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Screening of mango (*Mangifera indica*) genotypes for the incidence of lenticel browning—a new postharvest problem

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ABSTRACT

Several postharvest problems affect the sensory quality of mango (*Mangifera indica* L.) fruits which significantly deteriorates the market value of fruits. Among several such problems, lenticel browning (LB) has been reported recently, which affects face value of fruits. Hence, an attempt was made to screen 20 indigenous (Amrapali, Alphonso, Banglora, Bhaduran, Bombay Green, Dushehari , Gulabkhas Green, Langra, Mallika, Neelum, Pusa Arunima, Pusa Pitamber, Pusa Lalima, Pusa Pratibha, Pusa Shrestha, Rataul, Ratna, H-3-2, H-8-11, H-12-1) and 10 exotic (Edward, Eldon, Extrema, Sensation, Irwin, Iturba, Rosari, St. Alexendrina, Tommy Atkins and Zill) varieties/hybrids grown at IARI, New Delhi, to observe the severity of lenticel browning among various varieties/hybrids. Fruits were harvested at full maturity and stored at ambient conditions for 10 days. At the end of 10th day, healthy as well as brown lenticels were counted per square centimetre with the help of a magnifying lens. Our results revealed that among indigenous varieties, Langra had shown the maximum incidence of lenticels browning (100%), followed by Dushehari (52.8%), and among exotic varieties, Sensation had shown the highest (35.9%) incidence of lenticel browning followed by Eldon (28.3%). Interestingly, some hybrids developed by IARI, New Delhi such as H-3-2 (4.3%), H-8-11 (4.5%) Pusa Pratibha (4.8%), Pusa Lalima (5.2%), Pusa Arunima (5.7%), Pusa Shrestha (6.1%) and varieties such as Bhaduran (5.1%) and Alphonso (5.3%) were found to be less prone to LB as they exhibited < 10% incidence of LB. This study revealed that few varieties like Langra and Dushehari were highly susceptible and few hybrids were highly resistant to LB, thus have good scope in International export market.

Key words: Cultivar, Export quality, Lenticels browning, Mango, Postharvest, Screening

Several efforts were made to reduce factors which affect the fruit quality including appearance and ultimately the export of mango (*Mangifera indica* L.) fruits. Among the several such factors which affect cosmetic quality and appearance of mango fruits, lenticels browning (LB) is recently reported factor (Rymbai *et al.* 2012). It is one of the main reasons of quality loss in mango cultivars grown in India and abroad. Lenticels browning (LB) not only decreases the shelf-life of the mango fruits but also affects the appearance which has become a point of hindrance in trade and export of mango from several countries (Rymbai *et al.* 2012). Lenticels are macroscopic openings present on the surface of mango fruits. Lenticels act as a necessary evil as they are required for several physiological functions like respiration, transpiration etc in the plant; whereas their discoloration/browning leads to the loss in external appearance of fruit declining fruit quality, and act as a challenge to postharvest management of mango (Rymbai *et al.* 2012). Previous studies indicate that several factors including varietal susceptibility favours the development of lenticels browning (Cronje 2009). Hence, there is need of creation of database with respect to susceptibility/resistance to malady of lenticel browning among genotypes.

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MATERIALS AND METHODS

These studies were conducted in the Division of Food Science and Postharvest Technology, ICAR-Indian Agricultural Research Institute, New Delhi India in the year 2014-15. To screen out the available mango germplasm for the incidence of lenticel browning, 20 indigenous such as Amrapali (Dushehari × Neelum), Alphonso, Banglora, Bhaduran, Bombay Green, Dushehari, Gulabkhas Green, Langra, Mallika (Neelum × Dushehari), Neelum, Pusa Arunima (Amrapali × Sensation), Pusa Pitamber (Amrapali × Lal Sundari), Pusa Lalima (Dushehari ×Sensation), Pusa Pratibha (Amrapali × Sensation), Pusa Shrestha (Amrapali × Sensation), Rataul, Ratna (Neelum × Alphonso), H-3-2(Amrapali × Sensation), H-8-11(Amrapali × Lal Sundri), H-12-1(Amrapali × Sensation) and 10 exotic varieties such as Edward, Eldon, Extrema, Sensation, Irwin, Iturba, Rosari, St. Alexendrina, Tommy Atkins and Zill were harvested at appropriate maturity (specific gravity > 1) from the orchard of the Division of Fruits and Horticultural Technology, ICAR-Indian Agricultural Research Institute, New Delhi.

