

Short communication

## Evaluation of mango genotypes for morpho-physiological attributes under hot-arid zone of Rajasthan

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### Abstract

Ten mango cultivars namely 'Amrapali', 'Kesar', 'Rajapuri', 'Langra', 'Alphonso', 'Dashehari', 'Chausa', 'CISH-M-1', 'DC-1' and 'Mallika' were evaluated during 2008–'09 and 2009–'10 for morphological and physiological parameters at Bikaner, Rajasthan. 'Kesar' had least field mortality (9.0%) and better growth performance, followed by 'Amrapali'. Under the adverse environmental conditions of the site, 'Langra' and 'Dashehari' had the two highest specific leaf areas (SLA), while 'Kesar' registered the maximum chlorophyll content (*a*, *b*, and total), highest net photosynthesis ( $P_n$ ; 5.38  $\mu\text{mole m}^{-2} \text{s}^{-1}$ ), and transpiration rate (*E*; 2.27  $\text{mmole m}^{-2}$ ). Overall, 'Kesar', 'Amrapali', and 'Rajapuri' were better performing genotypes under the hot arid environment in the initial year of establishment.

**Keywords:** Chlorophyll, Leaf area, Photosynthetic rate, Specific Leaf Area.

Mango (*Mangifera indica* L.), essentially a tropical fruit generally does well within temperature ranging from 24 to 30°C but also can tolerate temperature as high as 48°C (Campbell et al., 1977), if irrigation is given. While mango has been grown in some of the semi-arid districts of Rajasthan (India), information on its growth and yield performance is lacking. Hence an attempt was made to assess the growth and development of this crop in extreme environment of arid region. In particular, aspects like leaf expansion, water relations and photosynthetic potential of the leaves under adverse climatic conditions were focussed.

The investigation was conducted at the Central Institute for Arid Horticulture, Bikaner during the year 2009 and 2010. The study area experiences high temperature during summer (45 to 50°C) and low freezing temperature in winter (–0.5 to –1.5°C), high wind velocity during summer (20–30  $\text{km h}^{-1}$ ), low precipitation (250 mm), and high potential evapotranspiration (1200 to 1700  $\text{mm year}^{-1}$ ). The soil is sandy loam, low in fertility and water

holding capacity with pH 8.4, organic carbon: 0.09%, available N: 110  $\text{kg ha}^{-1}$ , available P: 4  $\text{kg ha}^{-1}$  and available K: 224  $\text{kg ha}^{-1}$ . Two-year-old healthy uniform-sized plants of ten mango cultivars 'Amrapali', 'Mallika', 'Kesar', 'Rajapuri', 'Langra', 'Alphonso', 'Dashehari', 'Chausa', 'CISH-M-1' and 'DC (Dashehari clone)-51' were planted. Plant mortality and morphological (height, trunk girth) and physiological characters (net photosynthetic rate ( $P_n$ ), transpiration rate (*E*), were recorded at monthly intervals. Leaf samples were collected in the morning (7 am) and leaf area, specific leaf weight, and relative water content (RWC) were estimated using the methods described by Setak et al. (1971) and Weatherley (1970). Chlorophyll (Chl *a*, *b*, and total) contents of fully matured (3<sup>rd</sup> pair open) leaves from the shoot tip were analysed following the method of Barnase et al. (1992). Photosynthetically active radiation (PAR), net photosynthesis rate ( $P_n$ ), transpiration rate (*E*) were determined at bi-monthly intervals between 10 am to 2 pm during the experimental period on fully expanded leaves using a portable photosynthesis system (CI-340

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PS, CID, Inc., USA) with a 10 cm<sup>2</sup> window leaf chamber. Three randomly selected plants of each cultivar were selected for observations and analysis. The experiment was laid out in a completely randomized block design with three replicates and ANOVA was done using Indostat Software.

