

# FIELD PERFORMANCE, CORRELATION AND PATH COEFFICIENT ANALYSIS IN PAPAYA

M. G. Rabbani and M. H. Jahan

Department of Horticulture  
Bangladesh Agricultural University  
Mymensingh, Bangladesh

## ABSTRACT

An experiment was carried out to investigate the field performance of seven papaya cultivars namely, BAUP-1, Mallika Dwarf, CV1, CV6, CV8, CV21 and CV25 with a check variety Shahi and also to study the correlation and path coefficient among the yield contributing characters at the Horticulture Farm, Bangladesh Agricultural University, during the period from May, 1994 to April, 1995. Data on different yield contributing characters and yield were recorded. Significant differences were observed among the papaya cultivars in different characters CV21 had the tallest plant, highest leaf number and maximum stem girth at harvest. CV1 had highest fruit number per plant but yield was comparatively lower due to small fruits. While CV8 had the lowest fruit number but had highest yield per plant. The fruit yield was significantly correlated with fruit width, skin weight. Path coefficient analysis revealed that the weight of edible portion, fruit width, skin weight, plant height and average fruit weight had direct positive effect on fruit yield of papaya. Considering the yield, taste and flesh colour of the ripe fruits, BAUP-1 and CV1 were better than the other cultivars.

**Additional Key Words:** *Carica papaya*, cultivars, fruits, growth

## INTRODUCTION

Papaya (*Carica papaya* L.) is one of the most important quick growing fruit of Bangladesh. It is used both as vegetable and as fruit. It is a nutritious table fruit of high digestive value rich in vitamins and minerals (Rashid *et al.*, 1987). It is also the source of proteolytic enzymes (papain and chymopapain) used for various purposes. Being a nutritious fruit papaya can play a vital role in overcoming the malnutrition problem faced by the people of Bangladesh. However, the average yield of papaya is very low (7.9 t/ha) compared to other countries. One of the reason for low yield of papaya in Bangladesh is the attack of different virus diseases particularly papaya mosaic virus (PMV). Monogenic resistance against PMV exists in related species such as *C. cauliflora*, *C. pubescence* and *C. stipulata*. However, all of these species are incompatible with papaya and embryos abort before differentiating into polyembryonic structures (Manshardt and Wenslaff, 1989). *In vitro* techniques of rescuing hybrid embryos and subsequent back crossing with recurrent parents may result in developing a variety resistant to papaya mosaic virus. But selection of recurrent parents is one of the most important factor to develop a good variety. The present research work has, therefore, carried out to study the field performance and genetics of papaya with the view to select suitable recurrent parents for interspecific hybridization with *C. cauliflora* to develop a papaya variety resistant to PMV.

## MATERIALS AND METHODS

The present experiment was conducted at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh during the period from May 1994 to April 1995. The soil of the experimental plot was medium high with adequate irrigation facilities. The soil was sandy loam in texture with pH 6.4. The land was prepared by several ploughings followed by ladderings to obtain a good tilth. Weeds and stubble were removed from the plot and the colds were pulverized into smaller pieces. The land was evenly levelled and was finally prepared through addition of the basal doses of manures and fertilizers. In addition, irrigation and drainage channels were prepared around the plots for the ease of irrigation and drainage. Eight cultivars of papaya namely, Shahi, BAUP-1, Mallika Dwarf, CV1, CV6, CV8, CV21 and CV25 were used in the present study. The experiment was laid out in randomized complete block design (RCBD) with five replications. The unit plot size was 2.0 m x 2.0 m. Manures and fertilizers were applied in the pits before transplanting and on standing crop as side dressing at the rate of 10 kg of well rotten cowdung, 200 g of urea, 250 g of triple superphosphate (TSP), 200 g muriate of potash (MP) and 100 g of gypsum per plant. Two-months old seedlings were transplanted in the main field on 24 June, 1994. Three seedlings were transplanted per pit to obtain the desired number of female plant. Intercultural operations such as weeding, irrigation and drainage were done as and when necessary. Data on morphological features, yield contributing characters and yield were collected and analyzed using MSTAT computer package programme and means were separated using Least Significant Difference (LSD) test.

