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Biomass partitioning in *Brassica* as affected by sowing dates

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ABSTRACT

A two-year study on partitioning of biomass in four genotypes of *Brassica* species revealed that the contribution of leaf decreased consistently from first flower open till harvest in both the years. With the commencement of reproductive phases, the highest biomass was diverted towards the stem followed by siliquae, root and leaf in the same sequence. Delay in sowing reduced the biomass accumulation in different plant parts during both the years. The increased per cent contribution of stem from total biomass under late sown conditions resulted in drastic reduction in seed yield and its attributes. Further, it was observed that the higher biomass accumulation led to the healthy development of source during vegetative phase in timely sown crop which resulted in better sink development.

Key Words : Biomass partitioning, Brassica

The yielding ability of a crop is dependent on investment of a greater proportion of biomass in the harvested organs. Quite different processes may limit the yield of different cultivars due to variation in their edaphic and environmental conditions (Willman *et al.*, 1987). Synthesis, translocation partitioning and accumulation of photosynthates within the plant are controlled genetically and influenced by the environment (Snyder and Carlson, 1984). Present study was undertaken to understand the partitioning pattern of biomass in *Brassica* cultivars under different environmental conditions achieved through change in sowing date and planting densities.

MATERIALS AND METHODS

Present study was conducted during *rabi* (winter) season of 1996-97 and 1997-98 at the research farm of the Department of Agricultural Meteorology CCS Haryana Agricultural University, Hisar (29^0 10'N, 75^0 46'E and 215.2m a.m.s.l.).The soils of the area are derived from Indo-gangetic alluvium deposits and are sandy loam in texture, slightly alkaline with poor in nitrogen content, medium in phosphorus and rich in potash. The experiment was conducted in split plot design. The treatment comprised of combinations of three sowing dates viz., Oct. 5, Oct. 19 and Nov. 24 in 1996 and Nov. 24. Dec. 4 and Dec. 16 in 1997 and designated as D_1, D_2 and D_3 and two plant densities viz., 30 x 15cm and 40 x 20cm as main plots and four cultivars viz., Varuna, Laxmi, RH-30 an BSH-1 in sub-plots. The recommended dose of fertilizers and package of other cultural practices were followed to raise the crop. Biomass observations were recorded at phenopases of first flower appearance (P_2), 50% flowering (P_3), start of seed filling (P_4), end of seed filling (P_5) and physiological maturity (P_6). Five plants were randomly selected from each plot and pulled out every time and separated into leaves, stem, root and siliquae. Samples were oven dried at 70°C for 48 hrs and then weighed. Biomass accumulation in different plant parts was then converted to per square metre area basis.

RESULTS AND DISCUSSION

The partitioning of biomass of oilseed brassica as influenced by experimental treatments in two crop seasons are presented in Tables 1 & 2. During 1997-98, the accumulation of dry matter and its allocation to different plant parts was significantly reduced with delay in sowing owing to heavy rains (125mm) during October month. Subsequently, the prevalence of low day (11 to 18°C) and night (0 to 7°C) temperatures, high evening (66 to 95%) and morning (85 to 97%) RH and poor sunshine (0 to 6hrs) during the active vegetative growth phase led to poor growth and development of crop. The pattern of biomass allocation to plant parts changed with occurrence of different phenological events. Sowing dates and varieties influenced this pattern significantly, however, the plant densities showed no significant affect. At P_2 phenophase, biomass allocation to leaves was maximum followed by stem and roots. With the appearance of flowers and some siliquae at P_3, the partitioning of reproductive parts was recorded. At P_4, highest biomass was recorded in stem followed by leaves, roots and siliquae, in the same sequence. But latter on, at P_5 and P_6 the highest biomass was observed in stem followed by siliquae, root and leaves. While looking at per cent biomass allocation, it was noted that the root biomass increased till P_1. The percentage biomass allocation to leaves was highest at P_2 (59%) and declined thereafter. The consistent increase in biomass allocation to stem was possibly because of the continuous growth of stem till crop maturity and declined contribution of leaves to total dry weight due to leaf senescence during later reproductive phase of crop. The degeneration of roots in the latter crop season also contributed to this relative increase of stem dry matter.

The delayed sowing reduced the biomass accumulation in different plant parts in both the years with certain exceptions. However, while comparing the per cent allocation to different parts, it was observed that the difference was smaller between sowing dates. The delay in sowing increased the per cent contribution of stem to total dry matter and it was the siliquae weight which have to suffer most due to their poor development in terms of absolute dry weight as well as in terms of percent allocations. The delay in sowing resulted in significant reduction of stem biomass in both the years. A sudden drop in temperature (from 25.6 to 15.4 °C) particularly during the grand growth period followed by a sharp rise (from 32.4 to 41.5 °C) in it at crop maturity under delayed sowing led to reduced biomass accumulation and its allocation to various plant parts. The low temperature during grand growth period resulted in reduced plant growth because of poor crop growth rate. On the other hand, the increased temperatures during latter reproductive phase (36 to 41.5 °C) hastened the maturity. Tyagi (1994) has reported similar results in mustard crop. Plant spacing failed to infuence the biomass accumulation and its allocation to different plant parts. Earlier, Sharma (1994) have reported no significant effect of plant spacing on dry matter. Very little or non-significant difference in biomass partitioning at various phenophases of *B. juncea* cultivars is attributable to almost similar crop duration and growth behaviour of these cultivars and similarly, the lowest contribution of BSH-1 at latter reproductive phase and

Table 1: Effect of sowing dates on whole plant biomass and its allocation (gm^{-2}) in plant part in *Brassica* cultivars (1996-97).

