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Growth Dynamics of Rapeseed (*Brassica campestris* L.) CV. SAU Sarisha-1 as Influenced by Irrigation Levels and Row Spacings

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Abstract: Accumulation of above ground dry matter, dry matter partitioning, CGR and RGR of rapeseed (*Brassica campestris* L. cv. SAU Sarisha-1) plants, were studied under three irrigation levels (no irrigation, one irrigation at 30 DAS and two irrigations at 30 and 60 DAS) and three row spacings (20 cm, 30 cm and 40 cm) managements. The experiment was undertaken at Sher-e-Bangla Agricultural University (SAU) Farm, Dhaka-1207, Bangladesh during the period from October, 2004 to January, 2005. The results revealed that irrespective of treatment variations, dry matter accumulation in leaves and stem started slowly at early growth stage (30 DAS) and increased thereafter and was partitioned maximum at harvest in the reproductive units. The maximum dry accumulation was observed with two irrigation (at 30 DAS and 60 DAS) with 40 cm row spacing. The crop growth rate (CGR) was significantly affected by irrigation and row spacing where relative growth rate (RGR) was significantly influenced only by irrigation. Higher accumulation of dry matter in rapeseed ultimately elevated the seed yield as confirmed by relationship study between seed yield and dry matter.

Key words: Rapeseed, irrigation, row spacing, dry matter, CGR, RGR

INTRODUCTION

Rapeseed (*Brassica campestris* L.) belongs to the family Cruciferae is an important oil crop and currently the principal oil crop of Bangladesh. Rapeseed contains 40 - 45% oil and 20 - 25% protein in seed. The annual oil seed production is 376000 metric tons of which rapeseed covers 62% (MoA, 2006). It is top of the list in respect of area and production of oilseed crops cultivated in this country. The average seed yield of rapeseed is 0.71 t ha^{-1} (MoA, 2006), which is very low as compared to that of world average (FAO, 2006). The major reasons for such poor yield of rapeseed in Bangladesh may be attributed to the lack of using improved varieties and poor management practices in farmers' field.

The economic yield is greatly determined by the production of total dry matter and its partition to the reproductive organ (Singh and Yadav, 1989). Among the possible ways of promoting dry matter accumulation, optimum irrigation levels and row spacing are important (Johason and Hanson, 2003). In Bangladesh rapeseed is mostly grown on the residual soil moisture in Rabi (winter) season thus obtaining poor yield (Kaul and Das, 1986).

The present study was undertaken to investigate the impact of optimum irrigation levels and suitable row spacing on growth dynamics of a newly released variety (SAU sarisha-1) of rapeseed.

MATERIALS AND METHODS

The experiment was conducted at Sher-e-Bangla Agricultural University farm, Dhaka-1207, Bangladesh during the period from October 2004 to January 2005. The soil of the experimental site belongs to the agro-ecological region of "Madhupur Tract" (AEZ No. 28). It was Deep Red Brown Terrace soil and belonged to "Nodda" cultivated series. There were two factors in this experiment, viz. irrigation level and row spacing. The Irrigation levels were no irrigation (I_0), one irrigation at 30 DAS (I_1) and two irrigations at 30 and 60 DAS (I_2). Row spacings were 20 cm (S_1), 30 cm (S_2) and 40 cm (S_3). The experiment was laid out in split plot design with four replications. The experimental plots were fertilized with a recommended dose of 135,

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Table 1: Above ground dry weight (g plant^{-1}) of rapeseed plants at different ages as affected by irrigation levels, row spacings and their combined effects

Treatments	Days after sowing (DAS)				
	30	45	60	75	90
			Irrigation levels		
I_0	0.32	1.01	3.45	4.96	2.43
I_1	0.39	2.11	8.47	10.67	11.13
I_2	0.39	2.24	10.59	14.28	16.53
LSD 0.05	NS	0.03	0.48	0.34	0.29
			Row spacings		
S_1	0.38	1.54	6.55	7.77	8.47
S_2	0.39	2.05	7.89	9.72	9.95
S_3	0.43	2.06	8.20	10.43	11.67
LSD 0.05	NS	0.02	0.29	0.33	0.25
			Irrigation levels Row spacings		
I_0S_1	0.30	0.90	3.13	4.05	2.02
I_0S_2	0.33	1.17	3.58	4.97	2.78
I_0S_3	0.31	0.96	3.65	5.88	2.51
I_1S_1	0.43	2.23	7.73	10.1	8.59
I_1S_2	0.35	2.62	9.11	10.82	7.62
I_1S_3	0.49	2.06	8.64	11.1	15.18
I_2S_1	0.40	1.70	8.35	14.24	14.81
I_2S_2	0.40	2.39	11.36	14.30	17.32
I_2S_3	0.55	2.62	12.06	14.31	17.46
LSD 0.05	0.10	0.04	0.51	0.58	0.44
CV (%)	8.36	4.36	4.57	7.94	6.01

