PHOTOSYNTHETIC CARBOXYLASES IN WILD AND CULTIVATED WHEATS

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IN recent years physiological aspects such as photosynthesis rates, nitrate reductase activity, chlorophyll and nitrogen content have been examined in primitive and cultivated wheats (Evans and Dunstone, 1970 ; Khan and Tsunoda, 1970, Sinha and Khanna, 1972. Sinha *et al.*, 1974). These studies reveal that the primitive wheats are characterized by higher photosynthesis rates (Evans and Dunstone, 1970, Khan and Tsunoda, 1970). We report the variation in the activities of RuDP carboxylase (Ribulose 1–5 diphosphate carboxylase) and PEP carboxylase (phosphoenol pyruvate carboxylase) in diploid, tetraploid and hexaploid wheats during growth and development in flag leaf and ear parts. These were the same genotypes which we examined for variation in photophosphorylation (Sinha asd Khanna, 1972).

Seeds of a diploid *Triticum monococcum* L., a tetraploid *T. durum* Desf. and a hexaploid *T. aestivum* Villcv. Kalyansona were sown in pots and plants were raised as described earlier (Sinha and Khanna, 1972). The activities of RuDP carboxylase and PEP carboxylase were determined after the emergence of flag leaf. These enzymes were assayed according to the methods described by Bjorkman and Gauhl (1969) and Khanna and Sinha (1972). Photosynthetic carboxylase activity has been shown to be positively correlated with photosynthesis rate by Neals, Treharne and Wareing (1971) and Nagy *et al.* (1972). Results are expressed on fresh weight of leaves, awns, and glumes.

RuDP carboxylase activity in the flag leaf of diploid and tetraploid wheat was more than that in hexaploid before anthesis occurred (Table I). At anthesis, the activity of this enzyme was enhanced by 50% in tetraploid and about three times in hexaploid wheat. Earlier results had shown enhanced CO_2 fixation and O_2 evolution at anthesis in Kalyansona, a hexaploid type (Sinha unpublished). When the grain development started the diploid still maintained the same enzyme activity but it declined in the other two genotypes as compared to the anthesis stage.

The activity of PEP carboxylase was very low as compared to RuDP carboxylase. There was decline in the activity of this enzyme following anthesis in tetraploid and hexaploid but was less affected in diploid.

TABLE I

RuDP carboxylase and PEP carboxylase activities in the flag leaves of diploid, tetraploid and hexaploid wheats following ear emergence

Genotype	μ moles CO_2 fixed g^{-1} f.w. min^{-1}					
	Preanthesis		Anthesis		Post anthesis	
	RuDP	PEP	RuDP	PEP	RuDP	PEP
Diploid	5·0	0·70	4·7	0·43	5·8	0·62
Tetraploid	5·0	0·97	7·5	0·85	6·8	0·64
Hexaploid Cv. Kalyansona	3·1	0·87	9·5	0·33	5·5	0·54

TABLE II

RuDP carboxylase activity in the awns and glumes of diploid, tetraploid and hexaploid wheats

Genotype	μ moles CO_2 fixed g^{-1} f.w. min^{-1}					
	Preanthesis		Anthesis		Post anthesis	
	Awns	Glumes	Awns	Glumes	Awns	Glumes
Diploid	3·7	1·1	3·6	1·4	4·6	1·7
Tetraploid	3·9	1·1	6·7	3·8	6·5	8·0
Hexaploid Cv. Kalyansona	2·7	1·4	4·5	2·2	3·4	2·4

Awns of wheat and barley are known to contribule photosynthetically towards grain yield (Yoshida, 1972) RuDP carboxylase activity of awns was higher in diploid and tetraploid at preanthesis (Table II). At anthesis the enzyme activity in awns increased in tetraploid and hexaploid but was unaffected in diploid. In glumes which are even more closer to grains the activity of RuDP carboxylase was almost the same in all the types before anthesis (Table II). At anthesis maximum stimulation in the activity of this enzyme occurred in the tetraploid, although slight increase was observed in diploid and hexaploid types. Very low PEP (0·09–0·64 μ moles CO_2 fixed g^{-1} fw $min.^{-1}$) carboxylase activity was observed in the awns and glumes at all the three stages.

It is known that the ear size, grain number and grain weight increases from diploid to hexaploid leading to greater 'sink' capacity (Evans and Dunstone, 1970). Earlier studies were confined to seedlings wherein higher photosynthesis rates were obtained in primitive types (Evans and Dunstone, 1970; Khan and Tsunoda, 1970). The creation of 'sink' seems to have a profound effect on the photosynthetic potential of wheat leaves and other photosynthetically active parts. It would be seen from Table I that the flag leaf of hexaploid had poor rates before anthesis but reached maximum at anthesis. A similar observation was made in respect of photophosphorylation (Sinha and Khanna, 1972). However, the glumes and awns of tetraploid type had higher amount of RuDP carboxylase. Our recent studies indicate a large amount of photosynthate contribution by awns and glumes to the developing grains of wheat (Khanna and Sinha, 1973).

The present study indicates that the primitive wheats do not have higher photosynthesis rates at all stages of development as compared to the advanced types. The photosynthetic potential changes with the stage of development and the availability of 'sink'. Thus comparisons of physiological traits may have only a limited significance in determining evolutionary relationships.

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