DOI : 10.5958/0974-0112.2019.00058.6

Indian J. Hort. 76(2), June 2019: 364-367

Short communication

Studies on rejuvenation of old and senile orchards of Alphonso mango in Konkan region of Maharashtra

Y.R. Parulekar, P.M. Haldankar*, M.M. Kulkarni, N.V. Dalvi, V.S. Desai, J.J. Kadam and S.T. Patil

Dr Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri 415712, Maharashtra

ABSTRACT

Alphonso is the premier mango variety owing to its excellent flavour, aroma, colour and shelf life. It constitutes more than 90 per cent of area 1.82 Lakh hectares of the mango in Konkan region. Majority of orchards are old and senile with low productivity. The attempts were therefore made to develop and standardize the rejuvenation technology for such mango orchards. An experiment was conducted on 40 years old senile mango orchard of mango cv. Alphonso from 2011 to 2015 with two treatments *viz*., T_1 - Rejuvenated plants and T_2 - Non-Rejuvenated plants replicated 13 times in randomized block design. The observations *viz*., twig girth (cm), avg. leaf area (cm^2), rate of photosynthesis (µ mol $CO_2/m^2/sec$), rate of respiration (µ mol $CO_2/m^2/sec$), length of panicle (cm), breadth of panicle (cm), hermaphrodite flowers (%), number of fruits per plant, yield per plant (kg) and yield per hectare (t) were recorded on both rejuvenated and non-rejuvenated plants from 2013-14 to 2015-16. The rejuvenation technology was also demonstrated on farmers' field at Katta, Adeli, Nadan in Sindhudurg district and Asore and Mazgaon in Ratnagiri district. High rate of photosynthesis, high hermaphrodite flower percentage (%), more fruits per plant with better fruit weight and higher yield (per plant and per hectare) were recorded in rejuvenated plants as compared to non-rejuvenated plants. The chemical composition of the fruits *viz*., T.S.S, acidity, Total sugars and reducing sugars were non-significant. Due to rejuvenation there was appreciable reduction in the use of quantity of insecticide, fungicide and human labour in rejuvenated plants. The performance of rejuvenated plants on farmer's field was also better than non-rejuvenated plants.

Key words: Fruit quality, photosynthesis, respiration, rejuvenation, yield.

Alphonso is a mango variety known for its excellent flavor, aroma, color as well as shelf life and extensively used for table purpose and processing. It is traditionally planted in Konkan region of Maharashtra and presently occupies more than 90 percent of the total 1.82 lakh hectares mango orchards in the region. In most of the existing mango orchards trees are planted at 10 m × 10 m. Most of which have grown tall with advancement of age which made the intercultural operations *viz*., plan protection, harvesting costly, tedious and ineffective. Such trees also bear small sized fruits. These old and senile orchards have become vulnerable to acute climatic aberrations such as off seasonal rains, hot and cold wave. As a result the present average productivity of Konkan region is only 2.5 to 3 t/ha, mostly because of such orchards which are estimated on an area of about 40000 ha. One of the practical approaches to make senile orchards productive is rejuvenation. However, rejuvenation technique varies according to variety and agro climatic conditions. It was seldom attempted for Alphonso under warm and humid climatic condition of Konkan region of Maharashtra. The attempts were therefore made to improve productivity of existing mango orchards through rejuvenation.

*Corresponding author's E-mail: parag5663@rediffmail.com

The experiment was conducted in Mango orchard at the Department of Horticulture, College of Agriculture, Dapoli during 2011-12 to 2014-15. The experiment was conducted in randomized block design with two treatments, *viz*., T_1 = Rejuvenated plants and T_2 = Non rejuvenated plants. These treatments were replicated thirteen times on uniformly grown 40-year-old grafted mango plants. The selected mango trees under treatment T_1 were pruned in month of October, 2011 at 3.5 m height. Spraying of chloropyriphos @ 5 ml per litre of water was done thoroughly on entire cut ends as well as on tree trunk to avoid stem borer infestation. Black Japan coltar containing carbendazim (1 per cent) was applied on cut end of the pruned branches on every wound for protecting these branches from fungal infections. Pruned trees were irrigated for two months. After 40 days of pruning the newly emerged shoots were frequently thinned and maintained in such a fashion that they were developed all along the stem in all directions. From June, 2012 onwards the pruned and unpruned plants were managed as per the same appropriate integrated nutrient management, application of paclobutrazol for induction of flowering and plant protection measures during flowering and fruiting.

