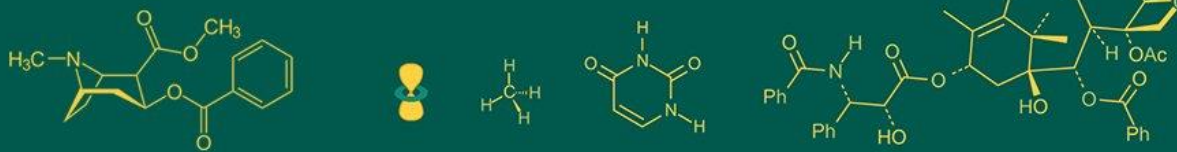


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Screening of frost tolerant cultivars of Ber under frost condition

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Abstract

This experiment entitled “Screening of Frost tolerant variety of ber under frost condition” was conducted during rabi season of 2021-22 at Asalpur Farm, S. K. N. College of Agriculture, Jobner. In this experiment 50 cultivars of ber were used for the identification of frost tolerant, medium tolerant and susceptible cultivars under semi-arid condition. Among the ber cultivars Sukhwani proved significantly superior over others frost tolerant cultivars i.e., Darkhi, Chomu local and Saphar Chandni and moderately tolerant (Tikadi) and susceptible cultivars of ber i.e., Hussain Reso, Chandni Supari, Saphar Chandni, Ponda, Jogia, Akhrota, Gola, Gulkhasi, Phalisa Alwari, Nilgiri, Thornless, Katha, Katha Bombay, Tabes Taso, Mehroon, Lakhani, Ilaichy, Noki, Morchia, Pathani, Najuk, Kheera, ZG-3, Kathaphal, Kismis, Chonchal, Tasinga, Kharkhi, Aliraj, Banarshipodi, Gulkhasi, Ashapuri-1, Sev, Sukhawani, Pusaprolific, Ashapuri-2, Pemadi, Supari, Chencho, Khirni, Kumari, Khatti, Rashmi, Tijara, Khattar, Heena, Banarshi Prolific in respect to leaf dried, fruit shranked, fruit drop percent proline content and cell membrane injury under frost stress.

Keywords: Ber, Frost, leaf dried, fruit shranked, fruit drop, proline, cell membrane injury

Introduction

Ber (*Ziziphus mauritiana* L.) is a spiny evergreen shrub or small tree that grows up to 15 metres tall, with stipular spines and many drooping branches. It is a member of the buckthorn family Rhamnaceae. The Ber (*Ziziphus mauritiana* L.) is a tropical fruit tree species that is a member of the Rhamnaceae family. It is also known as the desert apple, jujube, Chinese apple, Badari (Sanskrit), Kul or Boroi, Ber (Hindi), Dongs, Boroi, Bor, Beri, Indian plum and Permseret (Anguilla) [1]. The crop is a popular fruit crop for India's dry and semi-arid regions, taking up a huge area (22,000 ha) [2]. The crop is becoming more and more popular among growers since it produces well and survives in challenging climatic conditions. The fruits are quite nutritious, contains higher quantity of vitamin C, second only to Aonla and guava and much higher than citrus and apple [3].

Indian Jujube or Ber is a common fruit endogenous to India. Its fruits are palatable and delicious with high concentration of vitamin A, B and B complexes. Ber leaves contain 10-19% crude protein with about 40% digestibility. The leaves are commonly used as a fodder for animals [4], compared to other agricultural and horticultural crops, Indian Jujube is known to grow successfully under a low erratic rainfall. Temperature extremes and saline soils with low fertility [5].

One of the main factors restricting the global distribution of plants is low temperature. Plant growth and development are adversely affected by stress causes. Additionally, agricultural plantations are geographically constrained due to the cold, which also contributes to reduced output quantities and lower yield quality [6, 7, 8]. Many plant species that thrive in our climate have evolved to be tolerant of the sporadically low temperatures that occur [9]. Low temperature also slows down photosynthesis and interferes with cellular redox equilibrium, which can result in secondary oxidative stress and the generation of reactive oxygen species (ROS) [10] (Asada, 1999). [11] (Asada, 2006) ROS serve as signal molecules, but when they build up excessively in cells, they interfere with the transport of electrons in the mitochondria and chloroplasts. Key cellular components, including proteins, nucleic acids and lipids found in cellular membranes, may sustain significant damage as a result of this disruption [12].

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Materials and Methods

This experiment was carried out on 20 years old ber plants for "Identification of Low Temperature Stress Tolerant Ber (*Ziziphus mauritiana* L.) Cultivars Under Semi-arid Condition" was conducted at Asalpur Farm, S.K.N. College of Agriculture, Jobner. (Jaipur), Rajasthan during *rabi* season, 2021-22. In order to achieve the objectives of present investigation the experiment was planned and executed as described below.