As can be seen from Table 1, considerable variability existed in the survival and growth of the cultivars. 'Kesar' showed least field mortality (9.0%) followed by 'Amrapali' (18.2%) and 'Langra' (27.2%), while most of the 'Chausa' (87.0%) and 'DC-51' (80.0%) plants did not survive well in the field. Maximum increase in plant height was observed for 'Kesar', followed by 'Amrapali' while, 'Chausa' showed the lowest height. 'Dashehari', 'DC-51', and 'CISH-M-1' had slow growth rates

(<20.0% increment in tree height). 'Kesar' also had maximum leaf area (93.13 cm<sup>2</sup>) followed by 'Mallika', and 'Amrapali' (Table 2). Studies on leaf water revealed that maximum leaf water was in 'Amrapali' (70.0%) followed by 'Langra' (65.08%) which shows that these cultivars are more suited to drought conditions. It is well known that ability to maintain high relative water content (RWC) in leaves is an adaptive trait under arid conditions (Irigoyen et al., 1992).

Highest net photosynthesis rate ( $P_n = 5.38 \mu \text{ mole m}^{-2} \text{ s}^{-1}$ ) was recorded in 'Amrapali' followed by 'Mallika' while lowest  $P_n$  was observed in 'DC-51'. Further, 'DC-51' and 'Dashehari' had lower transpiration rates ( $E$ ) (1.11 and 1.12 m mole m<sup>-2</sup>, respectively) while 'Amrapali' and 'Mallika' mango had the highest  $E$ .

Table 1. Survival and growth of three year old mango cultivars at Bikaner, India.

Cultivars	Field mortality (%)	Tree girth (cm)	Leaf area (cm <sup>2</sup> )	SLA (cm <sup>2</sup> g <sup>-1</sup> )	RWC (%)	LWC-FW (%)	LWC-DW (%)
'Amrapali'	18	2.55	67	65	70	43	75
'Kesar'	9	2.90	93	80	51	44	80
'Rajapuri'	55	1.55	61	83	65	58	140
'Langra'	27	2.60	60	92	65	54	116
'Alphonso'	40	1.40	50	60	57	50	100
'Dashehari'	50	1.66	38	92	61	53	113
'Chausa'	88	1.60	-	-	-	-	-
'DC-51'	80	1.13	54	74	37	40	66
'CISH-M-1'	60	1.50	-	-	-	-	-
'Mallika'	38	1.23	72	62	58	43	90
CD <sub>0.05</sub>	3.44	0.65	8.71	6.63	7.27	4.06	6.45

SLA= specific leaf area; RWC= leaf relative water content; LWC= Leaf water content; FW= fresh weight basis; DW= dry weight basis.

Table 2. Physiological parameters of three year old mango cultivars at Bikaner, India.

Cultivars <sup>#</sup>	$P_n$ ( $\mu \text{ mole m}^{-2} \text{ s}^{-1}$ )	$E$ (m mole m <sup>-2</sup> s <sup>-1</sup> )	Chl <i>a</i> (mg g <sup>-1</sup> )	Chl <i>b</i> (mg g <sup>-1</sup> )	Total Chl (mg g <sup>-1</sup> )
'Amrapali'	5.38	2.27	0.238	0.488	0.732
'Kesar'	1.44	1.48	0.277	0.670	0.953
'Rajapuri'	1.95	2.10	0.221	0.548	0.775
'Alphonso'	4.42	2.08	0.225	0.650	0.881
'Langra'	2.96	1.44	0.137	0.463	0.604
'Mallika'	4.35	2.11	0.199	0.321	0.523
'Dashehari'	3.28	1.22	0.189	0.472	0.666
'DC-51'	1.18	1.11	0.202	0.332	0.537
CD <sub>0.05</sub>	4.04	1.67	0.033	0.022	0.077

$P_n$  = Net photosynthesis rate;  $E$ =Transpiration rates

<sup>#</sup>cultivars showing better vegetative growth in the field were taken for observation on physiological parameters.

'Kesar', 'Dashehari', and 'DC-51', had lower  $P_n$  (owing to high flux of PAR) had low  $E$  (Table 2), implying that 'Kesar' is capable of photosynthesis under restricted loss of water.

Extreme temperature regimes prevailing in the arid zone significantly affected leaf chlorophyll content (Table 2) and 'Kesar' had highest Chl  $a$ ,  $b$ , and total contents due to reduced transpiration ( $E$ ), followed by 'Langra' and 'Rajapuri', while 'Mallika' and 'DC-51' had the lowest Chl<sub>b</sub> and total contents. Overall, mango cultivars 'Kesar', 'Amrapali' and 'Rajapuri' (having thicker leaves, high chlorophyll contents, and low  $E$ ) are better performing genotypes under the hot semi-arid environment of Bikaner during the initial year of establishment.

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