EFFECT OF ORCHARD HEATING IN REDUCING PARTHENOCARPIC FRUITS IN 'HADEN' MANGO

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Abstract. **Orchard heating experiments were conducted during 1974-75 in Haden Mango to reduce the production of parthenocarpic fruits resulting in heavy loss of crop. The experiments were conducted in three blocks with trees uniform in age and bearing during January-March. The results indicated a possibility of reducing the formation of parthenocarpic fruits while increasing production of normal fruits in treated blocks when compared to untreated block. Temp lower than 10°C prevailing during January-March seem to play an important role in inducing the abortion of young and developing embryos whose participation is necessary for the development of normal fruits.**

'Haden' mango is one of the most important cvs grown in México. Being an early bearer it has very good market price and therefore, forms an important cv in the commercial mango orchards. Nearly all the finer varieties of mango except for 'Manila,' are Florida cultivars covering 25% of the total area under mango production. They are distributed along the Pacific and Gulf coasts as well as in South, Central Mexico. Florida mango cvs were introduced into Mexico during the last 10-15 years and as such precious little is known about the ecophysiology of different cultivars under Mexican conditions. Mexico presents a wide range of climatic and soil conditions, which sometimes function as microclimates and pose serious problems to fruit crops. Under suitable conditions 'Haden' mango produces extremely well in some parts of Mexico being prolific and precocious.

The area under 'Haden' mango is quite large in comparison with other cultivars. In the State of Sinaloa (Pacific coast) there are 4,290 hectares[2] under mango of which 961 hectares produce 'Haden' (1). In the Southern half of the State, starting from Mazatlan, 'Haden' mango performs; very well. From Culiacan to the North, most of the 'Haden' mango orchards suffer the serious problem of parthenocarpy. The area affected totals to 546 hectares.[2] 'Haden' mango trees flower during middle or late December and the fruits are ready for harvest in the middle of May, lasting a month and a half. The flowering and fruit set of 'Haden' mango coincides with the northern cold currents during January and March when the field temp will be ranging from 0-5° degrees centigrade. It is at this period the young and developing fruits are exposed to low field temps. However, the effect of low temps is not immediately noticed until the fruits reach the stage of physiological maturity. At this stage nearly 70-80% of the fruits remained very small and began to show signs of normal ripening on the tree (Fig. 1 and 2). The growers do not show any interest in harvesting such fruits which have no market value. A closer examination of such fruits indicated the presence of a thin endocarp (stone) consisting of a partially developed seed (Fig. 3) or none at all. Formation of seedless fruits due to high temperatures (44°C) and low humidity (15%) has been reported in mangos from Palestine (2).

There is no published information available regarding the abortion of seed leading to parthenocarpy in 'Haden' mango, although passing references are made to smoking or smudging to induce flowering and fruit set (5). The object of this experiment was to find out whether it was possible to control the formation parthenocarpic, seedless fruits by raising the field temperature in order to increase the production of normal fruits.

Fig. 1. Parthenocarpic fruits of mango 'Haden' ripening on the tree.

[1]The authors thank the assistance of Ing. Angel Valdez Gaxiola, also of CONAFRUT in conducting field studies.
[2]One hectare = 2.47 acres.

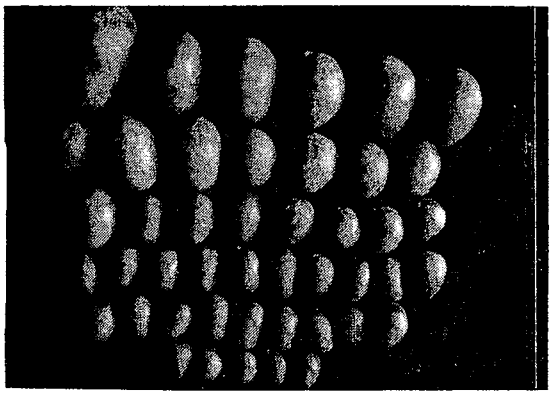

Fig. 2. Parthenocarpic fruits of 'Haden' mango of different sizes (Note: the fruit on the extreme left of the top row is normal).

Materials and Methods

A mango orchard exhibiting microclimate where temperatures lower than 3°C existed during nights between January-March, 10 km north of Culiacan in the State of Sinaloa was chosen for this experiment. The trees were 8 years old, uniform in size, flowering and fruit set. Meteorological data were collected by installing maximum-minimum thermometers and thermohygrographs. Initial studies were made regarding the number of heaters required to raise the temp of one block of four trees by 2°C in 30 min., and it was found that 30 field heaters burning diesel oil were required to cover one block of four trees with a planting distance of 10 meters.

