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Variation in physiological parameters of some ber (*Ziziphus maurtiana* var. *rotundifolia*) cultivars

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Abstract

The gene pool of the ber (*Ziziphus maurtiana*) cultivars available in the National repository at Central Institute for Arid Horticulture, Bikaner was evaluated for the variation in the photosynthetic rate and associated parameters. It was observed that the ber cultivars showed a marked variation on the basis of photosynthetic rate and can be grouped into two groups viz. i) showing mid day depression and ii) those which do not show mid day depression. The results on relative water content of leaves demonstrated that leaves of group (i) maintains high RWC as compared to that in group (ii).

Key words : *Ber (Ziziphus maurtiana), photosynthetic rate, mid day depression*

Introduction

Ziziphus mauritiana (Indian jujube) is an important fruit crop of arid region. It is drought hardy and bears nutritious fruits, which provide nutritional and income security to the inhabitants of this region. The species exhibit a rich variability in bio diversity (Vashishtha, 2001; Pareek, 2001), possess varying fruit maturity time which make the availability of fruit for a longer period of time. As a result of extensive survey and collection programme taken up at CIAH, a rich gene pool of ber cultivars is being maintained in the National repository at this Institute. Evaluation of these cultivars revealed that cultivars demonstrated a wide spectrum of phenotypic variability as well as in yield. Despite the existence of rich variability in this species, no physiological analysis has been taken up to evaluate the cultivars on the basis of physiological parameters. Accordingly, the present study was designed to assess the germplasm lines, available in National repository on the basis of photosynthetic efficiency and diurnal variation in photosynthetic rate using four cultivars of ber. The results thus obtained constitute the text of the present communication.

Material and Methods

Four cultivars of ber viz., Kali, ZG3, Jogia and Tikadi constituted the material for present study. These cultivars were selected because the leaves of Jogia and Tikadi are light green in colour whereas Kali and ZG3 have dark green colour leaves. Observation on photosynthetic rate, transpiration, RWC were measured from well developed plants maintained at National Repository of ber at CIAH, Bikaner during fruiting stage. The photosynthetic rate was estimated using Infra Red Gas Analyzer (LICOR-6200).

Relative water content in leaves was estimated using the method of Barrs and Weatherley (1962). The chlorophyll was extracted after the method of Hiscox and Israelstam (1979) and chl. a, chl. b and total chlorophyll were calculated using the Arnons formula (Arnon, 1949). The yield and pruned wood weight was recorded from the well-grown trees of respective varieties.

Results and Discussion

Changes in Relative water content in leaves

The changes in relative water content in leaves at 1100, 1300 and 1500 hrs are presented in Table 1. Perusal of table reveals that RWC in leaves varied from 68.16 to 90.90%. The diurnal variation in RWC of leaves of ber cultivars under study demonstrated that in cultivars such as ZG3 and Jogia the variation is very less. This is illustrated by the fact that in cv. ZG3 the RWC of leaves was 78.16, 75.88 and 75.58 at 1100, 1300 and 1500 hrs, respectively. However, the other two cultivars (Kali and Tikadi) under study showed a marked variation in the RWC. For instance in cv. Kali the RWC was 74.86, 68.69 and 70.57 at 1100, 1300 and 1500 hrs, respectively. Similar trend was also observed in cv Tikadi. The results thus obtained suggest that marked variation exist with respect to the diurnal variation in RWC of leaves in ber cultivars. This may be on account of the

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Table 1. Relative water content (%) in leaves of ber cultivars

Cultivars	Time		
	1100 hrs	1300 hrs	1500 hrs
Kali	74.86±9.99	68.69 ±10.38	70.57 ± 4.97
Tikadi	90.90±6.82	68.16 ± 6.70	78.76 ± 1.009
ZG3	78.16±8.78	75.88 ± 7.49	75.58 ± 9.87
Jogia	84.62±4.04	82.16 ± 7.31	75.10 ±13.80

fact that some cultivars have inherent mechanism to control water loss and maintain turgour even in the mid day whereas others lack such mechanisms.

