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PHYSIOLOGICAL FRUIT DROP IN AMBE BAHAR OF NAGPUR MANDARIN (*CITRUS RETICULATA* BLANCO.)

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Abstract: The present investigations were conducted at Nagpur mandarin orchard during 2014-15 at fruit Instructional farm of College of Horticulture and Forestry, Jhalawar to elucidate the flowering, assess the severity of losses caused by fruit drop during peak summer months (April-June). The study was conducted on 52 plants of Nagpur mandarin trees of 8 years age. Flowering period of ambe bahar at Jhalawar district extends from last week of February to end of March. Three fruit drop peaks were observed. The initial fruit set percentage was estimated to be 0.5% and final fruit set percentage was observed 0.21%. Fruit drop was heavier during hot, dry and windy weather. Fruit drop is chiefly characterized by sudden temperature change, intensity of heat at fruit set, lack of moisture and nutrient deficiency. Three peak stages were identified with respect to fruit drop i.e. End of May drop; Early June drop and End of June drop under vertisols of Jhalawar district and these losses are of significance to the fruit growers of the district. All the fruits that fail to mature do not drop at one time but there are waves of light and heavy fruit drop in citrus. This fruit drop can be reduced to some extent by proper water management, foliar feeding/spray of 2, 4-D horticultural grade and micronutrients and use of approved growth regulators.
Keywords: Ambe bahar, Nagpur mandarin, may drop, June drop.

Introduction

Nagpur mandarin (Citrus reticulata Blanco.) occupies premier position under fruit crops in Jhalawar district. Jhalawar district holds numero uno position in cultivation of oranges especially Nagpur mandarin in the vertisols of Rajasthan state resembling Vidharbh region of Maharashtra. The fruit growers possessing assured irrigation facilities take Ambe bahar fruit crop of Nagpur mandarin in Jhalawar district. Flowering season of Ambe bahar in Jhalawar district persist from last week of February to March end and fruit setting in Nagpur mandarin completes by end of March to first week of April. The sudden upsurge of temperatures during April to June months causes severe losses to mandarin fruit growers in the form of fruitlets dropping at regular intervals during peak summers. With an intent to understand the extent and physiology of fruit drop losses at different stages, the present study was undertaken at Block-A of Nagpur mandarin during 2014-15 at Fruit Instructional Farm of College of

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Horticulture and Forestry, Jhalawar and to assist remedial measures to mandarin growers of Jhalawar district for minimizing these losses for better returns.

Materials and Methods

The present studies were conducted under Block-A of Nagpur mandarin during 2014-15 at Fruit Instructional Farm of College of Horticulture and Forestry, Jhalawar. The study encompasses from augmentation of flowering up to final fruit set in selected fifty two Nagpur mandarin trees. The experiment was undertaken with five replications in Randomized Block design and unit replication comprised thirteen trees. The five branches being in South West slope of these trees having profuse flowering were marked and were used to estimate the no. of flowers on these trees. The basis of this bench mark was fixed on the criteria that maximum flowering in Nagpur mandarin occurred on South West direction. The periodical observations pertaining to fruit setting was estimated by counting the number of fruit set after recording of initial flower numbers at full bloom stage. After initial fruit setting, physiological drop of fruits in three waves were recorded as 'End of May drop', 'Early June drop', and 'End of June drop'. For recording these fruit droppings a piece of cloth was placed under the canopy of selected trees to estimate the number of dropped fruits under these three physiological drop stages. The physical parameters viz. peel thickness, horizontal diameter and vertical diameter of these dropped fruits were measured with the help of Vernier Callipers. Osmolality of these fruits was measured with Vapour Pressure Osmometer, Wescor Inc., USA at the laboratory of Department of Fruit Science.

Results

The results in table 1 indicate the profuse flowering behaviour of Nagpur mandarin on the selected Nagpur mandarin plants used for experimentation. The data in table 1 indicate average flowers numbers value of 40000 in Nagpur mandarin during the month of February, 2014. The initial fruit set per cent was very low (0.5%), the reason for this low fruit set could be attributed to high temperatures observed during early phase of April. The trend in Fig.1 depicts the low initial fruit and final fruit set with respect to number of flowers appeared at the time of full bloom during the month of March. End of May drop recorded a significant fruit drop percentage value of 28.57 under phase I. Physiological fruit drop is more severe when leaf temperatures reach > 35^0C and water stress is a problem. This has been widely reported in arid regions of Southern California or South Africa (Davies and Albrigo, 1994) and in north-central India. High temperatures and severe water stress cause stomatal closure with a concomitant reduction in net CO_2 assimilation. Fruit abscission then results because

the fruits maintain a negative carbon balance. It might be due to differences in hormone or carbohydrate levels. The trend in Fig.1 reveals fruit retention in Nagpur mandarin at different stages of fruit drop. However, the trend in Fig.2 represents initial and final fruit set percentage during the complete study period.

