



Studies on biochemical differences in regular and biennial bearing varieties of mango (*Mangifera indica* L.)

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Abstract: The experiment was layout in randomized block design with 3 replication. The experimental material consist of 9 cultivars of mango viz., Mallika, Amrapali, Totapuri, Neelum, Dashehari, Chausa, Bombay Green and Safeda. In biochemical parameter the chlorophyll a and total chlorophyll were counted maximum in biennial bearing variety during 'on' year and in 'off' year it was observed maximum in regular bearing variety. However, percentage of Carbohydrate, Nitrogen, Phenol and Auxin were recorded in highest in biennial bearing variety during both 'on' and 'off' year. Thus, it can be said, that alternate bearing problems of mango varieties can be minimize by increasing the C/N ratio and applying the morphological and Phenological measures viz. deblooming cultural practices and application of plant growth regulators.

Key words: *Mangifera indica*, Biennial bearing, Carbohydrate, Nitrogen, Phenol and Auxin

Introduction

Mango (*Mangifera indica* L.) belong to family anacardiaceae and is on of the most important fruit crop in India. The Mango, because of its great utility occupies a pro-eminent place amongst the fruit crops grown in India acknowledged as the king of fruits of this country. Amir Khwsrau (1330AD) has stated (popenoe, 1920). "The Mango is the pride of the garden the choicest fruit of Hindustan, other fruits we are content to eat when ripe but the mango is good in all stages of growth." Mango (*Mangifera indica* L.) is the fifth most important fruit crop of the world after Apple, Citrus, Banana and Grapes. It is cultivated in more than 100 countries spread over in five continents. Because of its delicious taste, excellent flavor, attractive, fragrance and excellent source of vitamin 'A' and 'C' Mango occupies about 70 per cent of the total area under fruits in India covering an area of 5.51 million hectares. The major mango productivity countries are India (12.538 Mt), China (3.676Mt), Mexico (1.679Mt.), Thailand (1.800Mt.), Pakistan (16.06 Mt), Indonesia (1.143 Mt.) and Philippines (1.003 Mt.). India share in world mango production share was 40.1% (N.H.B.Data base 2006) which has not increased since then substantially. The total annual production of mango in India is estimated to be 97.82 lakh tones with total coverage of 14.01 lakh hectares (2005-06). Although India has major area and production in the world producing states of India are Andhra Pradesh (2.379 MT), Uttar Pradesh (1.915 Mt), Bihar (1.872 Mt), Karnataka (1.180 Mt), Tamilnadu (0.70/ Mt), West Bengal (0.560 Mt) and Gujarat (0.382 Mt) (APEDA, database).

The average fruit production in India is 8-10 tones/ ha. Which is quite lower than the world production of 14-16 tones/ha.

The popular commercial varieties of different regions in India are:

Northern region:	Dashehari, Langra, Chausa, Bombay Green
Eastern region:	Himsagar, Langra, Fazli, Lakshman bhog, Krishana bhog, and Gulabkhas
Western region:	Alphanso, pairi, Kesar, Rajapuri, Mankurad and Jamadar
Southern region:	Bangalora, Neelum, Swarnrekha, Pairi (Peter), Banganpalli, Mulgoa and Badami (Alphonso)

Productivity of mango is low around 6.2 Mt/ha. There are ample opportunity to increase the productivity of mango. There are some major factors responsible in low productivity which is alternate bearing, fruit drop, disease and pest infestation.

Materials and Methods

The experimental site was located at Main Experimental Station, Department of Horticulture, Narendra Deva University of Agriculture and Technology, Faizabad on Faizabad- Raibareli road at 42 km away from Faizabad district Headquarter. The experimental site falls under subtropical climate zone of Indio-gangetic plains, which is situated at 26.47°N latitude, 82.12°E longitude at an altitude of 113m from mean sea level. The weekly meteorological data recorded at the meteorological observatory of NDUAT, Faizabad. The experiment was carried out on 15 years old plants of 9 cultivars of mango.

These cultivars are of two types:

- (A) Regular bearing variety: Mallika, Amrapali, Totapuri, Neelum
(B) Biennial bearing variety: Dashehari, Langra, Chausa, Bombay Green, Safeda

The all observation on important characteristics of shoot growth, leaf, flowers and biochemical characters have been recorded, methods used and genetic analysis made for determining traits in relation to variable genotypes have been described. Determination of chlorophyll content in leaf, Estimation of carbohydrate in mango leaves, Determination of Nitrogen Content in Leaf, Estimation of Phenols in leaf and Determination of auxins content per cent in flower bud. The statistical analysis were done following the standard methods.

