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CARBON DIOXIDE COMPENSATION VALUES IN SOME MEMBERS OF THE GENUS *ORYZA*[1]

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Abstract

None of the 24 strains belonging to 14 species of *Oryza* had low CO_2 compensation values. The compensation values ranged from 30 to 70 mg/l. Accordingly it is assumed that the genus *Oryza* is of temperate origin.

Introduction

Some plants can lower the CO_2 concentration in a closed system to a low of about 5 mg/l (low compensation plants), whereas others can lower it to about 50 mg/l (high compensation plants). The low compensation plants have a different CO_2 fixation cycle and in such plants a CO_2 producing process in light (photorespiration) does not occur (Kortschak *et al.* 1967, Downton and Tregunna 1968, Downes and Hesketh 1968). On the basis of studies conducted on a number of species Downton and Tregunna (1968) suggested the use of CO_2 compensation values as an additional criterion in the systematics of the Gramineae, concluding that low compensation values are associated with tropical origin, though it must be made clear that not all tropical plants have low compensation values.

The origin of the genus *Oryza* has been disputed. Roschevicz (1931) believed the centre of origin to be southeast Asia, particularly India and Indo-china. Chatterjee (1951) considered the centre of origin to be Africa. Katayama (1964) agreed with the classification of Roschevicz (1931) but was doubtful about the immediate ancestor and the place of origin.

If a low compensation value is a characteristic of the tropical grasses and if the origin of the genus *Oryza* was somewhere in the tropics, then one would expect in the genus *Oryza* some wild or cultivated species with low compensation values.

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According to Downton *et al.* (1969) the low compensation plants can fix CO_2 at a rate almost twice that of temperate species. Black and Schoolar (1970) recently emphasised the extreme efficiency of such plants in CO_2 fiaxtion. A successful search in isolating low compensation species within the genus *Oryza* would not only throw light on the origin of the genus but also it could be of some economic importance in breeding high yielding rice varieties.

Materials and Methods

Twenty-one strains belonging to 13 species were obtained from International Rice Research Institute (IRRI), Manila. Two *indica* and a *japonica* strain of *Oryza sativa* were also included in the present study. The distribution and source of the 13 species was supplied by IRRI ; additional information was taken from Katayama (1964).

The plants were grown in 1 litre pots containing 1.2 kg of steam-treated garden soil in growth cabinets maintained at 35/26 C day/night and 12-hr photoperiod. The light intensity was 16.0 Klux, and temperature was kept at 35 C. Compensation values were determined on third leaf of 5-week old plants using the method of Downton and Tregunna (1968). The measurements were taken in duplicate on two plants.

Results and Discussion

The lowest compensation value (30 mg/l CO_2) obtained in the present study was in *Oryza glaberrima* and *O. perrieri* (Table 1), and is much higher than values obtained for low compensation plants. Mostly the values were around 50 mg/l which is characteristic of high compensation plants. None of the species surveyed showed a low compensation value.

Downton and Tregunna (1968) reported *O. sativa* to be a high compensation plant and Downes and Hesketh (1968) reported oxygen effect on *O. rufipogon* and *O. sativa* which means that these are also high compensation plants. The finding is confirmed in the present study. *O. breviligulata*, *O. eichingri*, *O. glaberrima* and *O. punctata* all occur within the tropical rigion (15 S-15 N) but have a high compensation value, indicating that they are more akin to temperate grasses than to tropical grasses. This criterion is one more point in favour of Roschevicz's assertion that the genus *Oryza* is not of tropical origin.

Table 1

Distribution source and CO_2 compensation values for some species in the genus Oryza

Oryza species	Distribution	Source	Compensation values mg/l CO_2
brachyantha	Central and West Africa	Sierra Leone	45
breviligulata	West Africa to Sudan	Chad	37
breviligulata	-do-	Guinea	53
eichingeri	East Africa	Uganda	37
eichingeri	-do-	Uganda	60
glaberrima	West Africa (cultivated)	Gambia	40
glaberrima	-do-	Guinea	30
perennis	Tropical countries, world wide	Burma	65
perennis	-do-	Jeypore	70
punctata	North East Tropical Africa	Ghana	46
punctata	-do-	Ghana	45
stapfif	Africa	French Guinea	35
latifolia	Central and South America	U.S.D.A.	45
latifolia	-do-	C.R.R.I.	45
minuta	Malaya, Java, Philippines	C.R.R.I.	45
minuta	-do-	Philippines	45
officinalis	Tropical Asia	Philippines	54
officinalis	-do	Assam, India	54
perrieri	Madagascar	Madagascar	30
rufipogon	Assam	Assam, India	45
sativa (*indica*)	World wide (cultivated)	Pakistan	45
sativa (*indica*)	-do-	Pakistan	50
sativa (*japonica*)	-do-	California	45
tisseranti	Guinea	Guinea	39

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