The early losses due to End of May drop (Phase I) in Nagpur mandarin plants observed for fruit weight in the range of 2.78 to 3.22 g; Early June drop (Phase II) to be in the range of 4.46 to 5.40 g and End of June drop was measured to be in the range of 8.02 to 11.43g. The present studies indicated the losses of 28.57% during phase I; 20.00% losses during phase II and 25.00% losses during Phase III. Third phase was found statistically significant in terms of fruitlets biomass loss to the plant as well as fruit growers. The probable reason for dropping of these young fruitlets might be due to water stress, nutrition imbalance as well as growing competition for carbohydrates amongst the developing fruitlets. Fruit drop under this phase occurred from the abscission zone at the base of the fruit leaving the pedicel attached to the tree temporarily.

The peel thickness variations in dropped Nagpur mandarin fruitlets during three different phases were observed to be 2.71 mm in Phase I; 2.83 mm in Phase II and 3.02mm in Phase III, respectively. Dried juice vesicles were found in all the dropped fruitlets. This might be due to water stress and osmotic dehydration in these fruitlets causing them to succumb under intense thermo stress due to disturbed source-sink ratio due to retranslocation of assimilates. Under high temperature limited translocation of foods or high rate of respiration are probably responsible for abscission. The range of peel thickness during Phase I was between 2.63 to 2.92 mm; Phase II was observed between 2.66 to 2.99 mm and that of Phase III between 2.83 to 3.30 mm.

Fig.3 reveals the horizontal section of three different stages of fruit drop. Horizontal diameter variation of Nagpur mandarin fruitlets for Phase I was found between 8.09 mm to 15.65mm; Phase II was observed between 19.23 to 20.22 mm and of Phase III between 23.34 to 26.57 mm. Vertical diameter variation for fruitlets for Phase I was ranged between 16.98 to 19.84 mm; Phase II was observed between 20.92 to 23.54 mm and that of Phase III between 23.34 to 26.57 mm. Fruit size in June drop ranges from 2.0 to 3.0 cm in diameter in Nagpur mandarin. Fig. 4 reveals an overview of three important fruit drop stages in ambe bahar of Nagpur mandarin under vertisols of Jhalawar district.

Osmolality variation was found significant for all the three phases of fruit drop. During phase I, osmolality concentration of Nagpur mandarin fruitlets was found highest (270

cmole/kg); it got decreased significantly during Phase II (210 cmole/kg) and it was found lowest during Phase III (End of June drop) with a value of 180 cmole/kg. The decrease in osmolality with the progressive phases of fruit drop might be attributed to decline in electrolytic composition of mineral balance of the tree under harsh vagaries of weather coupled with moisture stress for the survival of plant itself. Water stress from drought is one of the commonest stress factors. Stress may leads to ethylene production in plants. The premature ethylene production leads to unusual pre-harvest drop from mandarin plants. Similar findings have been reported by Albrigo and Syvertsen (2015) in Valencia oranges in United States.

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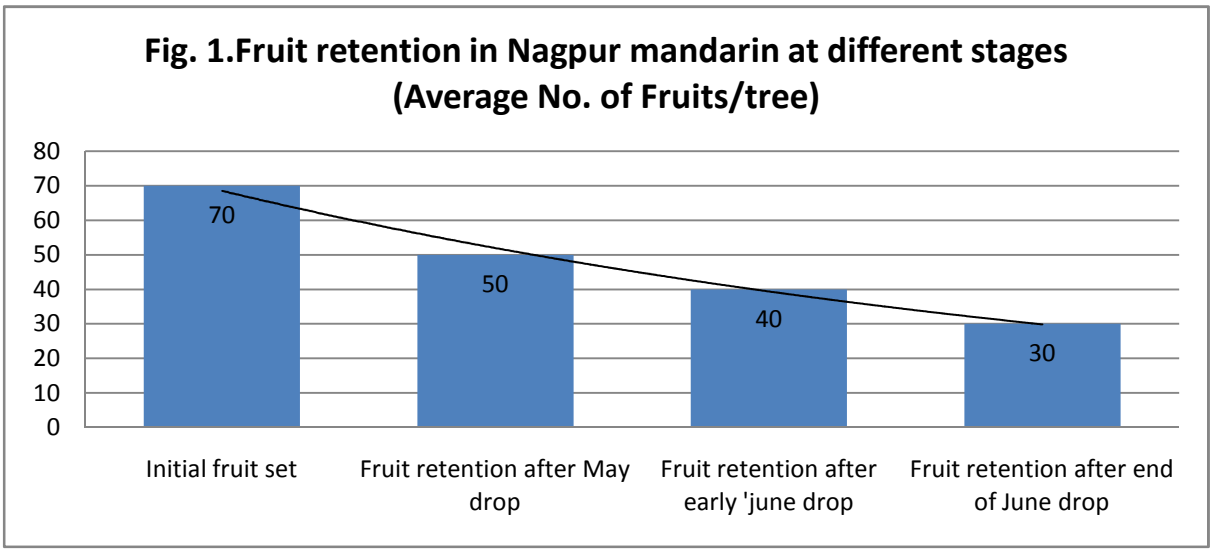
Table 1. Observations recorded for flowering, fruit set and fruit drop in Ambe bahar of Nagpur mandarin