## RESULTS AND DISCUSSION

Significant variations were observed among the varieties for almost all the growth parameters studied at flowering and at harvest (Table 1). The papaya cultivars, CV8 and CV21 also had the highest number of leaves (30.4 and 30.6, respectively). The number of leaves in a cultivar depends on the formation of new leaves. The node number of different cultivars increased with the increase in age. The plants of BAUP-1 had the highest number of nodes at first flowering although there was no significant difference among the cultivars in this respect, except CV8. However, at final harvest no significant difference was found among the cultivars in number of nodes per plant. Significant difference was also observed among the cultivars in stem girth at first flowering at final harvest. The plants of the cultivar BAUP-1 and CV8 were the tallest during first flowering. On the other hand, CV8 produced the shortest plants at first flowering while the plants of Mallika Dwarf and CV1 were found at final harvest of fruits. The results indicate that the elongating ability of stems of different cultivars of papaya was different at different growth stages which may be regulated by their genetic make up and also may be due to environmental conditions.

Among the eight papaya cultivars, CV8 was the early flowering type which required only 51.0 days for flowering after transplanting. On the other hand, CV6 and CV21 were the late flowering types requiring 69 and 70 days, respectively for first flowering after transplanting. The check variety Shahi took 65 days to flower after transplanting. This variation might be due to genetic make up of the plants and also due to environmental conditions. There was significant variation among the different cultivars in fruit characters at first and final harvest and also in number and yield of fruit per plant (Table 2). At final harvest, the longest fruit (20.3 cm) and maximum fruit width (17.2 cm) were produced by CV8. The check variety Shahi produced the second longest fruit (18.5 cm). The fruits of

Mallika Dwarf were the shortest one (13.0 cm). Saha *et al.* (1985) reported the fruit length of some indigenous papaya cultivars in the range of 11.6 cm to 28.4 cm. Fruit width of some papaya cultivars and their hybrids ranged from 11.3 to 15.2 cm (Shaha *et al.* 1975). The skin weight of papaya fruit was more or less proportional to the length of the fruit. The highest skin weight was found in CV8 (230 g) and the lowest skin weight was found in Mallika Dwarf (115 g). The maximum weight of edible portion of fruit was in CV8 which might be due to longest and maximum width of the fruit. The minimum weight of edible portion was in CV25 might be due to large inner empty spaces in the fruit. The plants of CV21 also required the longest time (258 days) for harvesting of the mature fruits. The cultivars CV6 required the shortest time (240 days) for harvesting (Table 3).

Table 1. Growth parameters of different papaya cultivars at flowering (F) and at harvest (H).

Cultivar	Leaf number at		Node number at		Stem girth (cm) at		Plant girth (cm) at	
	F	H	F	H	F	H	F	H
Shahi	16.4bc	26.2cd	25.8a	73.9	8.58c	29.9c	63.2c	157.3abc
BAUP-1	16.8bc	26.6c	28.0a	75.0	9.42b	28.8cd	70.8a	155.bc
Mallika Dwarf	15.8c	26.8c	26.2a	74.8	9.30b	30.2c	53.0d	138.2d
CV1	16.2bc	23.4de	28.0a	76.7	9.50b	27.6d	70.0ab	143.1d
CV6	17.4ab	22.0e	26.2a	72.0	9.70ab	35.2a	73.0a	160.abc
CV8	12.4b	30.4ab	21.1b	75.8	7.40d	36.0a	45.0e	162.9ab
CV21	16.8bc	30.6a	26.6a	75.8	9.80ab	36.9a	65.8bc	166.3a
CV25	18.8a	27.4bc	26.0a	73.9	10.3a	32.5b	63.8c	153.4c

In a column, figure (s) having common letter(s) do not differ significantly at 5% level of probability.

Table 2. Average fruit characters of eight papaya cultivars at first (1) and at final (2) harvest.

Cultivar and growth stage	Fruit length (cm)		Fruit width (cm)		Wt. of skin/ fruit (g)		Wt. of edible portion/ fruit (g)		Wt. of seed/ fruit (g)	
	1	2	1	2	1	2	1	2	1	2
Shahi	20.1a	18.5b	14.5b	13.0bc	189c	179c	895b	826bc	61c	54c
BAUP-1	17.2bc	14.7cd	13.4bc	12.0d	205b	193b	1125b	1011b	94a	82a
Mallika Dwarf	15.8de	13.0e	14.2b	12.1d	137e	115e	882c	796cd	44e	36d
CV1	15.2e	14.0de	13.1cd	12.5cd	126e	119e	862c	845c	45e	36d
CV6	16.4cde	14.8cd	12.6d	11.7d	159d	133d	833cd	791cd	52d	50c
CV8	21.4a	20.3a	18.1a	17.2a	244a	230a	1801a	1705a	80b	75b
CV21	17.5bc	15.8c	14.7b	13.1bc	189c	167c	875c	826c	57cd	52c
CV25	18.3b	17.4b	14.3b	13.4b	126e	120e	764b	740b	44e	40d

In a column, figure (s) having common letter(s) do not differ significantly at 5% level of probability.