I_0 = No irrigation
I_1 = One irrigation at 30 DAS (pre-flowering stage)
I_2 = Two irrigations at 30 and 60 DAS (pre-flowering and siliquae development stage
S_1 = 20 cm row spacing
S_2 = 30 cm row spacing
S_3 = 40 cm row spacing

Table 2: Crop growth rate (g m^{-2} d^{-1}) of rapeseed cv. SAU sarisha-1 plants as affected by row spacing, irrigation levels and their combined effects

Treatments	Days after sowing (DAS)			
	30 to 45	45 to 60	60 to 75	75 to 90
		Irrigation levels		
I_0	1.72	6.07	3.75	-6.28
I_1	4.22	15.07	5.29	1.11
I_2	4.49	22.19	9.66	5.89
LSD 0.05	0.009	1.96	1.68	0.66
		Row spacings		
S_1	3.48	14.95	9.58	-3.87
S_2	4.11	15.23	4.09	0.58
S_3	2.73	12.35	5.11	2.49
LSD 0.05	0.08	01.01	2.14	0.07
		Irrigation levels Row spacings		
I_0S_1	1.70	7.59	3.92	-8.36
I_0S_2	2.18	5.09	2.39	-3.31
I_0S_3	1.29	5.43	4.49	-6.78
I_1S_1	4.47	18.43	7.66	-4.88
I_1S_2	4.98	15.56	4.10	-4.48
I_1S_3	2.53	10.64	3.97	6.60
I_2S_1	3.76	19.18	6.96	1.64
I_2S_2	5.09	21.94	5.75	5.11
I_2S_3	5.16	24.82	8.03	7.25
LSD 0.05	0.016	1.031	2.88	1.64
CV (%)	2.34	5.36	3.15	4.60

I_0 = No irrigation
I_1 = One irrigation at 30 DAS (pre-flowering stage)
I_2 = Two irrigations at 30 and 60 DAS (pre-flowering and siliquae development stage S_1 = 20 cm row spacing
S_2 = 30 cm row spacing
S_3 = 40 cm row spacing

Table 3: Relative growth rate (g g^{-1} d^{-1}) of rapeseed cv. SAU sarisha-1 plants as affected by row spacing, irrigation levels and their combined effects

Treatments	Days after sowing (DAS)			
	30 to 45	45 to 60	60 to 75	75 to 90
		Irrigation levels		
I_0	0.077	0.082	0.020	-0.047
I_1	0.101	0.089	0.015	0.003
I_2	0.112	0.108	0.024	0.010
LSD 0.05	NS	0.002	0.001	0.01
		Row spacings		
S_1	0.093	0.096	0.017	-0.009
S_2	0.104	0.091	0.012	0.002
S_3	0.099	0.100	0.019	0.007
LSD 0.05	NS	NS	NS	NS
		Irrigation levels Row spacing		
I_0S_1	0.072	0.092	0.022	-0.060
I_0S_2	0.083	0.065	0.017	-0.025
I_0S_3	0.073	0.089	0.032	-0.057
I_1S_1	0.103	0.089	0.018	-0.011
I_1S_2	0.104	0.083	0.011	-0.191
I_1S_3	0.095	0.095	0.017	0.021
I_2S_1	0.096	0.106	0.036	0.003
I_2S_2	0.118	0.108	0.011	0.013
I_2S_3	0.120	0.109	0.015	0.013
LSD 0.05	NS	0.012	0.03	0.007
CV (%)	2.37	5.67	4.66	2.78

I_0 = No irrigation
I_1 = One irrigation at 30 DAS
I_2 = Two irrigations at 30 and 60 DAS
S_1 = 20 cm row spacing
S_2 = 30 cm row spacing
S_3 = 40 cm row spacing

85, 60, 35, 4 and 4 kg ha^{-1} of N, P_2O_5, K_2O, S, Zn and B in the form of urea, triple super phosphate (TSP), muriate of potash (MP), gypsum, zinc oxide (ZnO) and boric acid, respectively. Seeds were sown on October 26, 2004. Light irrigation was given immediate after sowing to ensure optimum germination.

Ten plants from each treatment were sampled periodically from 30 DAS to 90 DAS at an interval of 15 days to record data on above ground dry matter (DM), dry matter partition (into leaves, stems and siliquae). Crop growth rate (CGR) and Relative growth rate (RGR) were calculated following the formulae given by Brown (1984) and Radford (1967). The data were analyzed by using statistical computer programme ALPHA and MSTAT-C v.2.10 and means were compared by using LSD test at 5% level of significance.

