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Inter Specific Hybridization in Papaya (*Carica papaya L.*)

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Abstract: A study was carried out at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2005 for incorporating cold tolerance into a cultivated variety CO 2. Morphological and qualitative characters were recorded in papaya (*Carica papaya* CO 2), *Carica candamarcensis and* F_1 progenies. The study revealed that F_1 progenies expressed variability for morphological characters. F_1 hermaphrodite plants had low mean value for plant height, petiole length, leaf area, number of leaves per tree, fruit length, fruit circumference, fruit volume, fruit weight, fruit number and yield. In F_2, wide variations were observed for morphological characters viz. plant height, plant stem girth, petiole length, leaf area and number of leaves.

Key words: *CO 2, Carica candamarcensis, F_1, F_2 progenies*

INTRODUCTION

Carica papaya is a cultivated species of papaya and is mostly grown in tropical areas. It is sensitive to frost. But the wild species of papaya *Carica candamarcensis* is somewhat tolerant to frost and the species is mostly grown in higher altitude [3]. Incorporation of cold tolerance into cultivated variety may be useful for stabilizing the yield in cultivated variety. With this in view, a study was carried out at Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore during 2005 for incorporating cold tolerance into a cultivated variety CO 2. The variety CO 2 was crossed with *Carica candamarcensis* and their F_1 and F_2 progenies were evaluated.

MATERIALS AND METHODS

The female parent CO 2 (*Carica papaya*) was crossed with Hill papaya (*Carica candamarcensis,* Syn. *Carica pubescens, Vasconcella pubescens).*The F_1 seeds of CO 2 and *C. candamarcensis* were raised in polythene bags. Forty five days old seedlings were planted at 1.8 x 1.8m spacing. One hundred and seven F_1 progenies were raised. In F_1 population, 52 hermaphrodites and 55 female plants were observed.

The selfed seeds obtained from the F_1 population were raised and evaluated as F_2 progenies. A total of two hundred and forty F_2 plants were raised at Horticultural Research Station, Thadiankudisai. Morphological characters viz., plant height, first bearing height, plant girth, length of petiole, leaf area and number of leaves at first flowering, fruit length, fruit circumference, fruit volume, cavity volume, cavity index, pulp thickness, average fruit weight, number of fruits per tree and fruit yield per tree were recorded.

RESULTS AND DISCUSSIONS

The morphological and qualitative observations were recorded in all the hermaphrodite and female plants (Table 1). The F_1 progenies exhibited variability for their morphological characters in the present study. It might be due to the impact of wild male parent *Carica candamarcensis*. Supporting evidence could also be obtained from the cross *Carica papaya* and *Carica cauliflora* [6] and in the cross *Carica papaya* and *Vasconcella quercifolia* for this aspect [2].

Among the F_1 population of present study, only the hermaphrodite plants were identified for further study and selection. This is because of difficulties in maintaining purity in female plants through crossing. Besides, one of the objectives of the study is to develop gynodioecious cold tolerant line. Difficulties were encountered in maintaining purity in dioecious papaya varieties in the absence of distinct morphological trait to identify the 'male parent' plant[1].

Generally in papaya, short stature is a desirable character as it helps for easy and early harvesting of fruits. In the present investigation, F_1 progenies had a lower mean plant height at first flowering compared to the parents and the progeny 2/5 was the shortest. The first

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Table 1: Mean performance of parents and progenies for morphological characters

Sl.No.	Characters	CO2	*Carica candamarcensis*	Hermaphrodite F_1 plants
1.	Plant height at first flowering (cm)	172.15	305.00	167.12
2.	First bearing height (cm)	127.50	280.00	146.83
3.	Plant stem girth at first flowering (cm)	20.50	24.00	21.45
4.	Length of petiole at first flowering (cm^2)	62.42	54.00	54.72
5.	Leaf area of first flowering (cm^2)	2306.00	1152.00	2128.19
6.	Number of leaves at first flowering	27.60	35.00	16.71
7.	Fruit length (cm)	24.10	12.00	21.46
8.	Fruit circumference (cm)	47.50	17.50	37.54
9.	Fruit volume (ml)	2812.31	160.00	1672.69
10.	Cavity volume (ml)	508.35	13.00	289.80
11.	Cavity index (per cent)	18.07	8.13	17.45
12.	Pulp thickness (cm)	3.00	1.00	2.44
13.	TSS (°brix)	12.20	6.00	11.38
14.	Average fruit weight (kg)	1.95	0.12	1.29
15.	Number of fruits per tree	80.60	51.00	65.62
16.	Fruit yield per tree	172.26	4.44	85.98

