soybean occupies 7.28 m ha area with production of 8.13m tones and productivity of 1850 kg ha^{-1} in 2012-13. On the other hand, India now needs 58m tones of oilseeds by 2020 for maintaining minimum edible oil requirement of 12 kg capita^{-1} annum^{-1} (Mitall,2008) from the present level of 8.2 kg. in which the share of rapeseed – mustard solely contributes 53 per cent of the total oilseed production. The productivity of this crop is 764 kg ha^{-1} which is comparatively low though the agro- ecological conditions are favourable (Dutta, 2014). Among the production inputs required for augmenting the yield of the crops, irrigation is one of the essential component which is very much limited as compared to other crops. As the source of irrigation is limited as compared to total cropped area, it is advisable to use irrigation water economically and judiciously at proper time and in required quantity with proper water conservation practices so that the maximum WUE can be achieved. Therefore, keeping with this view an attempt was under taken to study the optimum schedule of irrigation and mulch for highest production of rapeseed under new alluvial. Zones of West Bengal during *rabi* seasons.

MATERIALS AND METHODS

The field experiment was conducted in sandy clay loam soil of the Regional Research Station, Gayeshpur Farm under BCKV, Nadia, West Bengal (23^0 $8^/$ N latitude and 88^0 longitude, at an elevation of 9.75m (above mean sea level). The experiment was conducted during *Rabi* season of 2014-15, to study the effect of scheduling irrigation and mulch levels on growth and yield attributes, yields, total water use and water use-efficiency of rapeseed crop. The crop received effective rainfall of 2 mm through out the growing period. Maximum and minimum temperature during that period were 30.55^0c and 11.6^0c, respectively. The experiment was laid out in a split plot design, have 4 levels of irrigation considered in main plots (I_1 – No irrigation, I_2 – irrigation at 1W:CPE ratio of 0.5, I_3-irrigation at 1W:CPE ratio of 0.75 and I_4- irrigation at IW:CPE ratio of 1.0) and 3 levels of mulch (Mo-no mulch, M_1 – full row straw mulch and M_2 –alternate row straw mulch) in sub plots respectively. Rice straw mulch was applied @5.0 tones ha^{-1}. The cultivar used was Benoy (B-9).

The recommended dose of fertilizer of N, $P_2$05 and K_2o was applied @ 80:40:40 kg ha^{-1} from the sources of Urea, Single super phosphate and Marinate of potash respectively. Growth attributes *viz,* plant height, leaf area index and dry matter production were recorded at 75 DAS. Leaf area index was computed by using the formula outlined by Palanisamy and Gomez (1974). Yield attributing characters like number of branches, number of siliqua plant^{-1}, number of seeds siliqua^{-1}, test weight as well as seed yield, stover yield and oil yield were recorded at harvest. Water use efficiency (WUE) was computed by using the following standard formula:

$$\text{WUE (kg ha}^{-1}\text{ mm}^{-1}\text{)} = \frac{\text{Yield (kg ha}^{-1}\text{)}}{\text{CU value (mm)}}$$

CU= Consumptive use

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The statistical analysis was done using the method of Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Levels of irrigation significantly influenced the growth attributes *viz.*, height of the plant, LAI, Dry matter production and Crop growth rate of rapeseed crop (Table-I). I_4 irrigation treatment *i.e.* irrigation at IW:CPF ratio of 1.0 produced maximum plant height (117.31 cm), dry matter production (71.30 g m^{-2}), LAI (3.43) and crop growth sale (4.47g m^{-2} day^{-1}) followed by I3 irrigation treatment *i.e.* irrigation at IW:CPE ratio of 0.75. Full row mulch *i.e.* M1 mulch treatment recorded maximum yield attributes of rapeseeds. This might be due to better utilization of water at different growth stage helps to produce maximum growth attributes of the crop as reported by Ghanbahadur *et al* .(2005).

Yield attributes such as number of primary branches, Number of siliqua $plant^{-1}$, no. of seed $siliqua^{-1}$ and test weight and seed yield (kg ha^{-1}), stover yield (kg ha^{-1}) and oil yield (kg ha^{-1}) were significantly influenced by the levels of irrigation (Table-1) and were recorded maximum 9.2, 114.20, 22.42 and 3.26 g and 1094 kg ha^{-1}, 3659 kg $ha^{-1}$and 357.65 kg ha^{-1} respectively under I_4 *i.e.* irrigation of IW:CPE of 1.0 treatment. Similarly, among the levels of mulch M_1 mulch treatment *i.e.* full row straw mulch significantly influenced and produced maximum, yield attributes and yields of rapeseed. The interaction effect between levels of irrigation and levels of straw mulch was significant and maximum seed yield (1226 kg ha^{-1}) was obtained in I_4M_1 treatment combination.