Results and Discussion

The present investigation involves a detailed evaluation of a variety of mango with regard to biochemical difference in regular and biennial bearing variety. Several criteria's were considered for evaluation and discussion pertaining to each of the selected criterion has been presented under separate head.

Morphological character: Result of biochemical parameter revealed that there was a wide range of variability among the varieties. The chlorophyll a content was recorded higher in biennial bearing variety Safeda during 'on' year while it was maximum in regular bearing variety Amrapali during 'off' year. Jyoti, *et al.* (1998) also observed that there was no significant difference in the chlorophyll content at all stage of flowering and fruit development for all variety and hybrid. However, during the fruit development stage, chlorophyll a was higher in 'off' year trees compared to 'on' year trees. Chlorophyll b content found maximum in regular bearing variety Amrapali during both off and 'on' year. Except Safeda and Bombay Green other all varieties were significant. Total chlorophyll content in leaf was recorded highest during on and 'off' year in Safeda and Amrapali of regular bearing variety respectively. Amrapali was non significant with Chausa, Bombay Green, Dashehari, Neelum and Mallika. Other variety was showed significant differences with chlorophyll content. Singh (V.K. *et al.* 1998) reported that the chlorophyll content of leaf was increased by maturity period. Nitrogen and carbohydrate reserves were observed maximum in biennial

bearing variety during both on and 'off' year with respect to carbohydrate content it was recorded highest in variety Bombay Green during 'on' year and in variety Dashehari during 'off' year. However, the nitrogen content recorded maximum in variety Bombay Green during 'on' year and in variety Chausa during 'off' year. Variety Neelum and Chausa were showed significant difference but other variety non significant differences during 'on' year with respect to carbohydrate content of leaf. Except Chausa and Mallika other varieties showed significant differences. The seasonal change in the carbohydrate reserves and nitrogen content of mango shoots and their relationship with flower bud initiation have been studied by Naik and Shaw, 1937; Sen, 1956; Mallik, 1953; Singh, L.B. 1960; Singh *et al.* 1963. They observed excepting in Baramasi it was found that higher starch reserve, total carbohydrate and C:N ratio in the shoots favored flower initiation in mango. Chacko (1968) showed that the total nitrogen content was higher in the stem and leaves of the trees which were expected to initiate flower buds irrespective of the varieties. Chacko *et al.* (1982) observed that thirty leaves the maximum available on a shoot in the 'on' year, could not support the growth of a single fruit to normal size. For the development of mango fruit it requires 60-90 fully expanded leaves for development, if the assimilates are to be met from current photosynthesis. As a consequence the developing fruit withdraws large content of reserves metabolites from vegetative organs during the 'on' year. This might contribute to biennial and erratic bearing in mango. C:N ratio was higher in regular bearing varieties rather than biennial bearing varieties. Therefore, vegetative growths were also maximum in biennial rather than regular bearing variety.

Total phenol content in leaf was counted maximum in biennial bearing variety Bombay Green during both 'on' and 'off' year. Patil *et al.* (1992) reported that total free phenol content and poly phenol oxidase activity were determined diurnally in different types of flower buds of the mango. Variety Alphonso during fruit bud differentiation. Phenolic content of fruit bud increase steadily with advancing flower bud differentiation, but remained stable in undifferentiated or scar buds.

Auxin content in flower bud was observed maximum in regular bearing variety during 'on' and 'off' year. It was observed

Table-1: Studies on biochemical differences in regular and biennial bearing varieties of mango

