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EFFECT OF GIBBERELLIC ACID ON PERIODICAL CHANGES IN BIO-CHEMICAL COMPOSITION OF BER CV. UMRAN

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ABSTRACT: The present studies aimed at evaluating the effects of varying doses of GA_3 on the bio-chemical changes of ber fruit during development. GA_3 @ 10, 30 and 50 ppm was applied at fruit set stage and then superimposed one month thereafter. The periodical bio-chemical analyses of developing ber fruits revealed that total soluble solids concentration increases maximum during initial stages of fruit development i.e. between interval of 25 to 50 days of GA_3 application while total sugars and ascorbic acid increase and acidity decreases as the fruit reaches maturity i.e. between 75 to 100 days of GA_3 application. The GA_3 50 ppm dose resulted in maximum expression of acidity, total sugars and ascorbic acid at final harvest of ber. Thus it is implicated that GA_3 application is beneficial in improving flavour and taste of ber.

Keywords: *Ber, gibberellic acid, bio-chemical changes, acidity, sugar content, interval.*

Ber (*Zizyphus mauritiana* Lamk.) is distributed throughout the tropical and sub-tropical regions of the world. It is one of the most hardy fruit trees with wider adaptability to adverse soil and climatic conditions and thus is recommended for cultivation on marginal land. India ranks first among the ber growing countries of the world. The fruit is equally relished by people of all classes. A comparison of nutritive value of ber and apple reveals that the ber is richer in the amount of protein, mineral matter, calcium, phosphorus, carotene and vitamin than that of apple. That's why ber is referred to as 'the apple of arid zone'.

In Punjab, the flowering in ber starts from first week of September and continues till first week of November, whereas the fruit setting starts in second week of October. The most active phase of fruit growth is first six weeks of fruit set (Bal and Mann, 2). During this time the developing fruits undergo numerous physical and bio-chemical changes which increase the fruit size and improve the taste. The application of growth regulators like gibberellic acid (GA_3) is reported to have profound effects on improving the fruit quality (Bal *et al.,* 3, Kale *et al.,* 8; Singh and Randhawa, 13; and Singh and Singh, 14). These effects are more pronounced if the application is done during active growth phase. In the present studies the periodical changes in bio-chemical composition of ber fruits as brought about by varying doses GA_3 were evaluated.

MATERIALS AND METHODS

The present investigations were carried out in the Faculty of Agriculture and Forestry, Khalsa College, GNDU, Amritsar during the year 2007-08 and 2008-09. Eight years old trees of ber cv Umran with uniform size and vigour were selected for the experiment. The trees were sprayed during active growth phase in the 3rd week of October and again superimposed spray was applied one month thereafter. The growth regulator i.e. gibberellic acid (GA_3) was applied in varying concentrations i.e. 10, 30 and 50 ppm in addition to water sprayed control. There were three replications each with one tree per replication. The trees were sprayed uniformly by using knapsack sprayer with flood jet nozzle. Five uniform branches per tree were selected and tagged. After second spray at 25 days interval (i.e. after 25 days, 50 days, 75 days, 100 days and then at harvest), the developing fruits were periodically harvested and the observations on four bio-chemical traits viz., total soluble solids (%), acidity (%), total sugars (%) and ascorbic acid (mg/100g) were recorded to evaluate changes in

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chemical composition of developing ber fruits. To record TSS percentage, the juice of ten randomly selected fruits from each replication was extracted and strained through a muslin cloth and TSS content of juice was measured with the help of Bausch and Lomb hand refractometer. The values of total soluble solids were then corrected to 20º C with the help of temperature correction chart (AOAC, 1). To determine citric acid percentage, 10g of fruit pulp was extracted and titrated against N/10 NaOH solution using phenolphthalein as an indicator. The total sugars were estimated by Lane and Eynon method (AOAC, 1). The ascorbic acid was determined by titration method using 10 g of fruit pulp macerated in 3 per cent meta phosphoric acid solution and titrated against 2,6-dichloro-phenol indophenol dye.

RESULTS AND DISCUSSION

The data pertaining to effect of varying concentrations of GA_3 on TSS content of Umran ber (Table 1 and Figure I) revealed that at the final harvest, all the treatments had improved the TSS over control, which revealed that application of GA3 had direct effect on assimilation of metabolic compounds within the fruits which improved TSS control and ultimately the fruit flavour and taste. Improvement in TSS is very important from processing point of view, as products like ber candy; Jelly, dried ber etc. have direct association with TSS percentage of the fruit. There was maximum increase in TSS with application of GA_3 50 ppm followed by GA_3 30 ppm. The periodic increase was significant for all the treatments as TSS increased significantly from 25 days to harvest, with the maximum increase obtained from 25 to 50 days after second spray. The studies corroborated with the findings of Bal *et al.* (3), Kale *et al.* (8), Singh and Randhawa (13), and Singh and Singh (14) who reported beneficial effects of GA_3 in improving TSS of ber fruits.