bearing height is an important character in papaya as it facilitates easy harvest and extends the economic life of plantation. The fruiting height was governed by multiple factors and the product of any cross could be expected to be intermediate to the parental lines [8]. In the present investigation, higher mean value for first bearing height was recorded in F_1 progenies than the better parent, even though low bearing height is a desirable one.

F_1 progenies had high mean plant stem girth at first flowering than the female parent CO 2 and the highest plant stem girth was observed in the progeny 3/9. This result was also quoted in papaya hybrids [5, 9]. The petiole length in interspecific hybrids of *Carica papaya* x *Carica cauliflora* was similar to female parent *Carica papaya* [6]. In the present investigation, the mean petiole length of F_1 progenies was lower than the female parent. Among the F_1 progenies, the highest petiole length was recorded by 7/6. Present results are in conformity with the earlier findings of Suma [9].

Higher leaf area results in increased photosynthesis and increased translocation of photosynthates to the developing fruit. Highest leaf area was reported in the hybrid CO 1 x Coorg Honey Dew whereas in the present study, a lower mean leaf area was observed than the better parent CO 2. The progeny 4/10 registered the highest leaf area among the F_1 progenies. The lower leaf area was also reported in the hybrid CP 9 x CP 81 [9].

More number of leaves is a pre-requisite for increased leaf area and increased photosynthesis. In respect of number of leaves per tree, F_1 progenies had a lower number of leaves than both the parents. Among the F_1 progenies studied, 2/5 registered the maximum number of leaves. The result of the present investigation was in line with the earlier finding of Suma [9] and Kamalkumar [5] wherein a higher number of leaves were recorded in papaya hybrids.

The mean fruit length was lower than the better parent in the present study and the progeny 2/5 recorded the lengthiest fruit among F_1. However, a higher fruit length was observed in hybrids than the parents in papaya crosses involving the parents CP 9, CP 81, CO 6, 9-1 (D), CO 5 and CO 2 [9].

F_1 progeny registered a low mean fruit circumference than the better parent CO 2 and the progeny 3/9 recorded the maximum fruit circumference among the F_1 progenies. Lower mean fruit volume was recorded in F_1 progenies than the better parent CO 2, because the wild male parent produced very small fruits. Among the F_1 progenies, 7/6 recorded the maximum fruit volume. A higher fruit volume was reported in hybrids of CP 81 x 9-1 (D), CP 81 x CO 2 [9]. F_1 progeny had a low cavity volume than the better parent and the progeny 2/9 registered the

maximum cavity volume. However, a higher cavity volume was recorded in hybrids of CP 81 x 9-1 (D), CO 6 x 9-1 (D) and 9-1 (D) x CO 5 [9].

Lower cavity index is beneficial in papaya as it relates with more pulp thickness. In the present investigation, lesser mean cavity index was recorded in the F_1 progeny than the better parent CO 2. Among the F_1 progenies, 6/3 registered the lowest cavity index. Similar results of lesser cavity indices were observed in papaya crosses CO 2 x CO 5, 9-1 (D) x CO 5, CO 5 x 9-1 (D), Pusa Dwarf x 9-1 (D) and IIHR 37 x Coorg Honey Dew [5]. The progenies *viz*., 1/1, 2/3, 2/5, 2/9, 3/9, 4/10, 5/9 and 7/6 had the cavity index of more than 18.00 per cent.

Fruit weight is an important trait contributing directly to the yield. In the present investigation, the average fruit weight was lesser than the better parent CO 2. This may be due to the wild male parent, *Carica candamarcensis,* which has a very small fruit with an average weight of 0.120 kg. Among the F_1 progenies, 4/10 registered the maximum fruit weight.