Table 3. Flowering and fruiting of eight papaya cultivars.

	Days from transplantation to first flowering	Weight of fruit (g)	Days required from planting to first harvest	Fruit No./ plantating to first harvest	Yield per plant (kg)
Shahi	65.0b	1059bc	245bcd	12.0d	12.7e
BAUP-1	55.0d	1286b	241d	14.2b	18.2b
Mallika Dwarf	61.0c	947c	244bcd	12.5cd	11.8e
CV1	62.0bc	1000c	240d	15.5a	15.5c
CV6	69.0a	967c	251ab	12.3	11.9e

CV8	51.0e	2010a	241cd	10.5e	21.1a
CV21	70.0a	1045bc	258a	13.5bc	14.1d
CV25	59.0c	900c	249abc	10.5e	9.4f

In a column, figure(s) having common letter(s) do not differ significantly at 5% level of probability.

Table 4. Correlation matrix among different yield contributing characters and yield of papaya.

Parameter	Plant height	Leaf number	Node number	Stem girth	Fruit length	Fruit width	Fruit Skin portion	Wt.of edible	Seed weight	Fruit weight	Fruit number	Days at first flowering	Days from planting to harvest
Plant height	-												
Leaf number	0.412	-											
Node number	0.292	0.525	-										
Stem girth	0.761*	0.488	-0.101	-									
Fruit length	0.597	0.599	0.177	0.420	-								
Fruit width	0.392	0.491	0.145	0.521	0.829**	-							
Skin weight	0.381	0.561	-0.004	0.441	0.737*	0.684*	-						
Wt. of edible portion	0.346	0.511	0.232	0.059	0.665*	0.832**	0.716*	-					
Seed weight	0.448	0.345	0.059	0.060	0.478	0.369	0.650*	0.681*	-				
Fruit weight	0.398	0.519	-0.114	0.360	0.685*	0.861**	0.851**	0.996**	0.736*	-			
Fruit number	-0.426	-0.379	0.652*	-0.536	-0.727*	-0.568	-0.353	-0.330	-0.114	-0.332	-		
Days to first flowering	0.403	0.732*	0.667	0.445	0.216	0.502	0.341	0.363	0.187	0.357	0.141	-	
Days from transplanting to harvest	0.268	-0.157	0.174	0.315	-0.390	-0.339	-0.312	-0.457	-0.491	0.463	0.434	0.381	-
Yield /plant	0.227	0.358	0.414	0.113	0.386	0.656	0.712*	0.870**	0.788**	0.883**	0.138	0.450	0.271

\* = significant at 5% level ; \*\* = significant at 1% level.

The plants of papaya cultivar, CV8 produced the largest and heaviest fruit compared to those produced in other cultivars and hence the yield was highest in this cultivars although it had the lowest number of fruits per plant. The plants of the cultivars, CV8 and CV25 had the lowest number of fruit per plant. The number of fruits in different cultivars may very widely depending on the genotypes (Bajwa and Jwanda, 1962; Saha *et al.*, 1985; Wagh *et al.*, 1992). The yield of papaya is mainly dependent on the weight of individual fruit rather than fruit number per plant as reported by Saha *et al.* (1985). Ito *et al.* (1977) also reported 37.5 and 21.6 kg being the highest and lowest per plant yield in Sunrise Solo and Local-A cultivars, respectively in Ghana. The yield potential of eight papaya cultivars in this study was not comparable to the yield potential of the papaya cultivars as reported by those authors. Saha *et al.* (1985) reported 21.5 kg and 11.6 kg as the highest and lowest per plant yield in Rajshahi cultivars and Barishal lines, respectively at Rajshahi. Wagh *et al.* (1992) noted that Pusa Delicious had produced the highest yield (44.8 kg/plant) and Solo and Sunrise gave the lowest yield (15.9 kg/plant). Biswas *et al.* (1981) reported that the cultivar Ranchi yielded 40-55 fruits depending on the season, each weighing 1.2 to 3.4 kg in West Bengal. Sulladamath *et al.* (1981) recorded an average yield per plant of 25.76 kg in cultivar Solo.

The fruit yield of papaya cultivars was significantly correlated with fruit width, skin weight, weight of edible portion, seed weight and average fruit weight (Table 4). On the

other hand, plant height, leaf number, node number and stem girth at maturity and days to first flowering had no significant correlation with yield per plant. Path coefficient analysis revealed that plant height, fruit width, skin weight, weight of edible portion and average fruit weight had direct positive effect on the yield of papaya (Table 5) while the seed weight, fruit length, stem girth, node number, fruit number and leaf number had direct negative effect. Allan (1969) found close correlation of fruit weight with weight of seeds per fruit. Khadi and Singh (1981) found positive correlation of fruit yield with fruit volume, average fruit weight and seed weight of papaya. In another study, Khadi and Singh (1980) found number of fruits per plant and average fruit weight had positive direct effect on yield per plant.