Name of varieties	Chlorophyll a		Chlorophyll b		Total chlorophyll		Carbohydrate % in leaf		N% in leaf		C/N ratio	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Regular bearing variety												
Mallika	0.251	0.241	0.604	0.597	1.889	1.870	0.180	0.179	0.887	0.800	0.202	0.222
Amrapali	1.230	1.743	1.750	1.743	2.929	2.922	0.161	0.160	0.930	0.976	0.173	0.163
Totapuri	0.537	0.688	0.241	0.241	2.083	1.183	0.079	0.074	1.030	1.206	0.076	0.061
Neelum	0.508	0.597	0.695	0.688	1.786	1.89	0.111	0.104	1.083	1.133	0.102	0.091
Biennial bearing variety												
Dashehari	0.578	0.730	0.735	0.730	1.596	2.048	0.093	0.086	1.200	1.250	0.077	0.068
Langra	0.304	0.432	0.441	0.432	1.741	1.383	0.148	0.143	1.083	1.116	0.136	0.128
Chausa	0.165	0.258	0.264	0.258	1.473	1.205	0.070	0.069	1.060	1.296	0.066	0.053
Bombay green	0.722	1.122	1.128	1.122	1.765	2.069	0.221	0.218	1.223	1.240	0.180	0.175
Safeda	1.246	1.634	1.650	1.634	2.990	2.674	0.141	0.137	1.030	1.070	0.136	0.128
SEM ±	0.136	0.248	0.248	0.248	0.294	0.448	0.015	0.017	0.025	0.076	0.014	0.015
CD at 5%	0.407	0.744	0.742	0.744	0.884	1.344	0.044	0.051	0.074	0.226	0.043	0.049

Table-2: Studies on biochemical differences in regular and biennial bearing varieties of mango

Name of varieties	Total phenols in leaf		Auxin level in flower buds	
	2006-07	2007-08	2006-07	2007-08
Regular bearing variety				
Mallika	6.670	6.633	0.260	0.260
Amrapali	6.997	6.803	0.273	0.270
Totapuri	6.370	6.183	0.277	0.263
Neelum	7.533	7.450	0.280	0.277
Biennial bearing variety				
Dashehari	7.997	7.873	0.280	0.260
Langra	7.750	7.617	0.277	0.260
Chausa	7.447	7.383	0.247	0.0
Bombay green	8.013	7.973	0.257	0.230
Safeda	7.497	7.360	0.260	0.0
SEM \pm	0.327	0.344	0.008	0.008
CD at 5%	0.981	1.031	0.024	0.024

highest in variety Dashehari during 'on' year while in variety Neelum during 'off' year. During 'on' year all variety showed non significant difference with var. Dashehari. Same as no significant difference were observed during 'off' year with variety Neelum.

Growth potential of ovary and ovules in most plants depend upon the pollination and fertilization. However, pollination and fertilization is not a prerequisite for ovary growth in most of the plants especially when the phenomenon of parthenocarphy prevails many investigators could obtained fruit set without pollination by application of auxin. This clearly indicate that these substances play a crucial role in the setting and development of the fruit in a number

of plant species (Gustafson, 1936, Luckwill 1953 and Kano *et al.* 1957,) reported that both early drop and June drop of apple fruits were associated with period of the lesser Auxin content in the seed.

Lal Kashmir, H. and Ram (1977) reported that in December which corresponds with the period of flower bud differentiation, 'on' year shoot tip of 'Dashehari' counted about 35 times more IAN than those in 'off' year among auxin. IAN was suggested to play a major role in the induction of flowering in mango. Chocko (1968) reported the shoot from Dashehari of 'on' year and from "Totapuri" red small trees which initiated flower buds experimental periods contained higher level of the above growth promoting substances during the period of flower bud initiation than those from 'Dashehari' of 'off' year tree which remained vegetative. However, if indigenous auxin is the only factor favoring flowering in mango, external application of synthetic auxin would have initiated flowering in the 'off' year.

References

- Chacko, E.K.: Studies on the physiology of flowering and fruit growth in mango (*Mangifera indica* L.). Thesis submitted to the faculty of Post-Graduate School, IARI, New Delhi, for the degree of Doctor of Philosophy in Horticulture (1968).
- Jyoti, M.H., Ravindra soppin, Suresh- Ekbote: Biochemical change in the leaf of bearing and non bearing trees of some mango (*Mangifera India* L.) varieties hybrids. *Advances in Agriculture Research in India*, **10**: 17-23 (1998).
- Singh, L.B.: The mango, Botany, Cultivation and Utilization. Leonard Hill (Books) Ltd. London (1960).
- Singh, R.: Mango hybridization in U.P. *Punjab Hort. J.*, **3**: 116-23 (1963).
- Singh, V.K., Saini, J.P., Mishra, A.K.: "Mango malformation in relation to physiological parameters under elevated temperature" *Indian J. of plant physiology* vol. 3 no.3 (N.S.) p. 231-233 (July-Sept. 1998).