Among the bio-chemical fruit characteristics, acidity is one of the most important traits as it signifies the characteristic tangy flavor of ber fruit. On periodic intervals, the acidity decreased significantly with application of GA_3 as compared to control (Table 2 and Figure II). Similarly, all the treatments differed significantly among each other confirming to reports of Bankar and Prasad (4), Sandhu *et al.* (12) and Singh and Randhawa (13). The maximum periodic decrease in acidity of fruits was seen in interval of 75 to 100 days after application i.e. as the fruit reaches towards maturity the acidity decreased. The decrease in acidity towards ripening may be attributed to faster movement of potassium into fruits with GA_3 application which in turn increased the membrane permeability of cells allowing respiration of stored acids within the cells, formation of complex compounds of malic acid (Kliewer, 9) and reduced ability of fruits to synthesize organic acids towards maturity (Hardy, 7).

Like TSS, the flavour and taste of any fruit is largely dependent on the total sugar content of the fruit. The application of GA_3 improved the percentage of total sugars in ber fruit at final harvest but the significant improvement was brought about by only 50 ppm dose of GA_3 (Table 2 and Figure III). Bhati and Yadav (5) and Masalkar and Wavhal (10) reported similar beneficial effects of GA_3 in improving fruit sugars of ber. There was significant periodic increase in sugars content at every interval with maximum increase recorded between 75 to 100 days interval i.e. towards fruit maturity. This increase can be attributed to increase in concentration of volatile components concentration in fruits along with hydrolysis of starchy compounds towards maturity. These hydrolytic changes usually lead to formation of sugars. The extent of these hydrolytic changes might have increased with GA_3 application. Moreover, the organic acids present in fruits are translocated into sugars towards maturity and this translocation is made faster with GA_3 application (Drawert and Steffen, 6).

Ber is one of the richest sources of ascorbic acid and is valued for in nutritional properties. Likewise other bio chemical constituents vitamin C content is also directly influenced by application of

Table 1: Effect of GA_3 on TSS (%) and acidity (%) of ber fruits during development.

Treatment	Parameter	Days after second spray									
		2007-08					2008-09				
		25	50	75	100	At harvest	25	50	75	100	At harvest
GA_3 10 ppm	TSS	8.37	10.17	10.88	12.28	13.26	9.04	10.38	12.27	13.10	13.21
	Acidity	0.46	0.38	0.33	0.27	0.24	0.45	0.37	0.37	0.25	0.22
GA_3 30 ppm	TSS	8.90	10.91	12.22	13.23	14.62	8.63	11.37	12.40	13.41	15.00
	Acidity	0.45	0.38	0.32	0.27	0.23	0.46	0.38	0.31	0.22	0.21
GA_3 50 ppm	TSS	9.73	11.59	12.54	13.54	15.29	9.21	11.17	12.42	13.62	15.72
	Acidity	0.42	0.36	0.29	0.21	0.16	0.46	0.37	0.30	0.23	0.17
Control	TSS	8.78	10.13	11.22	12.08	12.60	9.06	10.15	10.94	12.83	13.19
	Acidity	0.48	0.43	0.38	0.28	0.22	0.49	0.46	0.38	0.28	0.23

C.D. (P = 0.05)

	TSS (%)			Acidity (%)		
Intervals (A)	0.43	Year (B)	NS	Intervals (A)	0.013	Year (B)	NS
Treatments (C)	0.38	AB	NS	Tratrments (C)	0.011	AB	NS
AC	NS	BC	NS	AC	0.025	BC	0.016
ABC	NS		NS	ABC	NS		

Table 2: Effect of GA_3 on total sugars (%) and ascorbic acid (mg/100g) of ber fruits during development.