The experiment consisted of three blocks of four trees each. Block I was treated as control. Block II was treated as treatment 1 where the minimum temperature was maintained at 8°C and Block III as treatment 2 where the *minimum* temperature was maintained at 10°C. Allotment of treatments to blocks was done on a random basis. In the centre of each block was a thermohygrograph installed on a platform (Fig. 4) and a maximum and minimum thermometer installed on a pole. The heaters installed in and around blocks II and III were lighted at the signal of an alarm. They were extinguished only when the temperature was raised above the minimum temperature prescribed for each block. Observations were recorded continuously from January-March. At the commercial maturity (physiological maturity) each one of the trees was harvested blockwise separately and fruits were classified into parthenocarpic fruits and normal fruits.

Results and Discussion

Fig. 5 (a-d) indicates temperature and relative humidity fluctuations recorded in the field in the control block in five charts during February-March. The data of January is not presented as the inflorescences were just emerging. During 5th to 26th February, the min temp recorded was 1°C and on ten days during the same period oscillated between 1-3.5°C, lasting for 5 hours each day. The min relative humidity during this period was between 1-49% and the maximum ranged between 84-98%. At this period the fruits were of pea to marble size corresponding to stage I of fruit development (4) when the rapid enlargement of the fruit and seed took place while the embryo remained small. Any drastic drop in the temperature might affect the seed and the resting embryo seriously (3).

Tables 1 and 2 give the number of partheno-

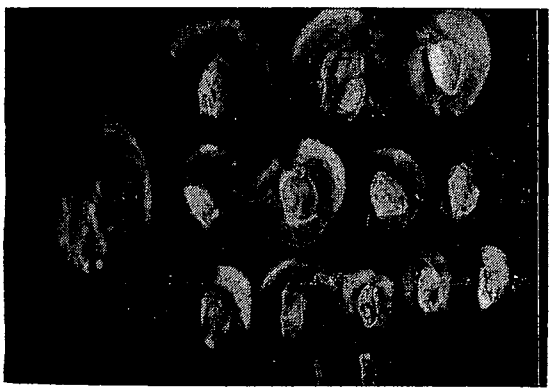

Fig. 3. Parthenocarpic fruits of 'Haden' mango showing absence of seed. The one on the right is normal with a fully developed seed.

Fig. 4. A experimental block of 'Haden' mango trees surrounded by field heaters with a thermohygrograph mounted on a platform and thermometer hung on the pole.

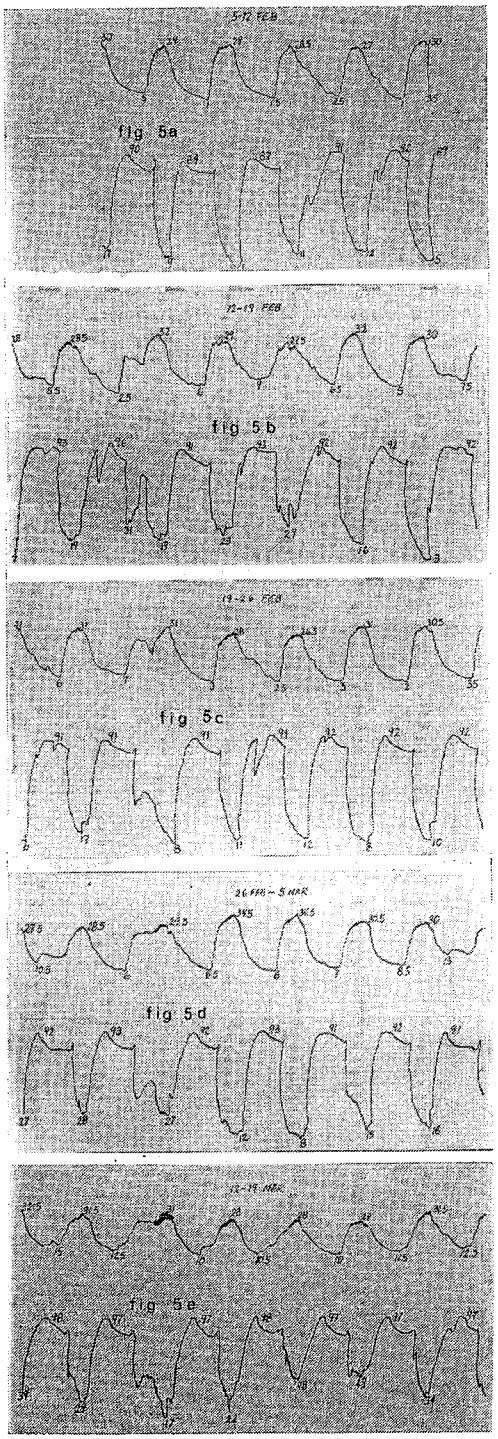

Fig. 5. (a.d.) Temperature and relative humidity charts showing fluctuations existing during Feb-March in a sequence.