Location of experimental site

The experiment was carried out at Asalpur Farm, S.K.N. College of Agriculture, Jobner. During *rabi* season, 2021-22. Geographically, Jobner is situated in Jaipur district of Rajasthan at 26° 05' North latitude, 75° 58' East longitude and an altitude of 427 meter above mean sea level. This region falls under agro-climatic zone-IIIA (Semi-arid Eastern plains).

Observations

The data will be recorded on the following physiological, biochemical and physical parameters.

Physical scoring of leaf burning (drying) injury (%)

After occurrence of low temperature stress on ber cultivars under field condition the leaf burning percentage were recorded at 5 and 10 days after low temperature occur.

Fruit dropping and shrinking (%)

Each tree of different selected cultivars was observed carefully and number of fruits shrunked and dropped were recorded at fruit maturity. These fruits were recorded by counting the number of normal and deformed fruits to get the incidence.

Membrane stability index (MSI): Leaves of were collected and thoroughly washed with distilled water. 200 mg of a leaf sample was placed in 25 ml of double distilled water at 40° C for 30 min and thereafter an electric conductivity (C1) was measured with conductivity meter.

Subsequently, the same samples were placed on boiling water bath (100°C) for 10 min and their electric conductivity was recorded (C2). MSI was calculated as $MSI = [1 - \{C1/C2\}] \times 100$.

Determination of proline

Leaves of plants were homogenized with 3% sulphosalicylic acid and the homogenate was centrifuged at 3,000 g for 20 min. The supernatant was treated with acetic acid and acid ninhydrin, boiled for 1 hr. and then absorbance at 520nm was determined. Contents of proline were expressed as µg/g fr. wt. of leaf (Bates, *et al.*, 1973) [13].

Statistical analysis

There were three replications for each treatment. Statistical analysis of data was processed using completely randomized block design [14] (Gomez and Gomez, 1984).

Results and Discussion

The data's of this table number 1 showing that Sukhwani, Darkhi, Chomu local and Saphar Chandini were found frost tolerant under frost condition (up to -2 °C) on the basis of leaf burning, fruit shrinking, fruit drop percent, proline and cell membrane injury in leaves under frost stress condition. The minimum leaf burning (1 percent), fruit shrunked (0 percent), fruit drop (0 percent), proline content (136 µg/g fr wt of leaf) and cell membrane injury (20.2 percent) were recorded in Sukhwani cultivar as compared to other tolerant cultivars i.e., Darkhi, Chomu local, Saphar chandni, The loss due to frost were found higher in Hussain Reso, Chandni Supari, Saphar Chandni, Ponda, Jogia, Akhrota, Gola, Gulkhasi, Phalisa Alwari, Nilgiri, Thornless, Katha, Katha Bombay, Tabes Taso, Mehroon, Lakhan, Ilaichy, Noki, Morchia, Pathani, Najuk, Kheera, ZG-3, Kathaphal, Kismis, Chonchal, Tasinga, Kharkhi, Aliraj, Banarshipodi, Gulkhasi, Ashapuri-1, Sev, Sukhawani, Pusaprolific, Ashapuri-2, Pemadi, Supari, Chencho, Khirni, Kumari, Khatti, Rashmi, Tijara, Khattar, Heena, Banarshi Prolific cultivars of ber as compared to tolerant cultivars of ber.

Table 1: Effects of frost stress on physio-biochemical traits of Ber (up to -2°C)

S. No	Name of genotypes	Scoring (0-10)		Percent (1-100)	Resistant/Tolerant/Moderately tolerant/Susceptible	Proline content (µg/g fr wt of leaf)	Cell Membrane Injury (%)
		Leaf dried	Fruit shrunked	Fruit drop %			
1	Hussain Reso	3	7	20	Susceptible	426	31.42
2	Chandni Supari	6	7	10	Susceptible	518	30.88
3	Saphar Chandni	2	2	4	Tolerant	260	22.14
4	Ponda	5	5	15	Susceptible	436	36.12
5	Jogia	7	7	3	Susceptible	466	32.32
6	Akhrota	10	9	5	Susceptible	412	33.14
7	Gola	7	6	10	Susceptible	483	26.55
8	Tikadi	3	2	6	M. Tolerant	360	27.17
9	Gulkhasi	4	4	5	Susceptible	516	30.21
10	Phalisa Alwari	8	7	7	Susceptible	528	33.35
11	Nilgiri	10	6	15	Susceptible	446	36.41
12	Thornless	4	4	7	Susceptible	513	27.61
13	Katha	4	4	10	Susceptible	503	29.32
14	Katha Bombay	3	4	20	Susceptible	546	25.21
15	Tabes Taso	4	5	5	Susceptible	410	21.33
16	Mehroon	4	3	15	Susceptible	520	33.52
17	Darkhi	1	0	2	Tolerant	215	22.14
18	Lakhan	4	4	5	Susceptible	521	32.18
19	Ilaichy	3	4	13	Susceptible	515	31.32
20	Noki	8	9	7	Susceptible	615	37.42