Table 6. Flesh colour, taste, shape, size and demand of fruits of eight papaya cultivars.

Cultivars	Flesh colour	Taste	Shape	Size	Demand
Shahi	Pale yellow	Less tasty	Medium long	Medium	Less
BAUP-1	Red	Sweet	Round	Medium	High
Mallika Dwarf	Yellow	Moderately sweet	Round	Medium	High
CV1	Yellow	Moderately sweet	Round	Medium	Moderate
CV6	Pale yellow	Less tasty	Medium long	Medium	Less
CV8	Yellow	Less tasty	Long	Big	Moderate
CV21	Yellow	Less tasty	Medium	Medium	Less
CV25	Yellow	Sweet	Long	Medium	High

A high demand was noticed for the fruits of BAUP-1, Mallika Dwarf and CV25 for their attractive flesh colour and taste vis-a-vis sweetness (Table 6). There was moderate demand for the fruits of CV1. The cultivar Shahi, CV6, CV8 and CV21 were good fruit yielders; however, the quality of fruits and sweetness were not good. The fruit yield of CV8 was almost double compared to other cultivars, but it could not be recommended as table fruit and may be used as vegetable. BAUP-1 appeared to be a promising cultivar when used as table fruit and may be recommended for cultivation as well as for interspecific hybridization with *C. cauliflora*. Next to that Mallika Dwarf and CV25 can also be used for the above purposes. However, further study may be needed in this respect before making any valid recommendation.

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Table 5. Direct and indirect effects of different yield contributing characters on yield of papaya (path coefficient analysis).

Parameter	Indirect effects through													Correlation with yield
	Plant height	Leaf number	Node number	Stem girth	Fruit length	Fruit width	Skin weight	Wt. of edible	Seed wt.	Av. fruit weight portion	Fruit No.	Days to 1st flowering	Days from transplanting to harvest	
Plant height	<u>0.301</u>	0.001	-0.197	-0.386	-0.247	-0.073	0.375	0.465	-0.289	0.095	0.102	-0.012	0.092	0.227
Leaf number	0.087	<u>-0.067</u>	-0.046	0.004	0.063	0.023	-0.023	0.200	0.033	-0.056	0.158	-0.029	0.011	0.358
Node number	0.202	0.064	<u>-0.261</u>	-0.007	0.155	-0.505	-0.323	0.501	0.275	-0.325	-0.179	-0.011	0.114	0.414
Stem girth	0.229	-0.043	0.001	<u>-0.284</u>	-0.292	0.290	-0.143	0.563	0.205	-0.152	-0.266	-0.011	0.016	0.113
Fruit length	0.390	0.002	-0.112	-0.299	<u>-0.367</u>	-0.125	0.327	0.532	-0.194	0.071	0.174	-0.004	0.005	0.386
Fruit width	0.355	0.031	-0.002	-0.135	-0.484	<u>0.608</u>	-0.331	0.712	0.499	0.397	0.182	0.021	0.003	0.656*
Skin weight	0.468	0.002	-0.157	-0.261	-0.267	-0.103	<u>0.465</u>	0.478	-0.343	0.090	0.330	-0.007	-0.017	0.712*
Wt. of edible portion	0.273	0.008	-0.071	-0.176	-0.250	-0.118	0.389	<u>0.893</u>	-0.271	0.103	0.112	-0.006	-0.010	0.870**
Seed weight	0.240	0.003	-0.173	-0.237	-0.188	-0.071	0.421	0.463	<u>-0.379</u>	0.379	0.331	0.106	0.017	0.788**
Av. fruit weight	0.406	0.002	-0.087	-0.194	-0.253	-0.117	0.407	0.720	-0.291	<u>0.203</u>	0.118	-0.001	-0.030	0.883**
Fruit number	0.329	-0.002	0.001	-0.304	0.290	-0.292	-0.143	0.573	0.302	-0.266	<u>-0.195</u>	0.152	0.015	0.138
Days to 1st flowering	0.202	0.004	0.048	-0.141	-0.098	-0.069	0.170	0.161	0.088	0.220	0.034	<u>-0.002</u>	0.009	0.450
Days from transplanting to harvest	0.121	-0.024	-0.045	-0.073	-0.143	-0.117	-0.268	0.430	0.120	-0.187	-0.035	0.003	<u>-0.043</u>	-0.271

Residual effect = 0.0356, Underlined figure denotes the direct effect.