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Research Article

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Effect of Gamma Radiation for Enhancing Qualitative and Quantitative Traits in Papaya (*Carica papaya* L.) Cv. Arka Prabhath in M_2 Generation through TILLING

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ABSTRACT

This experiment was carried out using the gynodioecious cultivar like Arka Prabhath. It is an advanced generation hybrid derivative from the cross of (Arka Surya x Tainung-1) x Local Dwarf has released from ICAR- IIHR.. It is gynodioecious in nature, with large sized fruits of 900-1200 g and smooth skin. The pulp is an attractive deep pink colour with good keeping quality and high TSS (13-14˚B). The seeds of this hybrid were treated with various doses (0 Gy, 50 Gy, 100 Gy, 250 Gy, 500 Gy and 750 Gy) of Gamma radiation to study the treatment impact on qualitative and quantitative traits viz., days to flowering, sex type, and height to first flowering, trunk circumference, canopy spread, shelf life and yield. M_1 populations of papaya were selected and forwarded to M_2 and assigned into families (A to Y). The X family (153 days) and D family (152.6 days) takes longer days to first flowering where as J family (146 days) and K family (146.4 days) takes shorter days to first flower. Significantly superior trunk circumference (33.90 cm) was observed in the A family and M family (32.80 cm). The highest canopy spread (E-W) was observed in C family (143.33 cm) and G family (140.50 cm). The highest yield was observed in G family (57.90 kg/pt) and M family (36.40 kg/pt) whereas lowest yield records in J family (15.90 kg/pt) and P family (16.78 kg/pt).

Key words: *Gamma irradiation, TILLING, Carica Papaya*

INTRODUCTION

Papaya, (2n=2x=18, Carica papaya L.) is basically a tropical fruit crop and believed to have originated from Mexico to Panama[1]. Most of the papaya growing regions are between 30˚N to the 45˚S latitude of the equator. It is being grown successfully in sub-tropical conditions too.

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It requires warmth throught the year and temperature below 12 to 14^{o}C strongly retards fruit maturation and adversely affect fruit production. As ambient temperature range between 21 to 33^{o}C is ideal[1]. Papaya plants are sensitive to waterlogging[2], hence well-drained soils are essential.

It is a dicotyledonous, polygamous species with three basic sex forms as male (staminate), female (pistillate) and hermaphrodite forms of inflorescence. It is a diploid species with a small genome of 372 Mbp/1C[3] and nine pairs of chromosomes. It is a small, arborescent, fast-growing, dicotyledonous plant with a single, straight, cylindrical, hollow, spongy, fibrous stem and contains prominent leaf scars. In recent times many biotechnological tools have been applied to improve fruit productivity, quality, and other traits. However resistance to transgenic technology, particularly in Europe has pushed non transgenic method like TILLING (Targeting Induced Local Lesion In Genomics) a powerful reverse genetic strategy that allows the detection of induced point mutations in individuals of the mutagenized populations, can address the major challenge of linking sequence information to the biological function of genes and can also identify novel variation for crop breeding and improving quality of the crop species.

Mutation breeding[4] is one of the approaches to create variability through novel recombinations using both chemical and physical mutagens. Hence, the same approach can be used for developing gynodioecious types, as there may be a chance of getting a dwarf mutant with tolerance or resistance for PRSV, good yield, quality and shelf life[5].

MATERIAL AND METHODS

The present investigation "Effect of Gamma radiation for enhancing qualitative and quantitative traits in papaya (*Carica papaya*.L) Cv. Arka Prabhath in M_2 generation through TILLING" was carried out at the ICAR-Indian Institute of Horticultural Research (ICAR-IIHR) station, Bengaluru during 2017-2019. The field and laboratory experiments were carried out at the ICAR- Indian Institute of Horticultural Research, Hessaraghatta lake post. The soil is red sandy loam with a pH 5.2-6.4. The climate of Hessaraghatta is moderately warm with mild summer months. The maximum mean temperature ranges from 30.6ºC to 30.7ºC with a mean of 30.65ºC while, the minimum mean temperature ranges from 15.3ºC to 15.5ºC with a mean of 15.4ºC. The mean relative humidity, mean wind speed and total rainfall were 59.41 per cent, 4.38 km/hr and 478.70 mm respectively.

This experiment was carried out using the gynodioecious cultivar like Arka Prabhath. It is an advanced generation hybrid derivative from the cross of (Arka Surya x Tainung-1) x Local Dwarf has released from ICAR- Indian Institute of Horticultural Research. It is gynodioecious in nature, with large sized fruits of 900-1200 g and smooth skin. The pulp is an attractive deep pink colour with good keeping quality and high TSS (13-14˚B). Plant material was collected from the Division of Fruit crops, Indian Institute of Horticultural Research, Bengaluru-560089. The seeds of this hybrid were treated with various doses (0 Gy, 50 Gy, 100 Gy, 250 Gy, 500 Gy and 750 Gy) of Gamma radiation to study the treatment impact on qualitative and quantitative traits. M_1 populations of papaya were selected and forwarded to M_2 based on particularly outstanding in vigor with medium dwarf stature, African type, Arka Prabhath type, highly terratogenic type, Orange red group mutants were selected and assigned into families. (A to Y). The seedlings were planted 45 days after sowing in RCBD design and the following quantitative and qualitative traits like plant height at Fruiting, trunk circumference, Canopy spread (E-W), canopy spread (N-S), number of leaf at first flowering, number of nodes to first flowering, height to first flowering, yield (Kg/plant) and shelf life of fruits were studied.

