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Short communication

Effect of pruning on productivity in sweet orange

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ABSTRACT

To sustainable production of quality fruits in eight year old sweet orange plants of cv. Mosambi budded onto *Citrus jambheri* rootstock, and grown in laterite soil at Jhargram, Paschim Medinipur, a canopy management trial was conducted for two consecutive years. The treatments included T_1: No pruning; T_2: Removal of dead and dry shoots and branches; T_3: T_2 + Removal of thin shoots and water-sprouts arising from the leaders at 90° angle; T_4: T_3 + Removal of selected laterals; T_5: T_4 + Removal of selected leaders for formation of open-centre-canopy. Randomized Block Design with five replications was set up. Results indicated that fruit production improved with regular pruning. Significantly high fruit retention (68%) with maximum number of fruits (250) was recorded in plants where open-canopy was maintained by judicious removal of the leaders, laterals, thin shoots and dead wood. Trees with open-canopy not only resulted in 71.4% increase in fruit number, but also enhanced fruit weight by 17.9% over Control. Significantly good fruit quality in terms of TSS, total sugars and Vitamin C content was recorded in fruits from the open canopy treatment. Dry weight of shoots / branch was lowest (1.50kg) in open-canopy treatment and highest in the unpruned Control (3.0kg). Foliar N, P and K status did not vary significantly with different pruning practices.

Key words: Canopy management, fruit production and quality, sweet orange, laterite soil

The sweet orange (*Citrus sinensis* Osbeck.) occupies the first position among all the commercial citrus species grown in the world. It prefers dry, sub-tropical climate for good growth yield and for producing quality fruits. It produces a well-spread canopy with well-developed leaders, laterals and sub-laterals. Sweet orange plants are generally planted at a spacing of 5 x 5 meters, and economical orchard life varies from 15 to 25 years depending upon the rootstock used, management practices followed and the prevailing agro-climatic conditions in a particular area. It is observed that on attaining the age of seven to eight years, the canopy of the sweet orange plant becomes dense and overcrowded, which results in susceptibility of the plant to insect-pests and diseases thereby drying up of shoots. Besides, excessive growth of the leaders and laterals may result in shade falling on the plants nearby. Due to formation of the dense canopy and the shading effect, fruit yield gradually decreases. Pruning, which is the art of removal of unwanted growth of plant parts in a scientific manner, is needed for sustained production and for increasing the efficiency of the orchard. In citrus *per se*, drastic pruning may not be desirable, but reports are available on the effect of pruning in sweet orange (Philips, 1978; Bevingten, 1980; Joubert *et al.*, 2000) from different countries. In India, this information is lacking, particularly, in sweet orange grown in laterite soils. With a view to increasing production and for improving fruit quality, this investigation was undertaken with different pruning intensities.

The experiment was conducted in a private orchard at Jhargram, Paschim Medinipur, West Bengal, on eight year old sweet orange plants cv. Mosambi, budded onto Jambheri (*Citrus jambheri)* rootstock planted at a spacing of 5m x 5m. Before pruning, the plants were over-crowded and had excessive growth of leaders and laterals. The pruning treatment comprised of: T_1: No pruning; T_2: Removal of dead and dry shoots and branches; T_3: T_2 + Removal of thin shoots and water-sprouts arising from the leaders at 90^0 angle; T_4: T_3 + Removal of selected laterals; T_5: T_4 + Removal of selected leaders for formation of open-centre-canopy. The pruning operation was conducted in the first week of January. In the first year (2010), all the pruning

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treatments were imposed as per schedule, while, in the second year (2011), dead shoots were removed. The experiment was laid out in Randomized Block Design, with five-replication by taking two plants as a unit. The plants were fertilized with 30kg FYM, 400g Nitrogen, 200g P_2O_5 and 300g K_2O plant^{-1} year^{-1} in two splits, viz., during March and June. The plants were irrigated at monthly interval after fruit-set (i.e. February) and this was continued until the onset of monsoon. Observations on fruit-retention (from the marble stage of fruit development to maturity), fruit yield (by number, and weight) was recorded each year. Shoot mortality (biomass) was recorded at the time of pruning and was expressed in kg, on fresh weight basis. Foliar N, P and K status was estimated from six month old leaves as per standard procedure (Bhargava, 1999). Physico-chemical characteristics of mature fruits were record each year using standard methods (A.O.A.C, 1990).

Fruit yield, which was the main focus of the experiment, improved significantly with various pruning treatments (Table 1). Highest fruit retention (68%) was observed in plants where open-canopy was formed by judicious removal of the leaders and laterals (T_5) thereby resulting in production of highest number of harvestable fruits in both the years. Highest fruit production in open-canopy plants (T_5) may be due to greater penetration of sunlight and better air circulation, creating a micro-climate conducive to synthesis of carbohydrates and phyto-hormones. The second best treatment was T_4, where laterals had been removed selectively. Control plants (T_1) produced the lowest number of fruits (140) in both the years. It was observed that fruit production was higher in the first year, and relatively less in the second year, irrespective of the treatment. This indicated that the sweet orange has a tendency for alternate bearing. This is in conformity with the findings of Ghosh and Tarai (2007) in sweet orange and Sharma *et al* (1997) in Kinnow mandarin.