The observations viz.,twig girth (cm), avg. leaf area (cm^2), rate of photosynthesis (µ mol $CO_2/m^2/sec$), rate of respiration (µ mol $CO_2/m^2/sec$), length of panicle (cm), breadth of panicle (cm), hermaphrodite flowers (%), no. of fruits per plant, yield per plant (kg) and yield per hectare (t) were recorded on both rejuvenated and non-rejuvenated plants from 2013-14 to 2015-16. Similarly, various physico chemical parameters were analyzed (Ranganna, 9). The data was analyzed statistically (Panse and Sukhatme, 8). The rejuvenation was also done on 200 farmers' field at Katta, Adeli, Nadan in Sindhudurg district and Asore and Mazgaon in Ratnagiri district (Fig. 1).

Rejuvenation (T_1) remarkably improved the vegetative flush as well as panicle of mango cv. Alphonso (Table 1).The twig (5.95 cm), average leaf area (99.26 cm^2), length of panicle (27.63 cm) and percentage hermaphrodite flowers (21.95) were significantly superior in rejuvenated plants (T_1) as compared to Non rejuvenated plants (T_2).Pruning regulates growth of tree and brings out balance between vegetative and reproductive functions of the plant (MadhavRao and Shanmugvelu, 7). Importantly, the rate of photosynthesis (9.46 µ mol $CO_2/m^2/sec$) was greater in rejuvenated plants was as compared to non rejuvenated control plants (5.81 µ mol $CO_2/m^2/sec$). The reverse was true for the rate of respiration and was highest in control (3.09 µ mol $CO_2/m^2/sec$) as compared to rejuvenated plants (1.69 µ mol $CO_2/m^2/sec$). Higher percentage of flowering in pruning treatment was due to the new growth and more availability of photosynthetic solar radiation to the leaves (Lal and Mishra, 5). Pruning promotes ethylene and reduces gibberellins (MadhavRao, 6). Pruning increases photosynthetic translocation (Ashraf and Ashraf, 1).The moderate pruning treatments enhanced photosynthetic rate in mango (sharma *et al.,* 11). In the present study the percentage of hermaphrodite flowers was improved in rejuvenated plants. The pruning intensity at moderate level improved hermaphrodite flowers in mango var. Amrapali, Mallika and Dasheri (Singh *et al.,* 12).

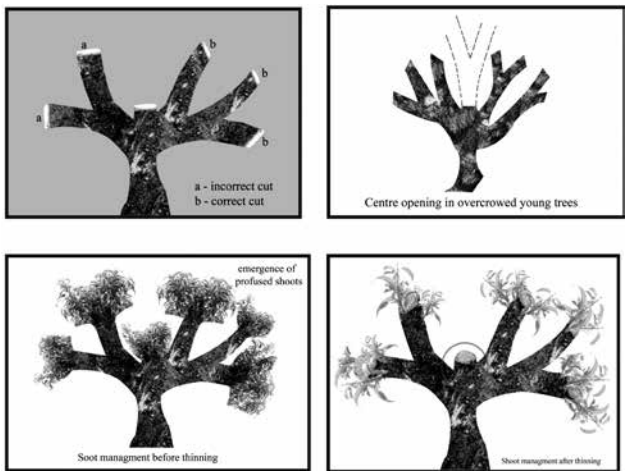

Fig. 1. Rejuvenating alphonso mango trees at farmer's fields.

In present study, after rejuvenation in 2011-12, the yield from rejuvenated plants was started from 2012-13. The rejuvenated plants consistently produced greater yield during 2012-13, 2013-14 and 2014-15 which was significantly more than control (non rejuvenated plants). The pooled yield per hectare was maximum in T_1 (3.38 t/ha) as compared to control (2.54 t/ha).Pruning maintain the optimum metabolic activities in the plant (Sharma *et al.*, 11). Irrespective of intensity and severity, pruning helps in balance vegetative growth and better availability of sunlight to the leaves (Singh *et al.*, 12). Rejuvenation in mango trees helped to improve yield (Shanmugvelu and Saidha, 10; Lal and Mishra, 5; Benic and Sen, 3). Yield in the pruned trees was higher than in unpruned trees (Jahjangeer *et al.*, 4).

