

Response of Periodic Dry Matter Partitioning and Crop Growth Rate on Yield of Wheat (*Triticum aestivum* L.) Cultivars as Influenced by Tillage Techniques

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Abstract

Studies were conducted during 2004-05 to determine the effect of two tillage systems (zero and conventional) and five wheat cultivars viz. PBW-343, Raj-3077, HD-2329, WH-542 and RSP-303 on dry matter partitioning and crop growth rate (CGR) of wheat (*Triticum aestivum* L.). The results revealed that the periodic dry matter partitioning and CGR did not differ significantly by the tillage systems, whereas, the cultivars were significantly influenced with respect to these parameters. Out of the two tillage systems, zero till wheat recorded higher dry matter accumulation in different parts of the plants and CGR at all stages of development. Similarly, wheat cultivar PBW-343 recorded the higher dry matter accumulation at 30, 60, 90, 120 and 150 days after sowing compared with WH-542, HD-2329, RSP-303 and Raj-3077. However, similar trend of CGR was observed with respect to wheat cultivars except at 120-150 days after sowing where the difference among the cultivars was not significant.

Key words : Dry matter, Growth rate, Yield, Wheat cultivars, Tillage techniques.

Rice (*Oryza sativa*)-wheat (*Triticum aestivum*) is the most important cropping system in India occupying an area of about 12 million hectares (1), whereas in Jammu and Kashmir, rice-wheat accounts for about an area of 2.49 lakh hectares of which basmati rice-wheat system contributes 7.23%, of which wheat is cultivated over an area of about 18,500 hectares (2). Wheat crop establishment after rice is an important factor in improving the productivity of wheat in rice-wheat system which is declining because of the delay in sowing time. Late sowing of normal sown wheat cultivars through conventional technique leads to production of less vigorous plants as compared to zero tilled ones. Delay in conventional sown wheat from normal sowing date decreased grain yield by 15.50 kg/ha per day in northern hills (3). The importance of zero tillage with respect to its economy in wheat sowing over conventional tillage has been well established. Further, the differential behavior of similar wheat cultivars under varied tillage and agro-climatic conditions has been reported by Dash and Verma (4). Keeping in view of the delayed sowing of wheat due to late harvesting of long duration basmati rice and economy of zero tillage sowing differential response of wheat cultivars with respect to dry matter accumulation and crop growth rate under varied

tillage conditions, the study on response of various cultivars sown under different tillage methods was initiated.

Methods

A field experiment was conducted at the Research Farm of Faculty of Agriculture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Chatta, Jammu during *rabi* of 2004-05. The soil was loamy in texture and slightly alkaline (7.76) in reaction, with low organic carbon (0.41%) and was found low in available nitrogen (223.0 kg/ha) and medium in available phosphorus (11.9 kg/ha) and potassium (126.2 kg/ha). The experiment was laid out in randomized block design with three replications. The treatments comprised two tillage systems (conventional and zero tillage) and five wheat cultivars (PBW-343, WH-542, RSP-303, Raj-3077 and HD-2329). After the harvest of basmati rice, the experimental field was laid out. The plots identified for zero till sowing were not disturbed, whereas conventional till plots were prepared manually. Half of the total dose of nitrogen and full dose of phosphorus and potassium were applied in furrows opened (at spacing of 20 cm) by the seed drill below the seed at the time of sowing using a seed

Table 1. Effect of tillage systems and cultivars on dry matter partitioning and dry matter accumulation (q/ha) in wheat. Tillage systems \times Cultivars : Non-significant.

Treatments	Days after sowing								
	30			60			90		
	Leaves	Stem	Total	Leaves	Stem	Total	Leaves	Stem	Total
Tillage Systems									
Zero tillage	1.87	0.53	2.40	7.04	9.94	16.98	13.86	30.02	43.88
Conventional tillage	1.85	0.52	2.37	7.01	9.90	16.91	13.80	29.98	43.78
SE (\pm)	0.01	0.01	0.07	0.01	0.02	0.26	0.02	0.03	0.06
CD ($P = 0.05$)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Cultivars									
PBW-343	2.26	0.83	3.09	9.44	12.89	22.12	16.13	33.99	50.12
Raj-3077	1.41	0.39	1.80	5.48	7.60	13.08	12.08	26.87	38.95
HD-2329	1.91	0.46	2.37	6.79	9.83	16.62	13.72	29.79	43.51
WH-542	2.06	0.48	2.54	6.79	10.06	16.85	14.33	29.83	44.16
RSP-303	1.65	0.47	2.12	6.70	9.31	16.08	12.86	29.54	42.40
SE (\pm)	0.02	0.017	0.12	0.02	0.03	0.42	0.04	0.05	0.09
CD ($P = 0.05$)	0.07	0.05	0.34	0.08	0.09	1.24	0.12	0.14	0.26

Table 1. Continued.

