

## Studies on fruit-bud differentiation in mango (*Mangifera indica* L.) under South Indian conditions

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### Abstract

An investigation was carried out to find out the time of fruit bud differentiation (FBD) in certain south Indian mango cvs. Neelam, Baneshan, Bangalora, AU-Rumani, Neeleshan and Neeluddin under Tirupati conditions. Five stages of differentiation were observed distinctly in buds during the process of FBD. In general, the time of FBD in the varieties studied was third week of September and completed by third week of November. The total carbohydrate fraction (%) and C/N ratio increased as FBD progressed and C/N ratio reached maximum at peak FBD. Whereas total nitrogen fraction (%) remained at the lowest level at the time of FBD.

**Key words:** Fruit bud differentiation, mango, C/N ratio, cultivars, south India

### Introduction

Flowering in mango is a complex phenomenon, which is not completely clear even today. Prediction of flowering under a set of conditions is difficult, because mango tree seems to be very responsive to slight changes in flower induction favouring factors. Understanding of the various external and internal factors involved in flower induction in mango is crucial for the developing suitable orchard management practices and achieving regular high yields. The time of FBD is believed to be influenced by climatic and other internal factors. In general, based upon geographical location, it has been found to vary between middle of August to middle of November (Sen and Mallick, 1941 and Ravishankar *et al.*, 1979). Singh (1958) reported that FBD under Saharanpur (U.P.) conditions occurred in December. Musahibuddin (1946) showed that in Punjab, time of FBD in mango ranged from August to the end of October. Not much information is available on the time of FBD under south Indian conditions. In view of the above, a study was undertaken to find out the time of FBD under Tirupati (A.P.) conditions in certain south Indian mangoes *viz.*, Neelam, Baneshan, Bangalora. AU -Rumani, Neeleshan and Neeluddin.

### Materials and methods

Six mango varieties, three hybrids (AU- Rumani, Neel eshan, and Neeluddin) and three popular South Indian varieties (Baneshan, Bangalora and Neelam), constituted the experimental plant material. All experimental trees received similar cultural treatments. A composite sample of 10 shoot tips was collected from August to December, randomly from each tree at weekly intervals to follow exact time of FBD and stages of development more closely. For studying the FBD the surrounded leaves and scales of the shoot tips were trimmed and shoot tips were fixed in formalin-aceto-alcohol (FAA) for 24 hours and then preserved in 70 per cent alcohol. The tips were then dehydrated in tertiary butyl alcohol series and embedded in pure paraffin wax (mp 56-60°C) for sectioning. Twelve micron thick longitudinal sections were cut using rotary microtome, stained with safranin and fast

green and mounted permanently in Canada Balsam (Johnson, 1940). For studying FBD the buds were classified into five different floral stages. Per cent floral differentiation at a particular time was calculated based on 10 observations in each tree. FBD was considered to have started when more than 60 per cent of the examined buds had progressed beyond stage-II. Flattening of the meristematic tissue at the apex of the bud was considered as differentiation of flower bud. The observations on the time of FBD, total carbohydrate fraction (%) and total nitrogen (%) were recorded in differentiating flower buds.

### Results and discussion

In general, FBD in the mango varieties included in the study was found to occur in the third week of September and was completed by third week of November. However, the time of commencement of FBD and the peaks of differentiation varied greatly among the varieties (Table 1a,b). The first sign of FBD (Stage-II) in AU-Rumani was apparent during the third week of September (18-9-1998) and 100 per cent differentiation was observed towards the end of October (30-10-1998). In case of Neeleshan and Baneshan, the first sign of FBD was apparent during fourth week of September *i.e.*, 25-9-1998 and 18-9-1998 respectively and reached 100 per cent differentiation towards second week of November *i.e.*, 13-11-1998 and 6-11-1998 respectively. In case of Neeluddin, Bangalora and Neelam, Stage- II of differentiation was seen during first week of October *i.e.*, 2-10-1998 and thereafter it reached 100 per cent during second and third week of November *i.e.* 13-11-1998 and 20-11-1998, respectively. These studies coincide with the general reports that early varieties like AU-Rumani differentiate their buds early and late varieties like Bangalora and Neelam differentiate late under the same climatic conditions (Sturrock, 1934). Mango hybrids - Neeleshan and Neeluddin followed the trend of their mother parent - Neelam which is a well known late variety. It was also reported that the time of FBD differs among the varieties in the same locality (Singh, 1958). A perusal of the available information on the