Desaping of the harvested fruits was done in the field to nullify the effect of fruit sap. Then fruits were precooled in water and stored under ambient storage conditions (35 ± 4º C and 65 ± 5% RH) for normal ripening. During storage observations on total lenticels, and the incidence of lenticel browning were recorded.

Counting of lenticels was done visually with the use of magnifying lens. Lenticel numbers were counted per cm^2 area at the three portions, i.e. nearby proximal, middle and distal end of the fruit, so that the mean lenticel count can be recorded. Observations were recorded each day with respect to parameters like initiation of haloing, and browning to screen the varieties for the incidence of LB. Initiation of browning signifies the sensitivity of mango variety to lenticel browning. Observations were recorded at each day from the day of harvest till senescence and the earliest day of occurring the lenticel browning designated as 'initiation of haloing and browning' for that particular variety/hybrid.

LB was estimated by counting the number of lenticels browned on the fruit peel with respect to total lenticels present per cm^2 and represented as percentage (%). Lenticel browning was recorded each day of storage but lenticel browning being irreversible process, and hence data of last observation were presented to draw conclusion.

The extent, to which the browning of lenticels occurred on mango fruits, was calculated in randomly selected 10 lenticels per fruit, replicated thrice and the intensity of lenticel browning among the various varieties was compared. This degree of browning was estimated by categorizing the lenticel browning extent under scale of 1-4 as under.

Scale	% mean area browned surrounding the lenticel
1	Browning of 25% area surrounding lenticel
2	Browning of 25-50% area surrounding lenticel
3	Browning of 50-75% area surrounding lenticel
4	Browning of > 75% area surrounding lenticel

Based on the incidence of lenticel browning, mango varieties were classified into 6 different groups as under:

Incidence of LB (%)	Classification group
<10	Highly Resistant (HR)
11- 20	Resistant (R)
21-30	Moderately Resistant (MR)
31-40	Susceptible (S)
41-50	Moderately Susceptible (MS)
>50	Highly Susceptible (HS)

RESULTS AND DISCUSSION

Total lenticels count

A greater variability existed among different varieties of mango with respect to total lenticel count (Table 1). Among, indigenous varieties, highest number of lenticels were found in Pusa Pitamber (81/cm^2), followed by H-8-

Table 1 Genotypic variation for initiation, degree, and incidence of lenticel browning (LB) among different cultivars of mango

Variety	Total lenticels (cm^2)	Initiation of LB (day)	Degree of LB (1-4 scale)	LB incidence (%)*	Remarks
Indian varieties					
Amrapali	58	8th	1	6.9 (15.2)	HR
Alphonso	42	9th	1	5.3 (13.3)	HR
Banglora	61	4th	2	11.2 (19.6)	R
Bhaduran	38	9th	1	5.1 (13.1)	HR
Bombay Green	35	4th	4	41.9 (40.4)	MS
Dushehari	46	6th	4	52.8 (46.6)	HS
Gulabkhas Green	38	8th	1	13.7 (21.7)	R
Langra	61	3rd	4	100.0 (90.0)	HS
Mallika	35	3rd	3	32.9 (35.0)	S
Neelum	65	4th	2	18.2 (25.3)	R
Pusa Arunima (Amrapali × Sensation)	68	6th	2	5.7 (13.8)	HR
Pusa Pitamber (Amrapali × Lal Sundri)	81	8th	1	6.6 (14.9)	HR
Pusa Lalima (Dushehari × Alphonso)	71	10th	1	5.2 (13.2)	HR
Pusa Pratibha (Amrapali × Sensation)	52	10th	1	4.8 (12.7)	HR
Pusa Shrestha (Amrapali × Sensation)	62	10th	1	6.1 (14.3)	HR
Rataul	24	6th	3	14.8 (22.6)	R
Ratna	39	8th	1	8.6 (17.1)	HR
H-3-2 (Amrapali × Sensation)	45	10th	1	4.3 (12.0)	HR
H-8-11 (Amrapali × Lal Sundri)	76	10th	2	4.5 (12.3)	HR
H-12-1 (Amrapali × Sensation)	58	10th	1	6.2 (14.4)	HR
Exotic varieties					
Edward	36	8th	3	22.1 (28.1)	MR
Eldon	59	3rd	4	28.3 (32.2)	MR
Extrema	32	9th	3	19.9 (26.5)	R
Sensation	68	4th	4	35.9 (36.8)	S
Irwin	44	7th	2	16.8 (24.2)	R
Iturba	41	8th	2	15.7 (23.2)	R
Rosari	29	9th	2	15.2 (23.0)	R
St. Alexendrina	41	4th	4	36.6 (37.3)	MR
Tommy Atkins	28	6th	3	18.1 (25.2)	R
Zill	36	9th	3	18.6 (25.6)	R
CD (P=0.05)	12.2			3.6	

*Data in parentheses represent Arscin's transformations.