The fruit length (91.80 mm) and breadth (83.24 mm) (Table 3) and fruit weight (257.53 g) (Table 2) were significantly superior in rejuvenated mango plants (Table 2). Pruning produced heavier and larger fruits in mango cv. Amrapali (Asrey *et al.*, 2). The different levels of pruning increased the fruit weight in litchi (Sonali *et al*., 13). However, the chemical composition of fruit *viz*., TSS, acidity, total sugars and reducing sugars were non-

Table 1. Effect of rejuvenation on twig girth (cm), average leaf area,rate of photosynthesis and rate of respiration after one year in mango cv. Alphonso.

Treatment	Twig girth (cm)	Avg. leaf area (cm^2)	Photosynthesis rate (µ mol $CO_2/m^2/sec$)	Respiration rate (µ mol $CO_2/m^2/sec$)	Length of panicle (cm)	Width of panicle (cm)	Hermaphrodite flowers (%)
T_1	5.95	99.26	9.46	1.69	27.63	20.55	21.95
T_2	4.18	85.79	5.81	3.09	24.19	17.07	14.47
$CD_{0.05}$	0.68	7.58	1.04	0.55	1.82	1.79	3.98

Table 2. Effect of rejuvenation on hermaphrodite flowers (%), No. of fruits, yield per plant and yield (kg, t) in Alphonso mango.

Treatment	No. of fruits	Av. fruit wt. (g)	Yield per plant (kg)	Yield per ha (t)
T_1	142.25	257.53	33.80	3.38
T_2	105.78	221.88	25.42	2.54
$CD_{0.05}$	13.93	15.52	5.57	0.55

Table 3. Effect of rejuvenation on physicochemical properties of Alphonso mango fruits.

Treatment	Fruit length (mm)	Fruit breadth (mm)	Acidity (%)	TSS (°B)	Reducing sugars (%)	Total sugars (%)	β –Carotene (ug/g)
T1	91.80	83.24	0.29	7.46	1.13	2.13	312.00
T2	80.21	75.20	0.28	7.45	1.12	2.12	311.71
$CD_{0.05}$	1.37	1.00	NS	NS	NS	NS	NS

significant (Table 3). Similar results were obtained in mango cv. Chausa by pruning treatments (Lal and Mishra, 5).

Rejuvenation remarkably reduced the quantity of insecticides, fungicides and human labour involved for various operations. The harvesting of fruits was possible with 60 labours per ha in rejuvenated plants as compared to 90 labours per ha in non rejuvenated plants (Table 4). The rejuvenation helped to restrict the plant height and allowed compact development of canopy on lower part of plant which facilitated the orchard management operation, viz., plant protection and harvesting. The rejuvenated plants also recorded remarkably higher yield as compared to non rejuvenated plants on various farmers' field where field demonstrations were conducted (Table 5).

From the present experiment it was concluded that the rejuvenation of old and senile orchards of mango cv. Alphonso in Konkan region of Maharashtra is beneficial for improving the productivity of existing mango orchards.

Table 4. Labour and chemicals requirement in rejuvenated and non rejuvenated plants of Alphonso mango.

Particulars	Rejuvenated plants		Non rejuvenated plants	
	Quantity	Cost (Rs.)	Quantity	Cost (Rs.)
Quantity of insecticide + Fungicide (6 sprays)	6 + 3	3600	9 + 4.5	5400
Labour required (Man days)	36	9720	54	14580
Cost of Harvesting for 1 ha (Rs.)	60	8100	90	24300

Table 5. Performance of rejuvenation of mango plants cv. Alphonso (age around 40 years) on farmers' field.

Village, Tehsil, District	Year of rejuvenation	No. of plants rejuvenated	Rejuvenated plants		Non rejuvenated plants	
			No. of fruits per plant	Yield (kg/ha)	No. of fruits per plant	Yield (kg/ha)
Adeli Tal – Vengurle Dist.- Sindhudurg	2012	10	332	86.3	217	49.5
Katta Tal – Malvan Dist- Sindhudurg	2012	20	312	82.6	234	51.5
Nadan Tal – Deogad Dist.- Sindhudurg	2012	10	278	78.1	227	53.4
Mazgaon Tal – Ratnagiri Dist.- Ratnagiri	2012	10	270	69.7	211	46.0
Asore Tal – Guhagar Dist.- Ratnagiri	2012	30	325	82.9	272	63.1

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Received : February, 2017; Revised : April, 2019;
Accepted : May, 2019