Treatments	First flower open					50% flowering				
Sowing Dates	Leaf	Stem	Apparent Root	Siliquae	Total	Leaf	Stem	Apparent Root	Siliquae	Total
D_1	79.00	38.11	19.02	-	136.13	127.24	64.41	30.08	11.68	233.41
	(58.03)	(28.00)	(13.97)	-		(54.51)	(27.59)	(12.89)	(5.01)	
D_2	73.03	34.52	12.35	-	119.90	104.57	53.50	26.40	6.22	190.69
	(60.90	(28.80)	(10.30)			(54.84)	(28.06)	13.84)	(3.26)	
D_3	41.61	19.09	8.97	-	69.67	71.33	35.46	20.96	2.80	130.55
	(59.72)	(27.40)	(12.88)			(54.64)	(27.16)	(16.06)	(2.14)	
C.D. at 5%	4.11	4.48	1.64	-	4.21	7.28	6.77	2.77	0.59	9.88
	Start of seed filling					End of seed filling				
D_1	174.87	205.36	42.21	44.81.	467.25	24.83	595.46	112.61	703.47	1436.37
	(37.43)	(43.95)	(9.03)	(9.59)		(1.73)	(41.46)	(7.84)	(48.97)	
D_2	144.14	169.26	37.92	32.56	383.88	35.11	575.07	96.41	535.47	1242.06
	(37.55)	(44.09)	(9.88)	(8.48)		(2.83)	(46.30)	(7.76)	(43.11)	
D_3	99.26	144.89	25.31	16.33	285.79	42.55	435.79	82.37	212.54	773.25
	(34.73)	(50.70)	(8.86)	(5.71)		(5.50)	(56.36)	(10.65)	(27.49)	
C.D. at 5%	5.87	7.02	3.00	2.51	15.81	4.57	19.32	5.35	29.34	33.69
	Maturity									
D_1	5.27	616.80	76.14	730.64	1428.85					
	(0.37)	(43.17)	(5.33)	(51.13)						
D_2	6.06	597.12	70.45	566.94	1240.57					
	(0.49)	(48.13)	(5.68)	(45.70)						
D_3	6.60	454.97	63.42	249.07	774.06					
	(0.85)	(58.78)	(8.19)	(32.18)						
C.D. at 5%	0.54	17.22	4.68	27.31	32.87					

Table 2: Effect of sowing dates on whole plant biomass and its allocation (g m^{-2}) in plant parts in brassica cultivars (1997-98)

Treatments	First flower open					50% flowering				
Sowing Dates	Leaf	Stem	Apparent Root	Siliquae	Total	Leaf	Stem	Apparent Root	Siliquae	Total
D_1	22.60 (55.42)	12.23 (30.00)	5.95 (14.58)	-	40.78	41.32 (54.23)	21.26 (27.90)	10.69 (14.04)	2.92 (3.83)	76.19
D_2	13.29 (54.89)	7.06 (29.16)	3.86 (15.94)	-	24.21	29.58 (55.53)	14.13 (26.53)	7.87 (14.78)	1.67 (3.14)	53.25
D_3	11.04 (54.60)	5.93 (29.33)	3.25 (16.07)	-	20.22	17.30 (48.71)	12.78 (35.98)	4.64 (13.06)	0.80 (2.25)	35.32
C.D. at 5%	1.05	0.29	0.57	-	1.08	0.64	0.88	0.70	0.09	3.40
	Start of seed filling					End of seed filling				
D_1	65.65 (38.08)	75.53 (43.81)	15.45 (8.96)	15.77 (9.15)	172.40	24.16 (6.10)	217.47 (54.95)	40.58 (10.25)	113.58 (28.70)	395.78
D_2	44.59 (36.51)	54.89 (44.95)	11.87 (9.72)	10.77 (8.82)	122.12	12.64 (6.41)	108.77 (55.16)	19.54 (9.91)	56.23 (28.52)	197.18
D_3	23.83 (38.70)	28.23 (45.85)	5.58 (9.06)	3.93 (6.39)	61.57	5.83 (5.94)	52.44 (53.44)	10.64 (10.84)	29.21 (29.78)	98.12
C.D. at 5%	1.37	2.60	0.50	0.74	3.80	1.63	9.10	2.48	4.89	14.23
	Maturity									
D_1	5.56 (1.38)	233.37 (58.05)	35.65 (9.12)	126.42 (63.13)	402.00					
D_2	4.08 (1.92)	126.64 (59.64)	18.38 (8.67)	63.13 (29.77)	212.06					
D_3	2.22 (2.06)	62.32 (57.87)	9.66 (8.97)	33.48 (31.10)	107.68					
C.D. at 5%	0.30	8.15	1.30	2.89	9.52					

physiological maturity in root and siliquae, to shorter reproductive phase.

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