Treatments	Days after sowing							
	120				150			
	Leaves	Stem	Ears	Total	Leaves	Stem	Ears	Total
Tillage Systems								
Zero tillage	13.29	43.62	25.55	82.46	13.00	42.75	46.10	101.85
Conventional tillage	13.17	43.62	25.55	82.34	12.90	42.67	46.02	101.59
SE (\pm)	0.07	0.03	0.05	0.14	0.05	0.10	0.11	0.24
CD ($P = 0.05$)	NS	NS	NS	NS	NS	NS	NS	NS
Cultivars								
PBW-343	15.90	50.99	28.28	95.17	14.27	48.29	52.37	114.93
Raj-3077	11.41	40.46	22.63	74.50	11.38	39.58	42.12	93.08
HD-2329	13.25	42.41	25.74	81.40	13.50	42.00	45.45	100.95
WH-542	13.29	42.62	26.46	82.37	13.72	42.30	46.13	101.93
RSP-303	12.25	41.64	24.67	78.56	11.86	41.36	44.49	97.71
SE (\pm)	0.11	0.06	0.08	0.22	0.08	0.15	0.17	0.38
CD ($P = 0.05$)	0.35	0.17	0.25	0.66	0.24	0.46	0.52	1.11

rate of 100 kg/ha. The half of remaining dose of total nitrogen was applied in two equal splits at crown root initiation (CRI) and boot stages of the crop. In zero tilled plots, sowing was done with help of zero seed drill. In both tillage systems, the seed was covered with the soil after sowing. Intercultural, water management and plant protection measures were adopted following recommended package of practices (5). Half meter row length of plants from border row of each plot was cut from the ground level at all the observa-

tional days. Depending upon the stage of the crop, the plant parts viz. leaves, stem and ears of all the plants were kept separately for air drying. Air dried plant parts were then kept in oven at 65 ± 5 C for drying till constant weight was obtained. For dry matter partitioning studies, weight of leaves, stems and ears were recorded separately and then converted on hectare basis. Total dry matter accumulation expressed as q/ha at each stage was worked out by combining of all the plant parts of that stage.

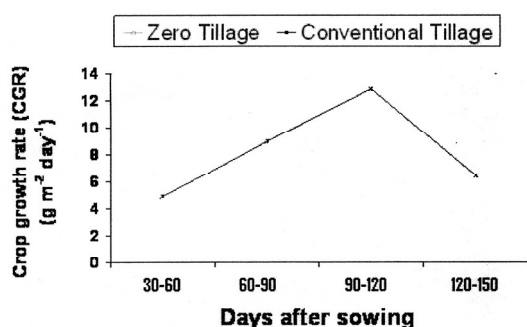


Figure 1. Effect of tillage systems on crop growth rate.

The crop growth rate (g/m^2 per day) for each observed stage was calculated by substituting the corresponding dry matter accumulation values of each stage following Redford (6).

The bundle weight of sun dried produce of each net plot was taken and expressed as biological yield in q/ha . Grains from each weighed bundle of each net plot were threshed to separate grains and straw. The weight of the grains and straw were recorded separately and converted to hectare basis to express grain and straw yield in q/ha . Harvest index was calculated by dividing economic (grain) yield by the biological (grain + straw) yield following Nichiporovich (7).

Results and Discussion

Dry Matter Partitioning

Total dry matter accumulation of a plant is sum total of dry matter accumulated in its leaves, stem and other parts during crop growth period. Table 1 reveals that dry matter accumulation in leaves, stem, and total dry matter were not significantly affected by the tillage systems, whereas cultivars significantly influenced partitioning and total dry matter accumulation in leaves, stem and ears. Wheat crop grown under zero till sowing accumulated little higher dry matter in leaves, stem and ears, and total dry matter as compared to corresponding values recorded under conventional sowing. These results corroborate the findings of Gupta (8). Dry matter accumulation after 60 days justifies sigmoid growth pattern of the plants. A sharp increase in leaves dry matter (q/ha) was recorded up to 90 days of crop age after which it declined, whereas almost a linear trend was observed in stem and total dry matter accumulation up to final

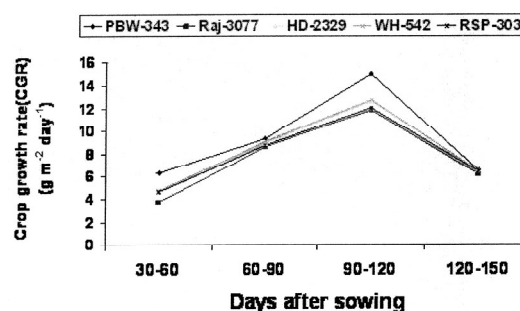


Figure 2. Effect of wheat cultivars on crop growth rate.

observation stage under the influence of both tillage systems. This can be attributed to coming up new leaves and increase in leaf area index up to 90 days, increase in plant height up to 120 days and coming up ears and their subsequent filling from 120–150 days after sowing. The leaf : stem : ear ratio at 120 and 150 days was 16.11 : 52.89 : 31.00 and 12.86 : 41.92 : 45.22, respectively under zero tillage. The leaf : stem ratio at 30, 60 and 90 days after sowing was 78.05 : 21.95, 41.45 : 58.55, 31.52 : 68.48, whereas under conventional tillage, leaf : stem : ear ratio at 120 and 150 days after sowing recorded values were 15.99 : 52.97 : 31.04, 12.69 : 42.00 : 45.31.

