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Short communication

Changes in the reducing and non-reducing sugars during fruit bud differentiation in mango hybrids

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ABSTRACT

The forms of sugar and the ratio of reducing to non-reducing sugar and the total sugars have considerable impact on fruit bud differentiation among the other biochemical factors. Sampling in three mango hybrids, Mallika, Amrapali and Pusa Arunima was done end of August to the end of December. The level of reducing sugars ranged from 3.70 to 6.95 mg/g FW and non-reducing sugars 0.75 to 2.45 mg/g FW during the study period in Amrapali, indicating their increase during FBD for the next year flowering. The trend was similar in the three genotypes being regular bearer.

Key words: Fruit bud, flowering, mango hybrids, sugars.

INTRODUCTION

The time of fruit-bud-differentiation in mango is known to be governed by local weather conditions, which varies from place to place. To some extent, it also varies with the varieties grown under the same climatic conditions. The knowledge of the time of fruit-bud-differentiation under a particular set of climatic conditions for a given variety would enable the orchardists to schedule the manuring, irrigation and other cultural operations to have better yield. The form of sugar and the ratio of reducing to non-reducing sugar and the total sugars have considerable impact on the process of fruit bud differentiation among the other biochemical factors. The newly developed hybrids are excellent material since limited work has been carried out regarding the time of fruit-bud-differentiation and the associated biochemical factors so that appropriate agronomical operations can be adopted (Palanichamy *et al*., 4). Hence, the present study was conducted.

A two year study was undertaken at IARI, New Delhi on three mango hybrids, namely Amrapali, Pusa Arunima and Mallika. For taking samples, three trees from each hybrid were labeled randomly for collection of shoot tissue from the end of August to the end of December. For the analysis of sugars, the apical five centimeters of shoots including the terminal bud and leaves were collected from the end of the August to the end of December at fortnightly intervals. By that time, the fruit-bud-differentiation was completed in all the three hybrids. The shoot samples were collect between 8 A.M. to 9 A.M. from each tree; a composite sample consisting of 12 shoots was collected and immediately brought to the laboratory. After cleaning, the shoot samples were chopped separately for stems and leaf portions.

Thirty grammes of the above samples containing equal portion of stem and leaves were weighed and stored in the deep freeze for subsequent extraction. The alcohol-free extract of fresh shoot sample was passed through ion exchange (Dowex-50) resin column (H^+) by the method followed by Rao *et al*. (5) and the effluent was used for the estimation of soluble carbohydrate fractions. The reducing and total sugars in this fraction were estimated (AOAC, 1). The quantity of non-reducing sugars was obtained by subtracting the reducing sugars from the total sugars. The residue obtained, after alcoholic extraction of the sample was dried and a known amount of it was hydrolyzed for three hours with one ml of concentrated hydrochloric acid. The hydrolyzed fraction of carbohydrate was estimated as reducing sugar. The experiments were laid out in factorial completely randomized design with five replications and the data were analyzed.

The maximum reducing sugars were recorded on 15th December and the minimum reducing sugars were found on 15th September in all the hybrids with an exception that in Pusa Arunima the maximum reducing sugars were found on 30th October (5.50 mg/g) on fresh weight basis. Whereas, the minimum reducing sugar contents was on 15th September in all the hybrids. The level of reducing sugars ranged from 3.70 to 6.95 mg/g on fresh weight basis during the study period in Amrapali (Table 1). The level of reducing sugars varied from 3.95 to 5.50 mg/g on fresh weight basis during the study period in Pusa Arunima. It ranged between 3.24 and 5.29 mg/g

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Table 1. Changes in the level of reducing sugars in the shoot and/or bud during the last week of August to the last week of December (pooled data).

Interval	Reducing sugars (mg/g FW)			
	Amrapali	Pusa Arunima	Mallika	Mean
August, 30	3.70	3.95	3.51	3.74
September, 15	3.45	3.80	3.24	3.49
September, 30	3.60	3.80	3.40	3.60
October, 15	4.65	4.25	4.30	4.55
October, 30	5.30	5.50	4.91	5.80
November, 15	5.50	5.19	4.98	5.22
November, 30	6.60	5.29	5.10	5.98
December, 15	6.95	5.49	5.29	5.91
December, 30	4.44	5.49	4.75	4.71
CD at 5%				
Hybrid (H)		0.103		
Interval (I)		0.179		
H × I		0.310		

