and Causton[6] contend that it provides a more biologically meaningful fit than a polynomial equation when fitted to data collected over several days.

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COMPARATIVE STUDY ON THE PHOTOSYNTHESIS AND PRODUCTIVITY OF TRITICALE, RYE AND WHEAT

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TRITICALE is established as a cereal crop in many countries. It appears to combine some of the yield and grain characteristics of its wheat parentage, with some of the hardiness of its rye parentage[1]. The potential productivity of the new cereal 'Triticale' is difficult to assess as it depends on the meiotic stability and seed fertility as well[2]. The comparison between the photosynthesis of leaves of triticales and that of cultivated *Triticum* and rye can provide information on the productive capacity of this new cereal. The experiment reported here was undertaken to compare the octoploid *Triticale* with *Aestivum* wheat and rye for their photosynthetic efficiency, leaf area development, stomatal resistance, chlorophyll content and biomass production.

Triticale PMT-5 (8x), Sonalika (*Triticum aestivum*) and Russian rye were raised in rectangular (30 × 20 cm) cement pots kept under natural conditions during the crop season 1984–85. Each pot with 6 plants were adequately fertilized for maintaining optimum growth. Sonalika and Russian rye were selected for comparison because they are being commonly used for Triticale breeding programme in India. Observations were taken at three stages *i.e.* preflowering, flowering and postflowering. Post-flowering observations were taken 15 days after flowering.

Photosynthesis in the flag leaf of mothershoot was measured by a portable infrared gas analyser (ADC) in the natural light conditions. Net photosynthesis was calculated from CO_2 exchange measurement made in the single leaf chamber[3]. LiCor Li 1600 diffusion promoter was used for measuring stomatal resistance in intact flag leaf in the forenoon under full sunlight. Chlorophyll was extracted by a nonmacerated method using dimethyl sulphoxide[4]. Chlorophyll A, chlorophyll B and total chlorophyll were determined on fresh weight basis. Leaf area development was studied using a leaf area meter (LiCor 3100). Growth data such as leaf number, dry weight of leaves, stem and ear were measured at all the three stages. The grain yield and harvest index were determined at harvest. All these data were taken on per plant basis. Data were analysed statistically following the method of analysis of variance.[5] The net photosynthesis in the flag leaf of triticale was significantly higher than that of wheat and rye at preflowering and flowering stages. At post-flowering stage, however, rye had more photosynthesis rate than the other two species. This was because rye maintained more or less similar photosynthesis rate at flowering and post-flowering stages. On the other hand photosynthesis rate was reduced at post-flowering in both triticale and wheat. The triticale and rye had significantly lower stomatal resistance than wheat in all the stages. Stomatal resistance of leaf was lowest at the flowering stage and highest at the post-flowering stage in all the species. The chlorophyll content (total) was higher in rye both at preflowering and flowering stages than wheat and triticale and it was due to higher chlorophyll A content. Though the total chlorophyll content in rye was not similarly high at post-flowering stage, chlorophyll A remained higher throughout the stages studied (table 1).

The number and the area of leaves per plant were higher in Russian rye at flowering and post flowering stages. The total photosynthetic surface including the leaf number was smaller in triticale as compared to wheat and rye. At the initial stage the dry weight of wheat leaves and stem was higher, however, at the post-flowering stage the dry matter production was significantly higher in triticale. In the case of rye the largest accumulation of dry matter was observed in stem and partitioning to ear was comparatively very poor *i.e.*,

Table 1. *Comparative study on the photosynthesis, growth and productivity of Triticale, rye and wheat*

Stages	Species	Net photo-synthesis μmol CO_2/ dm^2/hr	Stomatal resistance (S/cm^2)	Total chloro-phyll (mg/g fr. wt.)	Chloro-phyll 'A' (mg/g fr. wt.)	Chloro-phyll 'B' (mg/g fr. wt.)	Leaf area per plant (cm^2)	Leaf No. per plant	Leaf dry wt. per plant (g)	Shoot dry wt. per plant (g)	Ear dry weight per plant
Preflowering	Triticale (PMT-5)	328.20	2.09	1.650	1.131	0.519	328.38	26.0	2.325	1.840	—
	Russian rye	280.48	1.77	2.520	1.751	0.769	498.41	58.0	2.448	3.361	—
	Wheat (Sonalika)	287.81	3.27	2.079	1.429	0.650	728.32	54.6	4.189	5.413	—
Flowering	Triticale	276.72	1.11	3.663	2.100	1.563	619.50	39.6	5.247	23.306	7.515
	Russian rye	256.80	1.26	4.596	2.746	1.850	870.27	57.3	4.036	12.21	1.801
	Wheat	259.91	3.25	3.593	2.128	1.465	768.44	47.3	4.659	12.26	3.724
Post-flowering	Triticale	218.34	2.60	2.525	1.737	0.777	556.38	22.6	4.172	18.79	11.45
	Russian rye	252.89	1.95	3.409	2.296	1.104	706.44	40.3	3.942	26.38	5.72
	Wheat	193.01	4.09	2.393	1.620	0.773	476.82	38.3	3.506	16.79	6.37
CD at 5% P	Variety	14.60	0.408	—	—	—	47.23	5.117	0.529	1.505	0.816
	Stage	14.60	0.408	—	—	—	47.23	5.117	0.529	1.505	0.816
	Inter-action	25.27	N.S.	—	—	—	81.81	8.864	0.917	2.607	N.S.

Table 2 *Comparative study on the dry matter distribution, grain yield and harvest index of Triticale, rye and wheat*

Species	Stages	Dry matter distribution (%) Leaf	Stem	Ear	Grain yield (g/plant)	Harvest index (%)
Triticale	Preflowering	55.83	44.17	—	5.26	42.07
	Flowering	14.57	64.60	20.83		
	Postflowering	12.13	54.60	33.27		
Rye	Preflowering	42.15	57.85	—	3.12	27.52
	Flowering	22.18	67.85	9.97		
	Postflowering	10.94	73.19	15.87		
Wheat	Preflowering	43.63	56.37	—	4.36	35.47
	Flowering	22.57	59.39	18.04		
	Postflowering	13.16	62.96	23.88		
					CD at 5%P 0.731	CD at 5%P 6.05

10% and 15% at flowering and post-flowering stages respectively. It was observed that in the case of triticale, the partitioning of dry matter was maximum towards reproductive part; for instance, partitioning of dry matter to ear was 21% and 33% at flowering and post-flowering stages respectively. The grain yield and harvest index was maximum in triticale followed by wheat and minimum in rye (table 2).

In the present study in triticale var PMT-5 initial high photosynthesis as also observed by Krasichova *et al*[6] associated with its low stomatal resistance built initial store of photosynthates which on suitable partitioning towards ear development (33%) helped this species to produce more grain yield. Although the rate of photosynthesis was high in rye after flowering along with more photosynthetic surface (leaf number and leaf area) but had poor partitioning to sink (15%) and poor sink development caused low yield in this species. The cultivated *Triticum aestivum* var 'Sonalika' also had low partitioning to ear development (24%), high stomatal resistance and low photosynthesis compared to triticale. Therefore, this variety of wheat was not upto the level of triticale for productivity. In our study, no association of chlorophyll content with rate

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