Treatment	Parameter	Days after second spray									
		2007-08					2008-09				
		25	50	75	100	At harvest	25	50	75	100	At harv est
GA_3 10ppm	Total sugars	2.25	3.09	4.86	7.32	7.86	2.81	3.74	5.18	7.18	7.77
	Ascorbic acid	13.22	27.50	47.02	69.54	81.90	13.11	26.65	45.45	67.97	79.22
GA_3 30ppm	Total sugars	2.62	3.52	4.97	7.14	8.34	2.58	3.77	5.08	7.20	8.60
	Ascorbic acid	14.06	28.14	48.00	76.31	87.40	14.02	28.11	48.57	74.32	83.74
GA_3 50ppm	Total sugars	3.06	4.01	5.63	8.08	8.91	2.53	3.49	5.65	8.27	8.90
	Ascorbic acid	14.77	33.90	52.99	82.01	91.50	15.01	33.47	51.57	81.27	90.17
Control	Total sugars	2.07	3.37	5.47	7.63	8.12	2.20	3.30	5.33	7.55	7.99
	Ascorbic acid	14.44	30.99	41.81	72.05	79.51	13.22	30.70	41.49	71.92	80.91

C.D. (P = 0.05)

	TSS (%)			Acidity (%)		
Intervals (A)	0.22	Year (B)	NS	Intervals (A)	1.79	Year (B)	NS
Treatments (C)	0.19	AB	NS	Tratrments (C)	1.60	AB	NS
AC	0.43	BC	NS	AC	3.59	BC	NS
ABC	NS		NS	ABC	NS		

PGRs as is expressed in Table 2 and Figure IV. There was significant improvement in ascorbic acid content of ber fruits with GA_3 50 ppm however, in association to present evaluations, GA_3 (10 and 25 ppm) when applied at slow growth phase exhibited the significant increase in ascorbic acid content of fruits (Pandey, 11, and Singh and Randhawa, 13). There was significant periodic improvement in ascorbic acid content with every interval of 25 days. The maximum increase was noticed towards maturity i.e. between 75 to 100 days interval. Similar periodic improvement in ascorbic acid of ber has been reported by Sandhu *et al.* (12).

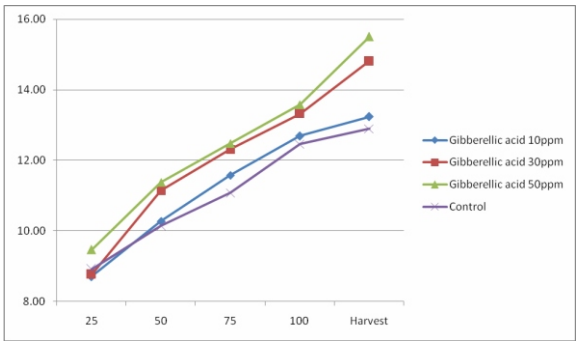

Fig. I : Effect of GA_3 on TSS (%) of ber fruits during development (pooled over both the seasons).

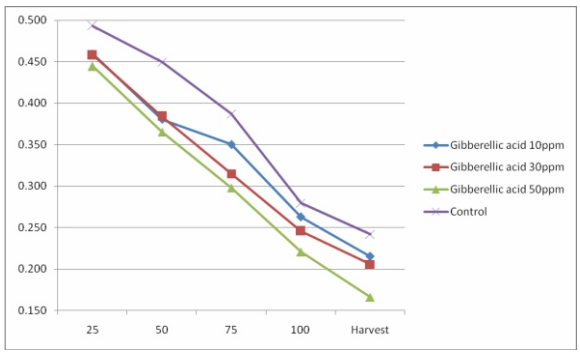

Fig. II : Effect of GA_3 on acidity (%) of ber fruits during development (pooled over both the seasons).

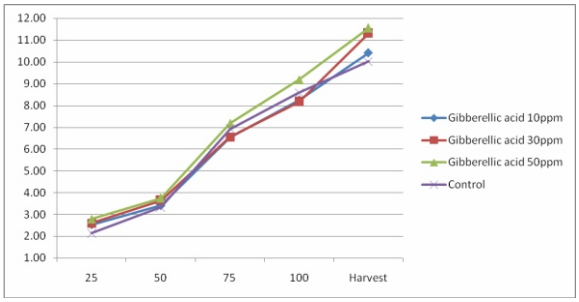

Fig. III : Effect of GA_3 on total sugars (%) of ber fruits during development (pooled over both the seasons).

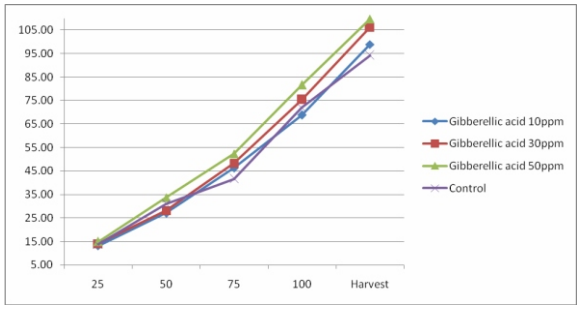

Fig. IV : Effect of GA_3 on ascorbic acid (mg/100g) of ber fruits during development (pooled over both the seasons).

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