Just as with fruit number, fruit yield was highest (41.3kg plant^{-1}) in the open-canopy plants (T_5), followed by plants (36.8kg plant^{-1}) where laterals were removed selectively (T_4) (Table 1). Highest fruit yield in T_5 may be due to best fruit retention and to production of weighable fruits (Table 2). Yield improvement in aged citrus plants due to pruning practices was also reported by Tayde and Ingle (1997) in Nagpur mandarin, Nath (1994) in Assam lemon, Sharma *et al* (1997) in Kinnow mandarin and Joubert *et al* (2000) in sweet orange and grapefruit.

Fruit weight increased significantly with various pruning treatments (Table 2). Highest fruit weight (165g) was recorded in the open-canopy plants (T_5), followed by T_4 (160g), while, the lowest was recorded in Control plants (140g). Highest fruit weight seen in open-canopy plants (T_5) may be attributed to better assimilation of reserve foods in the branches remaining on the plant. Sharma *et al* (1997) also recorded higher fruit weight in Kinnow plants where extra growth was removed judiciously. Fruit size (length and breadth) did not significantly vary among treatments. Quality of the fruits improved significantly with different pruning treatments. The highest juice percentage (52.5%), T.S.S. (8.6ºB), total sugars (5.6%) and Vitamin C (34.5mg/100ml) content were recorded in fruits from the open-canopy plants (T_5). These findings corroborate with those of Joubert *et al*

Table 1. Effect of canopy management on fruit production and shoot mortality, and, foliar N, P and K status in sweet orange cv. Mosambi

Treatment	Fruit retention (%)	Number of fruits plant^{-1}			Average fruit yield plant^{-1} (kg)	Shoot mortality plant^{-1} on fresh weight basis (kg)	Foliar N, P and K status		
		2010	2011	Average			N (%)	P (%)	K (%)
T_1 : No pruning (Control)	47	150	130	140	19.6	3.00	1.70	79.00	1.45
T_2 : Removal of dead shoots only	50	185	175	180	27.0	2.35	1.68	78.00	1.50
T_3 : T_2 + Removal of thin shoots and water sprouts, arisen from the leaders	56	205	195	200	31.4	2.30	1.68	78.00	1.55
T_4 : T_3 + Removal of selected laterals	64	240	220	230	36.8	1.50	1.70	80.00	1.55
T_5 : T_4 + Removal of selected leaders for formation of open canopy	68	270	230	250	41.3	1.20	1.74	88.50	1.58
CD *(P=0.05)*	5.2	10.5	7.4	8.0	3.8	0.20	N.S.*	N.S.*	N.S.*
CV (%)	9.2	16.4	11.7	12.2	8.1	3.9	2.4	3.6	1.8

*N.S. = Non-significant

Table 2. Effect of canopy management on physico-chemical characteristics of fruits (average of two years)

Treatment	Fruit weight (g)	Length of fruit (cm)	Breadth of fruit (cm)	Juice content (%)	T.S.S. (^{0}B)	Acidity (%)	Total sugars (%)	Vitamin C (mg/100 ml juice)
T_1 : No pruning (Control)	140	7.4	7.4	49.2	7.2	0.26	5.20	29.60
T_1 : Removal of dead shoots only	150	7.5	7.5	50.3	7.8	0.27	5.30	30.50
T_1 : T_2 + Removal of thin shoots and water sprouts, arisen from the leaders	157	7.7	7.7	50.5	8.0	0.25	5.40	31.50
T_4 : T_3 + Removal of selected laterals	160	7.8	7.8	52.0	8.2	0.26	5.50	34.10
T_5 : T_4 + Removal of selected leaders for formation of open canopy	165	7.9	7.9	52.5	8.6	0.26	5.60	34.50
CD *(P=0.05)*	4.8	N.S.*	N.S.*	1.1	0.30	N.S.	0.20	0.60
CV (%)	6.5	2.1	1.6	4.4	3.9	2.7	4.1	3.8

N.S. = Non-significant

(2000) and Tayde and Ingle (1997). The lowest values in quality parameters were recorded in fruits from Control plants.

Plants showing less intensity of shoot-drying is an indication of good plant health and *vice versa*. The lowest amount of dry shoots was recorded (1.2kg) in open-canopy plants (T_5), while it was highest (3.0kg) in Control plants (T_1), followed by T_2 (2.35kg). Results in Table 1 indicate that removal of dry and dead shoots every year is essential for maintaining plant health in citrus species like the sweet orange. The leaf is considered as the most suitable index tissue, and represents nutrient status of the plant (Bhargava, 1999). Foliar N, P and K status was assessed to ascertain the nutrient status of pruned and unpruned plants. It was found that N, P and K values did not vary significantly with various pruning treatments (Table 1). However, T_5 plants showed a slightly higher value for foliar N, P and K compared to the other pruning treatments imposed.

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