RESULTS AND DISCUSSION

Effect on Dry Matter Accumulation:

Accumulation of dry matter was very slow at initial stage (30 DAS) and thus no responses were observed due to treatment variables. Dry matter increased with time (45 to 90 DAS) showing significant response to different irrigation levels and row spacing. Treatment I_2 and S_3 gave significantly highest dry matter weights at all the growth stages (Table 1). Lowest dry matter weight was recorded from the plants with no irrigation (I_0) and under maximum intra competition of plant for an area (S_1). Tomer *et al*., (1992) and Giri (2001) reported maximum dry matter production in rapeseed with two irrigations. Chauhan *et al*., (1993) and Singh and Singh, (1984) suggested row spacing for greater rapeseed dry matter production as 40 cm. The combination between two irrigation and 40 cm row spacing (I_2S_3) had a positive influence on the maximum production of dry matter over other treatment variables and that was significant (Table 1).

Effect on Dry Matter Partition:

Irrespective of irrigation and row spacing variations, the dry matter partition was very slow in the early growth stage (30 DAS) and increased rapidly up to harvest (90 DAS). Leaves accounted for up to 19, 8, 0.01; stem 43, 39, 39 and siliquae 50, 54, 61 % of above ground dry matter at 60, 75 and 90 DAS, respectively. The similar trend of dry matter was reported by Alam (2004) and Siddique (1999) while working with rapeseed. Dry matter partition into stem increased up to harvest, whereas partition into leaves was found lower which could be attributed due to the leaf senescence and mobilization of metabolites from leaf to siliquae.

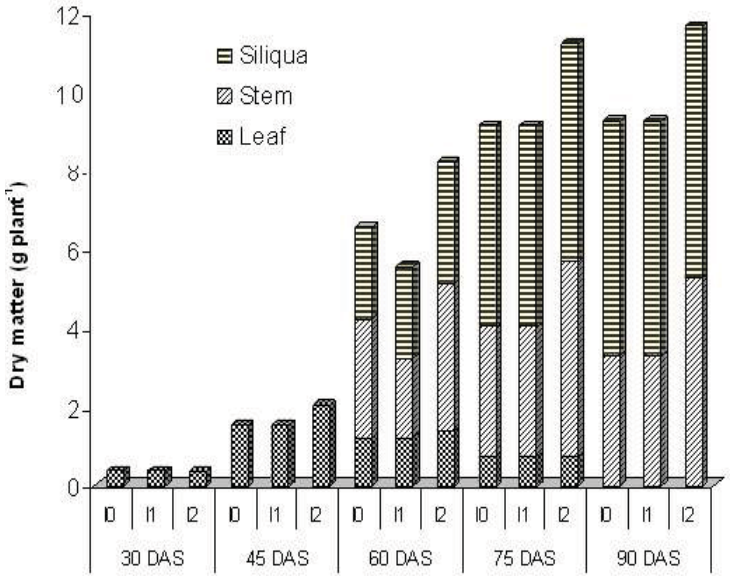

Fig. 1: Dry matter accumulation in different parts of rapeseed plant at different ages as affected by different irrigation levels

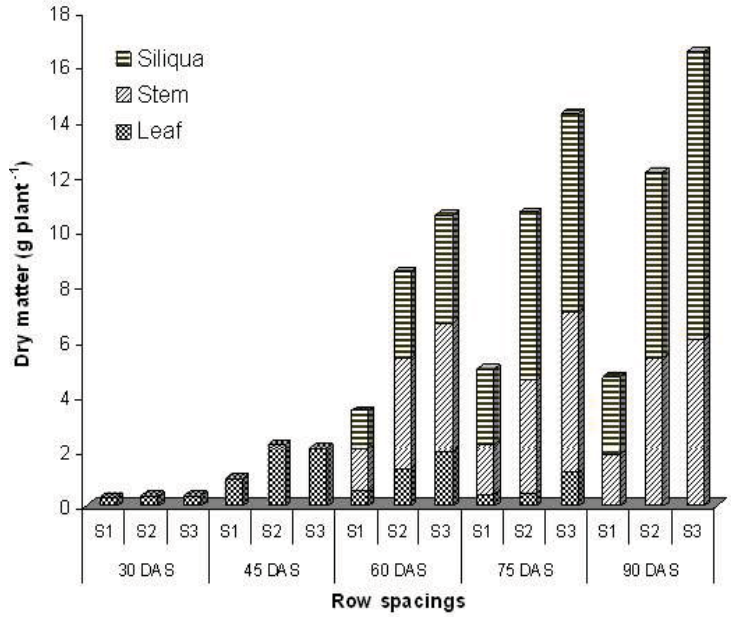

Fig. 2: Dry matter accumulation in different parts of rapeseed plant at different ages as affected by different row spacings