Cultivars significantly influenced its accumulation in leaves, stem, ears and total dry matter accumulation. Cultivar PBW-343 was followed by WH-542, HD-2329, RSP-303 and Raj-3077 in descending order of dry matter accumulation in leaves, stem, ears and total dry matter at all the observational days. At 30 and 90 days stage, all the cultivars differed significantly in dry matter accumulation of leaves and ears at 120 and 150 days stage. Stem dry matter accumulation in all the cultivars differed significantly at 60 and 120 days stages. Dry matter accumulation by ears as recorded at 120 and 150 days stages differed significantly in all the cultivars. The per cent dry matter accumulation in leaves and stem to the total was higher in leaves at 30 days stage, whereas it was higher in stem at all the other observational stages among cultivar treatments. All the cultivars followed almost similar dry matter accumulation, leaf : stem at 30, 60 and 90 days after sowing and leaf : ear at 120 and 150 days, respectively. The per cent leaf : stem dry matter accumulation ratio was 77.91 : 22.09, 41.46 : 58.54 and 31.58 : 68.42 at 30, 60 and 90 days after sowing, re-

Table 2. Effect of tillage systems and cultivars on crop growth rate, grain yield, straw yield and harvest index in wheat. Tillage systems \times Cultivars : Non-significant.

Treatments	Crop growth rate (g/m ² /day)				Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)
	30-60	60-90	90-120	120-150			
Tillage Systems							
Zero tillage	4.86	8.96	12.86	6.46	42.44	59.10	41.78
Conventional tillage	4.85	8.95	12.85	6.42	40.96	58.29	41.30
SE (\pm)	0.09	0.10	0.05	0.10	0.54	0.33	0.38
CD ($P = 0.05$)	NS	NS	NS	NS	NS	NS	NS
Cultivars							
PBW-343	6.34	9.34	15.02	6.59	46.65	66.56	41.22
Raj-3077	3.75	8.62	11.85	6.19	37.85	53.48	41.47
HD-2329	4.75	8.97	12.63	6.52	42.45	58.01	42.24
WH-542	4.77	9.10	12.74	6.52	42.65	58.42	42.22
RSP-303	4.65	8.77	12.05	6.48	38.91	57.02	40.57
SE (\pm)	0.15	0.16	0.07	0.16	0.85	0.59	0.61
CD ($P = 0.05$)	0.44	0.46	0.21	NS	2.51	1.76	NS

spectively. Differences and similarities in dry matter accumulation and its partitioning in plant parts by different cultivars at different periods might be due to variation in plant genetic characters responsible for variation in growth in different plant parts of the cultivars at different periods. More dry matter accumulation in leaves than stem at 30 days might be due to rapid emergence of new leaves as compared to increase in plant height.

Crop Growth Rate (CGR)

Crop growth rate is an important index which determines at what rate the crop is growing. The crop growth rate observations recorded at 30–60, 60–90, 90–120 and 120–150 days stages revealed that crop growth rate increased up to 90–120 days stage and declined there both under tillage systems and cultivar treatments (Fig. 1 and 2).

Table 2 indicates that tillage systems did not significantly influence the crop growth rate at any of the observation stages, though zero tillage system recorded a slightly higher crop growth rate at all the observational periods. These results are in conformity with Moore et al. (9) who also reported a non-significant but higher CGR in zero tillage as compared to reduced tillage and conventional tillage. However, significant effect of cultivars on crop growth rate was observed at different crop growth stages except at

120–150 days stage. The wheat cultivar PBW-343 recorded a higher CGR of 6.34, 9.34, 15.02 and 6.59 g/m² per day at 30–60, 60–90, 90–120 and 120–150 days stages, respectively, whereas Raj-3077 recorded the lowest CGR with values corresponding to 3.75, 8.62, 11.85 and 6.19 g/m² per day at respective crop growth stages. The differences in CGR of the cultivars at different periods during crop growth might be due to variation in dry matter accumulation at different by the different cultivars for their inherent varietal characters.

Grain and Straw Yield

The effects of dry matter accumulation on growth and development of crop recorded in grain yield (42.44 q/ha) and straw yield (59.10 q/ha) (Table 2) were little higher under zero tillage as compared to grain yield (40.96 q/ha) and straw yield (58.29 q/ha) under conventional tillage. The present findings corroborate the reports of Yadav et al. (10). Higher dry matter accumulation in PBW-343, WH-542, HD-2329 leads to higher grain and straw yield. Table 2 also revealed that neither tillage systems nor the cultivars had any significant effect on harvest index.

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