**Table 1a. Stages of fruit bud differentiation and its development in AU-Rumani, Neeluddin and Neeleshan**

Date of sampling	Cultivar and stage														
	AU-Rumani					Neeluddin					Neeleshan				
	0	I	II	III	IV	0	I	II	III	IV	0	I	II	III	IV
28-08-98	10	-	-	-	-	10	-	-	-	-	10	-	-	-	-
04-09-98	10	-	-	-	-	10	-	-	-	-	10	-	-	-	-
11-09-98	8	2	-	-	-	9	1	-	-	-	9	1	-	-	-
18-09-98	8	1	1	-	-	8	2	-	-	-	8	2	-	-	-
25-09-98	6	2	2	-	-	8	2	-	-	-	7	1	2	-	-
02-10-98	4	3	3	-	-	7	2	1	-	-	7	0	3	-	-
09-10-98	2	3	3	2	-	7	2	1	-	-	6	1	2	1	-
16-10-98	0	3	2	3	2	6	3	1	-	-	5	2	2	1	-
23-10-98	0	1	2	1	6	5	2	2	1	-	4	1	3	2	-
30-10-98	-	-	2	2	6	3	4	2	1	-	1	3	3	2	1
06-11-98	-	-	-	-	-	1	3	2	2	1	0	2	2	3	3
13-11-98	-	-	-	-	-	0	2	3	2	3	-	-	3	4	3
20-11-98	-	-	-	-	-	-	-	3	3	4	-	-	-	-	-

**Table 1b. Stages of fruit bud differentiation and its development in Bangalora, Baneshan and Neelum**

Date of sampling	Cultivar and stage														
	Bangalora					Baneshan					Neelum				
	0	I	II	III	IV	0	I	II	III	IV	0	I	II	III	IV
28-08-98	10	-	-	-	-	10	-	-	-	-	10	-	-	-	-
04-09-98	10	-	-	-	-	10	-	-	-	-	10	-	-	-	-
11-09-98	10	-	-	-	-	9	1	-	-	-	10	-	-	-	-
18-09-98	8	2	-	-	-	8	2	-	-	-	9	1	-	-	-
25-09-98	7	3	-	-	-	7	2	1	-	-	7	3	-	-	-
02-10-98	7	2	1	-	-	7	1	2	-	-	7	1	2	-	-
09-10-98	7	1	2	-	-	6	2	2	-	-	7	1	2	-	-
16-10-98	5	2	1	2	-	4	2	2	2	-	6	2	2	-	-
23-10-98	3	2	2	3	-	0	4	2	2	2	4	3	2	1	-
30-10-98	1	3	2	3	1	0	1	2	4	3	1	4	2	2	1
06-11-98	0	2	4	1	3	-	-	3	3	4	0	2	1	4	3
13-11-98	-	-	3	3	4	-	-	-	-	-	-	-	2	3	5
20-11-98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

subject indicates that the general time of FBD in mango in the country as well as in other countries is from October to November, with initiation as early as in August and completion as late as in the middle of January. The variation in the time of FBD in different varieties of mango at different localities was attributed to the prevailing temperature, physiological and biochemical nature of the plant and cultural practices adopted before the initiation of process of FBD (Sen and Mallick, 1941; Mustard and Lynch, 1946; Musahibuddin, 1946; Singh 1958).

Besides climatic conditions, biochemical and physiological factors are also implicated to influence the time of FBD in mango. The biochemical changes in respect of total nitrogen, total carbohydrates and C/N ratio are presented in Table 2. In general, the total carbohydrate fraction (%) and carbon nitrogen ratio increased as the FBD progressed and C/N ratio reached maximum at the 100 per cent stage of FBD in all the varieties studied whereas total nitrogen fraction (%) reached a lowest level at the time of FBD. In AU-Rumani at FBD total carbohydrate fraction, total nitrogen fraction and carbon/nitrogen ratio were 4.5%, 0.07%

and 64.28, respectively. In case of Neeluddin at FBD, total carbohydrate fraction, total nitrogen fraction and C/N ratio were 4.9%, 0.09% and 54.24, respectively. In case of Bangalora and Neelum total carbohydrate fraction reached same level of 4.4% whereas total nitrogen fraction and C/N ratio were different *i.e.*, 0.09%, 0.08% and 48.89, 55.00, respectively. In case of Neelum and Baneshan the total nitrogen fraction reached lowest of 0.08% and the total carbohydrate fractions were 4.6 and 4.4%, respectively whereas C/N ratio were 57.50 and 55.00, respectively. The variation may be attributed to their respective genetical nature. Both stored starch and soluble carbohydrates are utilized during FBD in mango (Ravishankar and Mohan Rao, 1982). However, some workers did not find any relationship between FBD in mango trees and the content of nitrogen in their shoots (Singh, 1960). A high C/N ratio indicates greater accumulation of carbohydrates in the shoots, pre disposing the plant for FBD (Medhabathi Devi and Tyagi, 1991). Singh (1960) and Sen *et al.* (1969) felt that suitable nutritional and biochemical conditions of the shoots were necessary for FBD in mango.