The partition of dry matter towards siliquae started at 60 DAS and maximised at 90 DAS. Irrigation levels did not influence in dry matter distribution towards leaves, stem and siliquae at all growth stages with exception at 60 DAS where I_2 gave greater dry matter partition over other levels (I_0 and I_1) (Fig. 1). Plant population densities i.e. row spacing showed its importance in this respect (Fig. 2). Wider spaced plant (S_3) got more dry matter into leaves, stem and siliquae in all growth stages. This result corroborated with the results observed by Lodhi *et al*. (1979).

Effect on Crop Growth Rate (CGR) and Relative Growth Rate (RGR):

Crop growth rate (CGR) is the increased in dry matter of plant per unit ground area per unit of time. In general the CGR was slow at early stage and found maximum between 45 and 60 DAS then declined up to harvest. Irrigation levels significantly influenced CGR from 30 to 90 DAS (Table 2). Highest CGR values were obtained with I_2 at all growth analyses. The plants were under water stressed (I_0) gave significantly lowest CGR values. At initial stages the CGR was highest with intermediate row spacing (S_2) where at the later stage of growth i.e. after 60 DAS CGR values were comparatively higher at widest row spacing of 40 cm (S_3) than closer row spacings. This might be due to decreased efficiency of leaves at higher population densities (Siddiqui, 1999). At every stages of growth, CGR was maximum with the combined effect of two irrigation and 40 cm row spacing (I_2S_3). Similar trend was also reported by Khader and Bhargava (1985).

Relative growth rate is the increase in dry matter per unit of material present per unit of time. Irrespective of treatment differences, the RGR values were found at early growth stage then declined with time (Table 3). The initial stage of a plant is important from RGR point of view as greater dry mater supports plants to have early growth coverage for initial dry matter production. At initial stages RGR was maximum with intermediate spacing (30 cm) and thereafter maximum RGR was attained by widest spacing (40 cm). However the row spacing did not exert any significant effect on the RGR of rapeseed at any growth stages (Table 3). Siddiqui (1999) observed similar results in rapeseed. Significant effect of population density on RGR was not found in other crops like soybean (Board *et al*., 1990) and sesame (Hossain and Salahuddin, 1994; Roshid, 1998). The interaction effect of two irrigation and 40 cm row spacing showed the highest RGR in early stage (30 to 45 DAS) in the present study.

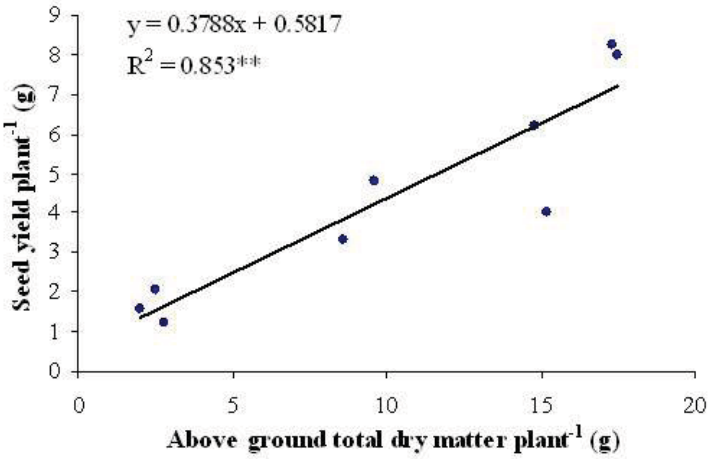

Fig. 3: Relationship between above ground dry matter and seed yield plant-1 of rapeseed cv. SAU sarisha-1

Relationship Between Seed Yield and above Ground Dry Matter:

The relationship between seed yield and above ground dry matter was strongly positive, linear and significant (R^2 = 0.85**) (Fig. 3). The slope for seed yield and above ground dry matter indicated that an increment of 1.00 g above ground dry matter promotes 0.38 g seed yield. Chauhan and Bhargava (1984) also reported similar results in rapeseed. Chowdhury *et al*. (1999) also found a correlation between these characters.

Conclusion:

It is concluded that rapeseed cv. SAU sarisha-1 may be cultivated at 40 cm row spacing along with two irrigation, one at 30 DAS (pre-flowering stage) and another at 60 DAS (siliquae development stage) for optimum dry matter production and partition. This findings could be evaluated further doing research at different agro-ecological regions of Bangladesh.

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