11 (76/cm^2) and Pusa Lalima (71/cm^2) and the lowest number of lenticels were recorded in Rataul (24/cm^2) followed by Mallika (35/cm^2), Gulabkhas Green (38/cm^2), Bhaduran (38/cm^2), and Ratna (39/cm^2) and Alphonso (42/cm^2) (Table 1). Among exotic varieties, Sensation (68/cm^2) had highest number of lenticels, followed by Eldon (59/cm^2) and the lowest by Tommy Atkins (28/cm^2), followed by Rosari (29/cm^2) (Table 1). The variability in the number of lenticels among different selected mango varieties may be attributed to genetic differences among them (Ersoy *et al*. 2008).

The initiation of haloing and browning in lenticels

The initiation of haloing and browning of lenticel in terms of day after harvesting in storage and has shown a large variation among various varieties and/or hybrids. The initiation of haloing and browning of lenticel marked to be important as the cultivars which have shown early haloing and browning, had also recorded higher incidence and degree of lenticel browning. For example, haloing and browning of lenticels started very early (3rd day of storage) in Langra and Mallika among indigenous group and Eldon among exotic group. Whereas, there was significant delay (9th or 10th day) in H-3-2, H-8-11, Pusa Lalima, Pusa Pratibha, Pusa Shrestha, Rosari, and Extrema (Table 1).

Incidence and extent of lenticel browning

Among indigenous varieties, Langra had shown the maximum LB (100%), followed by Dushehari (52.8%); whereas, among exotic varieties, Sensation (35.9%) has shown the highest incidence of lenticel browning. Interestingly, some hybrids developed by IARI, New Delhi such as H-3-2 (4.3%), H-8-11 (4.5%) Pusa Pratibha (4.8%), Pusa Lalima (5.2%), Pusa Arunima (5.7%), Pusa Shrestha (6.1%) , H-12-1 (6.2%) , Pusa Pitamber (6.6%) and some varieties like Bhaduran (5.1%) and Alphonso (5.3%) were found to be less prone to LB as they exhibited < 10% incidence of LB (Table 1). Such variability in browning incidence might be due variability in total phenolic content, PPO activity, rendered by genetic makeup of the individual variety. Rymbai *et al.* (2012) have reported that cultivars differ in their susceptibility to LB. In a study, Oosthuyse (1998) and Bezuidenhout *et al*. (2003) reported that Tommy Atkins and Keitt varieties of mango were more susceptible and Kent was least susceptible to LB in South Africa. Similarly, Calypso was reported to be susceptible t and Kensington Pride, and Honey Gold to be resistant to LB in Australia (Joyce *et al*. 2011).

Extent of browning was found to be very high (4) in the cultivars like Bombay Green, Dushehari, Langra, Mallika, Eldon, and Sensation, whereas, varieties like Amrapali, Alphonso, Bhaduran, H-3-2, H-8-11, H-12-1, Pusa Arunima, Pusa Pitamber, Pusa Lalima, Pusa Pratibha, Pusa Shrestha, and Ratna have very low scale of browning (1 scale). Since the scale of browning might have some relationship with the incidence of LB, and hence varieties showing higher LB incidence, have also shown higher extent of LB extent as well.

Classification/grouping of varieties

On the basis of incidence of LB, the varieties were classified into six groups (Table 1). Based on this grouping, the varieties like Amrapali, Alphonso, Bhaduran, Pusa Arunima, Pusa Pitamber, Pusa Lalima, Pusa Pratibha, Pusa Shrestha, Ratna, H-3-2, H-8-11 and H-12-1 were found to be highly resistant to LB with very less LB (<10%); whereas, varieties like Langra, Dushehari were found to be highly susceptible to LB as they exhibited very high incidence of LB (> 50%). Rest of the varieties were found either resistant, moderately resistant, moderately susceptible or susceptible to LB with LB values ranging from 10-50%. Studies conducted in South Africa and Australia have indicated that some varieties were very susceptible to LB and few were resistant **(**Oosthuyse 1998, Bezuidenhout *et al*. 2003, Joyce *et al*. 2011).

From this study, it can be concluded that Indian varieties like Langra and Dushehari were highly susceptible whereas few hybrids were highly resistant to lenticels browing, indicating that such hybrids have good scope in International export market of mango.

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