**Table 2a. Changes in total carbohydrate fraction, total nitrogen fraction and C/N ratio in twigs of AU-Rumani, Neeluddin and Neeleshan before, during and after fruit bud differentiation**

Date of sampling	Name of cultivar											
	AU-Rumani				Neeluddin				Neeleshan			
	FBD (%)	C (%)	N (%)	C/N ratio	FBD (%)	C (%)	N (%)	C/N ratio	FBD (%)	C (%)	N (%)	C/N ratio
28-08-98	0	3.4	0.117	29.06	0	3.2	0.140	22.86	0	3.1	0.117	26.49
04-09-98	0	3.3	0.118	27.96	0	4.1	0.141	29.07	0	2.9	0.112	25.89
11-09-98	0	2.8	0.112	25.00	0	3.1	0.117	26.49	0	3.8	0.125	30.40
18-09-98	10	4.6	0.140	32.86	0	3.5	0.121	28.92	0	4.1	0.125	32.80
25-09-98	20	4.4	0.130	33.85	0	3.8	0.120	31.66	20	4.4	0.131	33.58
02-10-98	30	4.9	0.136	36.02	10	4.3	0.127	31.27	30	3.8	0.114	33.33
09-10-98	50	2.9	0.140	36.25	10	3.9	0.116	33.62	30	3.9	0.111	35.45
16-10-98	70	5.1	0.140	36.43	10	4.5	0.130	34.61	30	4.8	0.130	36.92
23-10-98	90	4.6	0.110	41.82	30	4.6	0.131	35.11	50	4.6	0.121	38.02
30-10-98	100	4.5	0.070	64.28	30	4.8	0.111	43.24	60	4.7	0.100	47.00
06-11-98	-	4.8	0.090	53.33	60	5.1	0.112	45.53	80	4.4	0.090	48.88
13-11-98	-	3.0	0.090	33.33	80	4.4	0.090	48.88	100	4.6	0.080	57.50
20-11-98	-	-	-	-	100	4.9	0.090	54.24	-	-	-	-

**Table 2b. Changes in total carbohydrate fraction, total nitrogen fraction and C/N ratio in twigs of Bangalora, Neelum and Baneshan before, during and after fruit bud differentiation**

Date of sampling	Name of cultivar											
	Bangalora				Neelum				Baneshan			
	FBD (%)	C (%)	N (%)	C/N Ratio	FBD (%)	C (%)	N (%)	C/N Ratio	FBD (%)	C (%)	N (%)	C/N Ratio
28-08-98	0	3.2	0.112	28.57	0	4.2	0.130	32.30	0	3.7	0.114	32.46
04-09-98	0	3.0	0.110	27.27	0	4.0	0.121	33.06	0	3.0	0.112	26.95
11-09-98	0	4.6	0.136	33.82	0	3.5	0.111	31.53	0	3.9	0.115	33.91
18-09-98	0	4.1	0.131	31.30	10	3.6	0.118	30.50	0	4.1	0.125	32.80
25-09-98	0	3.9	0.118	33.05	10	3.9	0.121	32.23	0	3.1	0.090	34.44
02-10-98	10	4.8	0.138	34.78	20	4.4	0.131	33.59	20	4.5	0.128	35.16
09-10-98	20	3.9	0.111	34.14	20	3.9	0.116	33.62	20	4.6	0.120	38.33
16-10-98	30	4.0	0.111	36.03	40	3.8	0.090	42.22	20	4.1	0.112	36.61
23-10-98	50	4.2	0.112	37.50	60	3.9	0.090	43.00	33	4.4	0.111	39.64
30-10-98	60	3.8	0.100	38.08	90	4.1	0.080	51.25	50	4.2	0.100	42.00
06-11-98	80	4.3	0.090	47.78	100	4.4	0.080	55.00	80	4.0	0.090	44.34
13-11-98	100	4.4	0.090	48.89	-	-	-	-	100	4.4	0.080	55.00
20-11-98	-	-	-	-	-	-	-	-	-	-	-	-

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