Chlorophyll content

The chlorophyll content in the leaves was estimated using dimethyl sulphoxide (DMSO) and the data is presented in Fig. 1. Perusal of data reveals that total

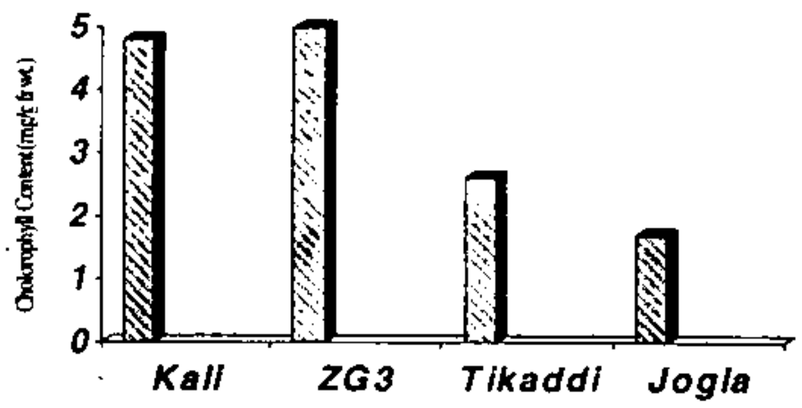

Fig. 1 Cholorophyll content in diffrent ber Cultivars

chlorophyll content in Kali and ZG3 was maximum 4.80 and 4.99 mg/g fresh weight of leaves, respectively. Whereas Tikadi ranked next with 2.60 mg/g fresh weight of leaves followed by Jogia 1.69 mg/g fresh weight of leaves.

Table 2. Photosynthetic rate (mg CO_2 $m^{-2}s^{-1}$) in selected ber cultivars

Cultivars	Time		
	1100 hrs	1300 hrs	1500 hrs
Kali	1.609	0.957	0.930
Tikadi	0.898	0.638	0.622
ZG3	1.144	1.166	1.129
Jogia	0.498	0.436	0.588

Photosynthetic rate

The diurnal pattern in photosynthetic rate recorded in four cultivars under investigation is presented in Table 2. Perusal of data reveals that at 1100 hrs Jogia is having a very low photosynthetic rate (0.498 mg CO_2 $m^{-2}s^{-1}$) whereas, Kali had the highest rate of photosynthesis (1.609 mg CO_2 $m^{-2}s^{-1}$). The other two cultivars lies in between with Tikadi displaying 0.898 mg CO_2 $m^{-2}s^{-1}$ and ZG3 1.144 mg CO_2 $m^{-2}s^{-1}$.

The data at 1300 hrs in cultivar Kali and Tikadi showed a marked reduction in rate of photosynthesis. This is illustrated by the fact that photosynthesis rate dropped from 1.609 at 1100 hrs to 0.957 mg CO_2 $m^{-2}s^{-1}$ at 1300 hrs. Similarly, in Tikadi the photosynthetic rate dropped from 0.898 mg CO_2 $m^{-2}s^{-1}$ at 1100 hrs to 0.638 mg CO_2 $m^{-2}s^{-1}$ at 1300 hrs. On the contrary, the photosynthetic rate remained fairly constant in other two cultivars. This is illustrated by the fact that in ZG3 the rate was 1.144 mg CO_2 $m^{-2}s^{-1}$ and 1.166 mg CO_2 $m^{-2}s^{-1}$ at 1000 hrs and 1300 hrs, respectively.

Perusal of photosynthesis rate at 1500 hrs reveals that the magnitude remained nearly same as that at 1300 hrs (Table 2). This is illustrated by the fact that values were 0.930 mg CO_2 $m^{-2}s^{-1}$ in Kali, 0.622 mg CO_2 $m^{-2}s^{-1}$ in Tikadi, 1.129 mg CO_2 $m^{-2}s^{-1}$ in ZG3 and 0.588 mg CO_2 $m^{-2}s^{-1}$ in Jogia.