21	Morchia	7	7	10	Susceptible	565	31.52
22	Pathani	6	5	30	Susceptible	531	33.56
23	Chomu Local	2	2	3	Tolerant	343	25.24
24	Najuk	8	8	10	Susceptible	541	33.24
25	Kheera	8	8	20	Susceptible	538	35.44
26	ZG-3	5	5	10	Susceptible	527	32.35
27	Kathaphal	3	6	30	Susceptible	488	31.28
28	Kismis	GF	GF	GF	Susceptible	542	31.21
29	Chonchal	8	8	20	Susceptible	622	33.33
30	Tasinga	GF	GF	GF	Susceptible	585	30.72
31	Kharkhi	8	8	20	Susceptible	490	35.52
32	Aliraj	9	9	15	Susceptible	466	32.34
33	Banarshipodi	7	8	20	Susceptible	545	30.32
34	Gulkhasi	9	9	10	Susceptible	510	29.10
35	Ashapuri-1	GF	GF	GF	Susceptible	544	30.38
36	Sev	5	5	15	Susceptible	480	34.20
37	Sukhawani	1	0	0	Tolerant	136	20.28
38	Pusaprolific	8	9	10	Susceptible	545	33.26
39	Ashapuri-2	3	3	18	Susceptible	528	33.32
40	Pemadi	GF	GF	GF	Susceptible	645	34.18
41	Supari	5	3	15	Susceptible	420	31.41
42	Chencho	6	6	20	Susceptible	426	31.45
43	Khirmi	9	9	7	Susceptible	883	41.25
44	Kumari	8	8	10	Susceptible	846	33.21
45	Khatti	7	8	20	Susceptible	442	36.33
46	Rashmi	7	8	10	Susceptible	863	38.20
47	Tijara	4	4	8	Susceptible	466	35.45
48	Khattar	4	4	25	Susceptible	478	32.30
49	Heena	7	8	15	Susceptible	528	45.12
50	Banarshi Prolific	8	9	15	Susceptible	535	37.20
S.Em+	-	-	-	-	-	7.76	0.51
CD(P=0.05)	-	-	-	-	-	22.08	1.44

The Tikadi cultivar was found frost moderately tolerant on the basis of leaf burning(3 percent), fruit shrinking(2 percent), fruit dropping percent(6 percent), proline(360 ug/g fr wt of leaf) and cell membrane injury(27.17 percent) in leaves of these cultivars of ber as compared to susceptible cultivars of ber Hussain Reso, Chandni Supari, Saphar Chandni, Ponda, Jogia, Akhrota, Gola, Gulkhasi, Phalisa Alwari, Nilgiri, Thornless, Katha, Katha Bombay, Tabes Taso, Mehroon, Lakhan, Ilaichy, Noki, Morchia, Pathani, Najuk, Kheera, ZG-3, Kathaphal, Kismis, Chonchal, Tasinga, Kharkhi, Aliraj, Banarshipodi, Gulkhasi, Ashapuri-1, Sev, Sukhawani, Pusaprolific, Ashapuri-2, Pemadi, Supari, Chencho, Khirmi, Kumari, Khatti, Rashmi, Tijara, Khattar, Heena, Banarshi Prolific.

Conclusion

Based on the results presented in Table 1, it is evident that Sukhwani, Darkhi, Chomu local, and Saphar Chandini cultivars of ber demonstrate significant frost tolerance, exhibiting minimal leaf burning, fruit shrinking, fruit drop percentage, proline content, and cell membrane injury under frost stress conditions, with Sukhwani displaying the lowest values among the tolerant cultivars. Conversely, numerous cultivars including Hussain Reso, Chandni Supari, Saphar Chandni, and several others incurred substantial losses due to frost, highlighting their susceptibility. Tikadi cultivar falls in the moderate frost tolerance category, showing intermediate values compared to both tolerant and susceptible cultivars. These findings underscore the importance of selecting frost-tolerant cultivars for ber cultivation to mitigate frost-induced damage and ensure better yields.

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