Effect of Different Pollens on Setting and Subsequent Development of Fruit in Certain Citrus Varieties

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The effect of applying Musambi and Kinnow pollens on Washington Navel and Musambi oranges and Kinnow mandarin was studied. Musambi pollen hastened the maturity of Kinnow by about a month whereas Kinnow pollen delayed the ripening of Musambi by 26 days. However, fruit drop, percentage maturity, weight and size of the fruit, number of seeds and segments per fruit were not effected by different pollens. Kinnow pollen increased the juice and reduced the rag percentage, whereas Musambi pollen increased rag and reduced the juice percentage. Likewise, total soluble solids, sugars and vitamin C were increased by Kinnow pollen. Musambi pollen decreased the acidity in Kinnow while the acidity percentage in Musambi was increased by Kinnow pollen. On the whole, chemical characte.s of the fruit were affected by the pollens while the influence on the physical characters and the productivity was non-significant.

INTRODUCTION

Of the various citrus fruits, Musambi sweet orange and Kinnow mandarin claim the largest area and production in the central zone of West Pakistan. Though high yielding these two varieties suffer from certain qualitative defects. Musambi, for example, lacks sugar-acid blend, contains less juice and is susceptible to granulation. Kinnow, a juicy and sweet variety is very late ripening and is subject to alternate bearing. Washington Navel, one of the leading varieties in U.S.A. and U.A.R. has not done well in West Pakistan. It is shy bearer, attains an abnormal shape and is prone to granulation.

The direct effect of pollen on seed and fruit has been observed in certain plants. For such influences, Swingle (1928) coined a term 'metaxenia' to denote the effect of pollen on the maternal tissues lying outside the embryo and endosperm. He attributed the influence of pollen to the hormone like action of substances secreted by embryo or endosperm or both.

Chandler (1957) stated that the embryo contains genes from both male and female gametes, so the quality of hormone produced is, virtually, influenced by both male and female parents. Nixon (1935) extensively studied the effect of pollen on date palm. He observed a definite effect of pollen on fruit and seed and the ripening season.

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Dhillon (1953) compared self-pollination with cross pollination in sweet lime (*Citrus aurantifolia*) by using pollens from grapefruit and sweet orange. Fruit size, skin thickness and the number of seeds per fruit were all increased by cross pollination.

Cociu (1962) reported that in sour cherry the pollen parent influenced fruit weight, pulp/stone ratio, dry matter contents and the ripening date. May Duke as a pollinator imparted its character of uneven ripening to the pollinated variety.

MATERIALS AND METHODS

The experiments reported in the paper were carried out during the year 1963-64, in the Experimental Fruit Garden, West Pakistan Agricultural University, Lyallpur. Three full grown plants, each of Musambi, Kinnow and Washington Navel were selected as female on which pollens from Kinnow and Musambi plants were applied. The flowers were emasculated in bud condition and were pollinated later on when the stigma became receptive. The emasculated flowers were kept covered by polyethelene bags to avoid chance pollination by insect or wind.

EXPERIMENTAL RESULTS

The results in respect of the characters studied are presented in Table 1.

TABLE 1. *Effect of different pollens on fruit set, days required for maturity, juice percentage, rag percentage, rind percentage, seeds per fruit, acidity percentage and total soluble solids.*

Characters	Washington Navel pollinated with		Musambi pollinated with		Kinnow pollinated with	
	Musambi	Kinnow	Musambi	Kinnow	Musambi	Kinnow
Fruit set ..	35.3	38.3	38.6	40.0	41.0	40.6
Days required for maturity.	274.3	292.6	260.6	289.3	316.0	339.6
Juice percentage ..	39.9	40.8	38.7	40.4	42.1	47.4
Rag percentage ..	28.0	27.8	31.1	30.3	28.3	23.2
Ring percentage ..	32.1	31.4	30.2	29.3	29.5	29.7
No. of seeds ..	4.3	4.8	16.1	17.0	18.0	16.9
Acidity percentage ..	0.5	0.6	0.3	0.3	0.8	0.9
Total soluble salts ..	9.2	11.1	10.1	11.9	12.9	14.9

Fruit setting

The maximum fruit set (41.0 per cent) was recorded for Kinnow pollinated by Musambi, followed by Kinnow selfed (40.6 per cent). Fruit setting in case of Musambi variety was 40.0 and 38.6 per cent for Kinnow and Musambi pollens respectively. Washington Navel showed minimum fruit setting, that is, 35.3 per cent by Musambi pollen ; with Kinnow pollen it increased a little (38.3 per cent).