Fruit number is a major component which contributes towards higher yield. In respect of number of fruits per tree, F_1 progenies recorded lesser fruits than the better parent CO 2, which could be due to the male parent which has a very low number of fruits. The progenies 2/9 and 7/6 recorded a higher number of fruits per tree.

Yield is a complex character and is dependent on its component traits. Lower mean yield was recorded by the F_1 progenies than the better parent in the present investigation. Among the F_1 progenies, 7/6 registered the maximum yield. Low mean yield of F_1 might be due to wild male parent, *Carica candamarcensis*, which has a very low yield of 4.44 kg per tree. However, a higher yield was reported in papaya crosses 9-1 (D) x CO 2, CO 6 x CO 2 and CP 81 X 9-1 (D) [9].

F_2 Population: In the present study, the genotypes of F_2 progenies showed wide variations among themselves for the morphological characters *viz*., plant height, plant stem girth, length of petiole, leaf area and number of leaves at 9th MAP. In the present investigation, eighteen genotypes *viz*., G 3, G 8, G 9, G 15, G 17, G 19, G 20, G 22, G 23, G 26, G 27, G 34, G 40, G 41, G 42, G 52, G 58 and G 62 flowered and set fruits, 14 months after planting. Among them, G 3, G 15, G 17, G 19, G 20, G 22, G 23, G 27, G 41 and G 58 were hermaphrodite plants and the rest are female plants.

The mean plant height of F_2 progenies were less than the F_1 progenies and parents involved in the cross. Minimum plant height is a desirable character in papaya breeding. A wide variation was observed for this character, which will make selection easy and effective. Similar variations were also observed previously [7, 10].

In respect of plant stem girth, low mean value was noticed in F_2 progenies than the F_1 progenies and parents. The genotype G 34, a female plant, registered the maximum plant stem girth among the F_2 population. The mean petiole length in F_2 progenies was lesser than the F_1 progenies and parents. Generally low temperature delays the growth and development of plants. This might be the possible reason for reduced petiole length in F_2 progenies, which were grown at Horticultural Research Station, Thadiyankudisai. Lesser leaf area was registered in F_2 progenies compared to F_1 progenies and parents. The leaf area is extremely variable in F_2 and supporting evidence could be obtained from the earlier report of Warmke *et al.* [10] in interspecific cross between *Carica goudotiana* and *Carica monoica*. Low mean number of leaves was observed in F_2 population compared to F_1 progenies and parents. Poor growth at Horticultural Research Station, Thadiyankudisai might be due to low temperature and low light intensity.

Among the 62 genotypes in F_2 population, 41 genotypes produced flowers till May 2006. Among them, 26 were found to be hermaphrodite and 15 were female plants. The ratio of segregation of hermaphrodite and female plants in F_2 is almost 2:1. The ratio was in accordance with the previous report [4]. Flowering was postponed to 9th month after planting in Thadiyankudisai as against 6th month in Coimbatore condition. The delayed flowering might be due to the low temperature that prevailed during the growth stage.

Fruit set and development were delayed in sub tropical climate due to prevailing low temperature in the experimental area. Fruits attained harvestable maturity by 16th month from germination in the experimental area against 11th month in the tropics. Among the genotypes, G15, G 22 and G 27 produced fruits which are harvestable. Among them, G 27 recorded the maximum number of fruits by the end of the harvest. Among the three genotypes that reached the harvestable stage, G 27 had recorded the maximum fruit yield with fruit weighing more than 0.900 kg. The fruits of G 27 were found to be bigger in size with more length, circumference, fruit volume and cavity volume. Pulp thickness and TSS were found to be higher in the genotype G 27 followed by G 22. The genotype G 15 had low cavity index among the three and it is a desirable character.

Conclusion: The study revealed that among F_1 and F_2 progenies, F_1 expressed variability for morphological characters. F_1 hermaphrodite plants had lesser plant height, petiole length, leaf area, number of leaves per tree, fruit length, fruit circumference, fruit volume, fruit

weight, fruit number and yield. In F_2, wide variations were observed for morphological characters viz. plant height, plant stem girth, petiole length, leaf area and number of leaves.

The three genotypes *viz*., G 15, G 22 and G 27 produced fruits with attractive red flesh colour. Based on the morphological and qualitative characters, these genotypes may be forwarded further for evaluation and selection.

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