The highest total water use was recorded under I_4 irrigation treatment (Table-2) and it decreased with the decrease in levels of irrigation and was recorded the lowest under I_1 rainfed irrigation treatment. The maximum water use efficiency was recorded in I_1 (rainfed treatment) due to lowest total water use. However, the minimum water use efficiency was recorded under I_4 treatment *i.e.* irrigation applied at IW: CPE of 1.0 mainly because of the highest total water use (388.78 mm) and the lowest total water use was recorded under I_1 Mo treatment combination (89.57mm). The highest WUE was recorded under I_1M_o treatment (6.3 kg ha^{-1}) as the yield per unit of water was more as compare to other treatment combination and lower under I_4 M_1 (3.06 kg ha^{-1} m^{-1}).

Under irrigated condition seed yield, stover yield and oil yield were recorded more over rainfed treatment as the crop utilized more water through irrigation. However, the seed yield per mm of water was greater in rainfed treatment over irrigated treatments. The crop perform best in terms of yield attributes and yields under IW: CPE of 1.0 and full row straw mulching.

Table 1: Effect of levels of irrigation and mulch on growth attributes of rapeseed at 75 DAS

Treatment	Plant height (cm)	Dry matter accumulation (gm^{-2})	Leaf area index	Crop growth rate (g m^{-2} day^{-1}) (51 – 75 DAS)
Level of irrigation (I) *				
I_1	107.48	56.08	1.54	3.69
I_2	111.90	63.35	3.02	4.22
I_3	116.22	68.21	3.18	4.24
I_4	117.31	71.30	3.43	4.47
SEm(±)	**1.49**	**0.27**	**0.02**	**0.12**
LSD(P=0.05)	**5.26**	**0.97**	**0.05**	**0.32**
Levels of mulch (M)				
M_0	110.66	63.53	2.00	3.97
M_1	115.86	66.47	3.51	4.33
M_2	113.16	64.26	2.67	4.16
SEm(±)	**1.58**	**0.24**	**0.01**	**0.04**
LSD(P=0.05)	**3.91**	**0.73**	**0.06**	**0.13**

Table 2: Effect of levels of Irrigation and mulch on yield attribute and yield of rapeseed

Treatment	No. of braches	No. of siliqua plant^{-1}	No. of seed siliqua^{-1}	Test weight (g)	Seed yield (kg ha^{-1})	Stover yield (kg ha^{-1})	Oil yield (Kg ha^{-1})
Levels of irrigation(I) *							
I_1	6.22	56.61	16.27	2.31	565.92	1811.26	192.42
I_2	7.34	76.06	20.05	2.69	899.84	2786.10	237.90
I_3	7.87	101.77	21.91	3.15	1003.10	3410.00	350.28
I_4	9.20	114.20	22.42	3.26	1094.05	3658.94	357.65
SEm(±)	**0.29**	**0.24**	**0.40**	**0.45**	**11.12**	**79.20**	**34.15**
LSD(P=0.05)	**1.03**	**0.68**	**1.42**	**0.16**	**42.01**	**252.11**	**97.58**
Levels of mulch (M)							
M_0	7.01	81.26	19.02	2.79	832.94	2756.12	237.18
M_1	8.30	95.03	21.76	2.96	945.98	3083.24	346.05
M_2	7.66	84.57	19.70	2.82	892.20	2919.94	312.21
SEm(±)	**0.16**	**0.87**	**0.29**	**0.02**	**16.14**	**151.00**	**11.28**
LSD(P=0.05)	**0.56**	**1.34**	**0.89**	**0.07**	**49.26**	**267.50**	**32.37**

* *I_1 - No Irrigation, F_2 – irrigation at IW: CPE ratio of 0.5, I_3 – irrigations IW: CPE ratio of 0.75 and I_4 – irrigation IW:CPE ratio of 1.0*
M_O – No Mulching, M_1 – Full row straw mulching and M_2 – Alternate row straw mulching

Table 3: Total water use and water use efficiency of rapeseed under different levels of irrigation and mulching.

Treatment combination	Profile contribution (mm)	Irrigation (mm)	Effective rainfall (mm)	Total water use (mm)	Yield (kg ha^{-1})	WUE (kgha^{-1}mm^{-1})
I_1M_0	87.57	-	2.00	89.57	537	6.31
I_1M_2	90.11	-	2.00	92.11	572	6.20
I_1M_1	96.25	-	2.00	98.25	591	6.01
I_2M_0	99.23	50	2.00	151.23	810	5.35
I_2M_2	124.27	50	2.00	176.27	933	5.29
I_2M_1	133.36	50	2.00	185.36	956	5.15
I_3M_0	135.15	100	2.00	237.15	976	4.11
I_3M_2	141.08	100	2.00	243.08	988	4.06
I_3M_1	165.21	100	2.00	267.21	1046	3.91
I_4M_0	167.41	150	2.00	319.41	1024	3.20
I_4M_2	193.52	150	2.00	346.52	1076	3.11
I_4M_1	236.78	150	2.00	388.78	1193	3.06

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