S.No.	Observations taken	Values
1.	No. of flowers per tree	14000
2.	No. of fruits/tree (May 2014)	70
3.	Initial Fruit set %	0.5
4.	End of May drop	28.57%
5.	Fruit retention after May drop	50
6.	Early June drop	20.00%
7.	Fruit retention after Early June drop	40
8.	End of June drop	25.00%
9.	Final fruit set (No. of fruits/tree)	30
10.	Final fruit set %	0.21

- **Values are means of 52 plants of Nagpur mandarin purposely selected for this study**

Table 2. Fruit weight, Peel thickness, Horizontal diameter and Vertical diameter of Nagpur mandarin fruitlets at three stages during summer months.

Fruit drop stages	Fruit weight(g)	Peel Thickness (mm)	Horizontal Diameter (mm)	Vertical diameter (mm)	Osmolality (cmole/kg)
End of May drop	3.07	2.71	14.16	18.74	270
Early June drop	4.92	2.83	19.58	21.93	210
End of June drop	9.86	3.02	24.55	26.63	180
CD 5%	2.00	0.30	3.97	3.17	32.49
SEm	0.81	0.12	1.62	1.29	9.39



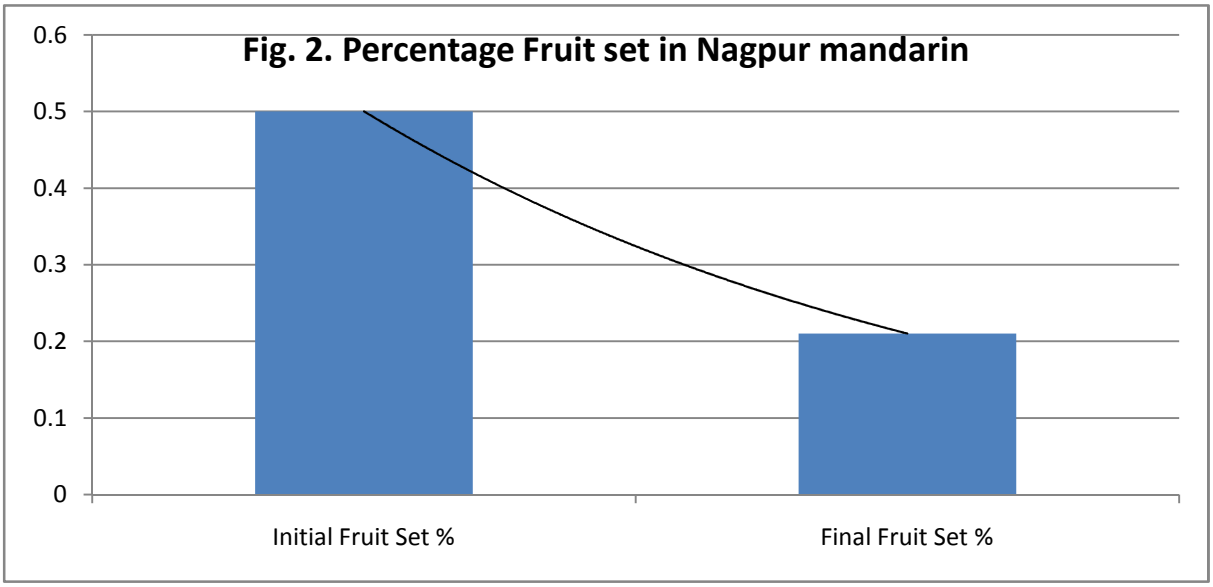


Fig. 3 Horizontal Section of stages of fruit drop Nagpur mandarin

Fig.4. Overview of fruit drop stages in