Critical analysis of the spectrum further reveals that the ber cultivars demonstrates two typical patterns with respect to photosynthetic rates i) there is reduction in rate of photosynthesis during mid day (showing mid day depression) and ii) there is no reduction in rate of photosynthesis during mid day (do not show mid day depression). The former is typical for cultivars Kali and Tikadi. For instance in Kali the rate of photosynthesis at 1100 hrs, 1300 hrs and 1500 hrs are 1.609, 0.957 and 0.930 mg CO_2 $m^{-2}s^{-1}$, respectively. Identical pattern was also observed in cv. Tikadi showing thereby that the photosynthetic rate declined during midday.

In contrast to this cvs. ZG3 and Jogia demonstrate no reduction in photosynthetic rate during midday. This is illustrated by the fact that rate of photosynthesis was 1.144, 1.166 and 1.129 mg CO_2 $m^{-2}s^{-1}$ at 1100 hrs, 1300 hrs and 1500 hrs, respectively in ZG3. Although, cv. Jogia had very low rate of photosynthesis but is maintained throughout the day.

Table 3. Fruit yield and pruned wood weight of ber cultivars

Cultivars	Pruned wood weight (g/ tree)	Fruit Yield (kg/ tree)
Kali	15.0	17.0
Tikadi	09.0	08.0
ZG3	18.0	20.0
Jogia	17.0	16.0

Fruit yield and Pruned wood weight

The yield of four cultivars were recorded for two years and the mean data is presented in Table 3. Perusal of table reveals that fruit yield was recorded maximum in ZG3 (20.0 kg/ tree) followed by Kali (17.0 kg/ tree) and Jogia (16.0 kg/

tree). The minimum fruit yield was recorded in germplasm line Tikadi (08.0 Kg/ tree).

Data on pruned wood weight of 4 cultivars under study is presented in Table 3. Perusal of table reveals that maximum pruned wood weight was recorded in ZG3 (18.0 kg/ tree) followed by Jogia (17.0 kg/ tree) and Kali (15.0 kg/ tree). Tikadi recorded lowest pruned wood weight (9.0 kg/ tree).

In the earlier studies on photosynthesis in ber it was pointed out that the assimilation was highest early in the morning, which gradually declined throughout the remainder of the day (Clifford et al., 1997). In our study too, some cultivars demonstrated the trend as depicted by Clifford et al. (1997) but in addition to this, some cultivars showed relatively constant photosynthetic rate through out the day.

The data on yield of cultivars under investigation also reveals that the cultivars which do not show mid day depression are more productive as compared to those which shows mid day depression. This is illustrated by the fact that the yield of ZG3 is higher than that reported for Kali and Tikadi. Similar results were also observed with respect to pruned wood weight. Perusal of data in Table 3 illustrates that pruned wood weight of Kali and Tikadi was much less than those of ZG3 and Jogia. This is illustrated by the fact that the pruned wood weight of ZG3 and Jogia are 18.0 and 17.0 kg per tress whereas that recorded in Kali and Tikadi were 15.0 and 9.0 kg per tress respectively. In addition to above, it was further recorded that cultivars which do not show mid day depression are also able to maintain the turgour of the leaves. Perusal of data in Table 1 reveals that in ZG 3 the RWC of leaves were 78.16, 75.88 and 75.58 at 1100, 1300 and 1500 hrs. However, in Kali the RWC of leaves was 74.86, 68.69 and 70.57 at 1100, 1300 and 1500 hrs, respectively. Thus the maintenance of photosynthetic rate through out the day in cultivars which do not show mid day depression may be on account of fact that these cultivars are able to maintain leaf water potential to a magnitude which allows the photosynthetic activity to continue through out the day.

From the foregoing account it is apparent that apart from phenotypic variability, the ber cultivars also reveals the physiological variability in terms of photosynthetic rate and associated parameters. The ber cultivars can be grouped into two groups viz., those i) showing mid day depression and ii) those which do not show mid day depression. The cultivars which do not show mid day depression also maintains the high relative water content. However, it remains to be identified how the plants of group (ii) maintains fairly constant relative water content.

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