TABLE 1. NUMBER OF PARTHENOCARPIC FRUITS PRODUCED BY THE EXPERIMENTAL TREES.

Treatment	Control	Not less than 8°C	Not less than 10°C
Replicate 1	292	573	291
Replicate 2	240	417	293
Replicate 3	430	157	235
Replicate 4	270	305	342
T o t a l	1232	1452	1161
Average number of parthenocarpic fruits per replicate.	308	363	290

carpic fruits and normal fruits, respectively, produced by the four replicates under each treatment. The values presented indicate variations among treatments as a whole, the values were quite significant. From amongst the 4 replicates in block I (control) a total 1688 fruits completed the developmental cycle of which 1232 were parthenocarpic and 456 normal. In block II, where the minimum temperature was maintained at 8°C the total number of fruits produced was 2172 of which 1452 were parthenocarpic and 720 normal showing approximately an increase of 58 per cent

TABLE 2. NUMBER OF NORMAL FRUITS PRODUCED BY THE EXPERIMENTAL TREES.

Treatment	Control	Not less than 8°C	Not less than 10°C
Replicate 1	148	185	253
Replicate 2	125	208	268
Replicate 3	96	162	345
Replicate 4	87	165	178
T o t a l	456	720	1044
Average number of normal fruits per replicate.	114	180	261

normal fruits. In block III (min temp 10°C) the total number of fruits produced was 2205 of which 1044 were normal an increase of approximately 129 per cent. Considering the data presented in Table 3, it can be observed that the % normal fruits was highest in block III where the minimum temperature was maintained at 10°C. This shows that the field temp existing at the initial stages of fruit set and development greatly influenced the production of normal fruits. However, mango cvs like 'Irwin' growing in the same area were not susceptible to low temps indicating that cv. 'Haden' is highly susceptible to low field temperatures. Local varieties like 'Manila *Chapeado*' also behaved similarly exhibiting seedless fruits. No participation of microorganisms was however, noticed affecting the seed development. Deficiency tests were not carried out since other varieties, under similar conditions were performing well. Possible interaction of stock and scion in 'Haden' mango and failure of fertilization due to failure of pollination resulting in parthenocarpic fruits have not been ruled out. The preliminary results presented here indicate the possibilities of increasing normal fruit production in 'Haden' mango by maintaining the field temp not less than 10°C. However, the experiment requires to be repeated with more replications and blocks to confirm the results besides taking into account the economic aspects of heating the orchard to increase production of normal fruits.

TABLE 3. RELATION OF PARTHENOCARPIC TO NORMAL FRUITS PRODUCED IN EACH TREATMENT.

Treatment	Total number of fruits harvested	Number of parthenocarpic fruits		Number of normal fruits	
		actual	% of total	actual	% of total
Control	1688	1232	73	456	27
Not less than 8°C	2172	1452	67	720	33
Not less than 10°C	2205	1161	53	1044	47

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MOISTURE LOSS FROM YOUNG CONTAINER-GROWN MANGO PLANTS[1]

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Abstract. **Six-month-old 'Zill' on 'Turpentine' and 1-year-old 'Turpentine' seedling mango (Mangifera indica L.) plants in closed- and open-topped containers were watered at 14- and 28-day intervals for 16 weeks. Calculation of daily water loss as logarithmic water remaining gave virtually a straight line relationship when values were plotted against days after watering or cumulative vapor pressure deficit, air temp or soil temp. Unexplained variations from multiple and simple correlations were substantially less than 10% for most treatments. Water loss from plants in either closed- or open-topped containers could thus be estimated with good precision.**

Mango cultivars are propagated in Florida by grafting or budding on seedling, usually polyembryonic, rootstocks (4,6). General nursery practice is to grow the plants in containers, which are watered daily. Numerius reports have been published on various aspects of nursery handling in Florida and other areas of mango culture (7) but only 1 on water flow through plant tissues (3).

[1]Florida Agricultural Experiment Station Journal Series No. 7030. This research was one section of a dissertation submitted in partial fulfillment of the Ph.D. in the Department of Horticulture, University of Florida, June 1954. Acknowledgment of assistance is made to Dr. George D. Ruehle, late Vice-Director of the Subtropical Experiment Station, Homestead, where this work was conducted, Mr. Dave Roberts, Dr. Ibrahim Fahmy and Dr. Jon F. Bartholic.