on fresh weight in Mallika. As per the mean values there was gradual increase in the level of reducing sugars from 15th September (3.49 mg/g fr. wt.) up to 30th November (5.98 mg/g fr. wt.) after that the level of reducing sugars declined. The reducing sugar contents were increased from 15th September the date, one month prior to the initiation of fruit buds and reached to their maximum limit by 30th November. This stage was the advance stage of fruit-bud-differentiation in both the years in all the hybrids with few exceptions. The reducing sugars increased continuously and reached the highest level during the period of fruit-bud-differentiation as per their mean values up to 30th November. However, the level went down significantly after it. The fact that the level of reducing sugar was high at the date of first sampling which was much earlier to the date of initiation of fruit-bud-differentiation, *i.e.* 15th October, suggest that the requirement of the reducing sugar was more for higher respiratory activities due to increased meristematic activities. Therefore, the breakdown of insoluble carbohydrates might be necessary to meet these requirements which are possible by enzymatic hydrolysis of nonreducing sugars as well as disaccharides. Jyothi *et al*. (2) reported that the level of reducing sugar were the highest during fruit bud differentiation period in regular bearing cultivars like Neelam and Totapuri in Karnataka. Singh (7) also reported that level of monosaccharides had significant influence on the fruit bud differentiation in mango.

The non-reducing sugars level varied from 0.75 to 2.45 mg/g on fresh weight basis in Amrapali (Table 2). The non-reducing sugar contents ranged from 0.93 to 2.63 mg/g on fresh weight basis in Pusa Arunima. It varied from 0.94 to 2.39 mg/g on fresh weight basis in Mallika. During first year 2003, the level of non-reducing sugars gradually decreased from 15th September to 15th December after that there was significant increase in the non-reducing sugar contents in all the cultivars (Table 2). It was interesting to note that the level of non-reducing sugar content was minimum on 15th December and the contents of non-reducing sugars were the highest on 30th August in all the hybrids. Furthermore, the role of carbohydrate fractions and nitrogen contents of mango shoots and their relationship with fruit bud differentiation were studied (Mallick, 3).

The ratio of reducing sugars to the non-reducing sugars showed significant and distinct variations (Table 3). The average values were the highest (8.20) on 15th December as far as reducing to the non-reducing sugars ratio on was concerned. Whereas, the minimum ratio (1.50) was found on 30th August. The ratio varied from 1.51 to 10.50 in Amrapali. The ratio ranged from 1.50 to 7.30 in Pusa Arunima and 1.49 to 7.60 in Mallika. The ratio of the reducing sugars to the non-reducing sugar contents started increasing from 30th August to 15th December in both the years in all the hybrids. The increasing trend of reducing sugar to non-reducing sugar ratio might be due to the reduction in the non-reducing sugar contents and an increase in reducing sugar contents during the above mentioned period. It might be attributed to an elevated level of reducing sugars, which has been

Table 2. Changes in the level of non-reducing sugars in the shoot and/or bud during the last week of August to the last week of December (pooled data).

Interval	Non-reducing sugars (mg/g fr. wt.)			
	Amrapali	Pusa Arunima	Mallika	Mean
August, 30	2.45	2.63	2.39	2.49
September, 15	1.95	2.35	1.91	2.07
September, 30	1.85	2.26	1.82	1.97
October, 15	1.97	1.25	1.50	1.73
October, 30	1.60	1.20	1.10	1.30
November, 15	1.5	1.14	1.07	1.23
November, 30	0.98	1.08	1.03	1.03
December, 15	0.75	0.93	0.94	0.87
December, 30	2.3	2.45	2.31	2.35
CD at 5%				
Hybrid (H)		0.032		
Interval (I)		0.056		
H × I		0.097		

Table 3. Changes in the ratio of reducing to non-reducing sugars in the shoot and / or bud during the last week of August to the last week of December (pooled data).

Interval	Ratio of reducing to non-reducing sugars			
	Amrapali	Pusa Arunima	Mallika	Mean
August, 30	1.51	1.5	1.49	1.50
September, 15	1.76	1.61	1.68	1.69
September, 30	1.94	1.67	1.86	1.83
October, 15	4.59	5.25	4.56	4.78
October, 30	5.32	5.65	5.71	5.56
November, 15	5.60	5.94	5.90	6.08
November, 30	6.72	6.24	6.17	6.36
December, 15	10.50	7.30	7.60	8.20
December, 30	3.20	1.92	2.05	2.39
CD at 5%				
Hybrid (H)		0.119		
Interval (I)		0.205		
H × I		0.356		

caused by the production of reducing sugars from the insoluble carbohydrates. Furthermore, some of the non-reducing sugars might be converted into reducing sugars due to enzymatic activity. Similar observations have been made by Ravishankar *et al.* (6).

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