Days required to ripen fruit

Kinnow selfed took the maximum number of days (339.6) followed by Kinnow pollinated with Musambi pollen (316.0). Musambi selfed was the earliest, reaching maturity in 260.6 days ; when pollinated by Kinnow, it matured in 289.3 days. Washington Navel was intermediate in maturity.

Juice, rag and rind percentages

Juice percentage in Kinnow was more than both Musambi and Washington Navel. Kinnow pollen increased the juice percentage of Washington Navel fruits as well as the Musambi. The differences due to different pollens were highly significant. The juice percentage of Kinnow was decreased by Musambi pollen.

Musambi had higher rag percentage than Washington Navel which in turn was higher than Kinnow. The differences due to pollens were also significant, Musambi pollen being the champion of rag production.

Rind percentage of Washington Navel fruits was significantly higher than the other two varieties, Musambi and Kinnow. The pollen had no effect on the rind percentage.

Number of seeds per fruit

There was little difference in the seed number of Musambi and Kinnow varieties. Kinnow and Musambi pollens when applied on Washington Navel, a seedless variety, produced on an average 4.8 and 4.3 seeds per fruit respectively.

Acidity

Kinnow was more acidic than Washington Navel while Musambi contained the least percentage acidity. Kinnow pollen increased acidity while Musambi pollen lowered it. The effect due to pollens was significant.

Total soluble substances

Kinnow with its own pollen had the maximum total soluble salts (15.2 per cent), with Musambi pollen it was only 13.2 per cent. The least total soluble salts contents were recorded for Washington Navel fruits resulting from Musambi pollen (9.2 per cent).

DISCUSSION

The results of this study have shown that for fruit setting cross pollination has been more effective than selfing. Uphof (1934) obtained better setting in citrus fruits by cross pollination.

Thinning and selection of flower buds while emasculating for cross-pollination might have resulted in better setting. It is not sure that increase in setting percentage was due to pollen or thinning effect.

Days required to ripen fruit

According to Single (1928) hormones produced by the seed activate the ripening process in date berries. Unpollinated dates develop into small fruit which never reach maturity, probably due to the absence of hormones which are given out by the developing embryo.

Embryo contains genes both from male and female parents. Like all other characters, the production of hormones and their quality is also dependent on the genotype of the embryo. Similar views have been expressed by Crane (1952) that such influences are due to the embryonic differences which are transferred to and expressed in the maternal tissues. It should be noted here particularly that Kinnow and Musambi belong to two different species, *C. reticulata* and *C. sinensis* respectively, and the pollen effects on the maturity periods are of considerable magnitude. By interspecific pollinations in plums, Crane and Brown (1942) also showed that different pollens resulted in differences in the time of maturity and fruit size. Cociu (1962) reported that May Duke pollen imparted its character of uneven ripening to the pollinated varieties of sour cherry.

Number of seeds per fruit

The seed number did not differ due to the pollen because it depended on the number of ovules fertilized by male gametes. Both the pollens were equally compatible with all the three varieties and set equal or nearly equal number of seeds.

With Washington Navel variety, Musambi and Kinnow pollens produced on an average 4.3 and 4.8 seeds per fruit. Less seed number in Washington Navel is due to high female sterility. The seeds formed could be apomictic rather than resulting from fertilization.

Juice and rag percentage

It can be speculated that the genetic variation of Kinnow and Musambi pollen is the possible cause of differences in juice and rag production. There appears to be no correlation between seed number and juice production because

Musambi and Kinnow had nearly similar number of seeds but differed greatly in juice and rag contents.

Increase in juice percentage, reduction in rag percentage and granulation in Musambi resulting from Kinnow pollen lead to the possibilities of using Kinnow as a pollinator for Musambi.

Chemical characters

Kinnow pollen was superior to Musambi in increasing the total soluble substance and acidity. Likewise, Nebel (1930) observed in apple that acidity, keeping quality and the chemical composition of fruit varied according to the pollen used. Nixon (1935) observed that early ripening dates lacked flavour and were poor in keeping quality as compared to dates maturing at proper time. The differential effect of Kinnow pollen on the chemical characters of the fruit could be explained partly to the genetic constitution of Kinnow pollen and partly to the late ripening effect of Kinnow pollen.

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