RESULTS AND DISCUSSION

The results of experiments on "Effect of Gamma radiation for enhancing qualitative and quantitative traits in papaya (*Carica*

papaya.L) Cv. Arka Prabhath in M_2 generation through TILLING'' carried out during 2017-2019 at the Division of Biotechnology, ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru.Mutagenic work on papaya was carried out using gamma facility provided by Institute are presented here.

M_1 populations of papaya were selected and forwarded to M_2 based on particularly outstanding in vigor with medium dwarf stature, bearing the first flower at a height of 50-60 cm from the ground and improved fruit quality when compared to control, African type mutants, Arka Prabhath type, highly terratogenic type, Orange red group mutants were selected and assigned into (A to Y) families[4].

Table 1: Representing mutant lines assigned in to different families

SL.NO	Mutant line	No. of plants (N)	Families
1	R1P20	22	A Family
2	R2P8	5	B Family
3	R2P18	3	C Family
4	R2P20	5	D Family
5	R2P24	13	E Family
6	R3P6	2	F Family
7	R3P13	2	G Family
8	R3P14	2	H Family
9	R3P25	14	I Family
10	R5P7	2	J Family
11	R5P8	5	K Family
12	R5P24	13	L Family
13	R5P25	9	M Family
14	R5P31	1	N Family
15	R6P11	19	O Family
16	R6P14	23	P Family
17	R6P19	20	Q Family
18	R6P20	21	R Family
19	R7P6	25	S Family
20	R7P7	24	T Family
21	R7P8	17	U Family
22	R7P18	5	V Family
23	R7P25	21	W Family
24	R7P26	24	X Family
25	R14P7	3	Y Family

Morphological parameters

The results pertaining to morphological parameters such as days to first flowering, height to first flowering, plant height, trunk circumference, canopy spread (E-W and N-S), number of leaves, number of nodes to first flowering, recorded during first flowering among the M_2 progenies of Arka Prabhath are presented in (Table 2).

Number of days to first flowering

The data on number of days to first flowering revealed significant difference between the families and ranged from 146 to153days. The X family(153 days) and D family (152.6 days) takes longer days to first flowering where as J family (146 days) and K family (146.4days) takes shorter days to first flower, however K family is highly significant than other families. Early flowering is good indication for varietal improvement and quality enhancement in papaya. The higher error of variance observed in V, B and C families, whereas lesser error of variance observed (Table 2) in K family[6].

Trunk circumference (cm)

Data on trunk circumference among different families revealed significant differences, which varied from 26.0 to 33.90 cm (Table 3). Significantly superior trunk circumference (33.90) was observed in the A family and M family (32.80) whereas K family shows lowest (26.60) trunk circumference. However error of variance was highest in H and M family and lowest was recorded in O, P, W, and Y family. Higher trunk circumference plants can bear and withstand higher number of fruits in papaya.

Canopy spread (E-W) (cm)

The data on canopy spread in east to west direction recorded among the progenies revealed a significant difference which was in the range of 114.00 to 143.33 cm (Table 4). The highest canopy spread (E-W) was observed in C family (143.33) and G family (140.50). The J family shows lowest canopy spread (114.00). The X, F and S families revealed highest significant variation in the field condition. However, U and W family shows highest error of variance whereas X and R family shows lowest error of variance. High canopy spread enhances good yield and quality of the fruits.

Canopy spread (N-S) (cm)

The data on canopy spread in east to west direction recorded among the progenies revealed a significant difference which was in the range of 116.37 to 142.66 cm (Table 5). The highest canopy spread (N-S) was observed in C family (142.66) and K family (141.80). The S family shows lowest canopy spread (116.37). The A, E and Q families revealed highest significant variation in the field condition. However J and C family shows highest error of variance whereas X and E family showed lowest error of variance. High canopy spread enhances good yield and quality of the fruits. The reason behind this might be due to both gamma and EMS are strong mutagens that can act on chromosome resulting in chromosomal aberrations which might have exhibited higher canopy spread than normal canopy[7].

Number of leaves at first flowering

The data on number of leaves at first flowering presented revealed significant difference among the families. It ranged from 14 to 19.00 between families. The highest number of leaves was observed in G family (19.00) and C family (18.00). The J family shows lowest number of leaves (14.00). The X, A, C, I, P, S and W families revealed highest significant variation in the field condition. However H and J family shows highest error of variance whereas J and Q family (Table 6) shows lowest error of variance.

Number of nodes to first flowering

The data on number of nodes to first flowering presented, revealed significant difference among different families and it was ranged from 13.20 to 15.33 between families. The highest no of nodes to first flowering was observed in C family (15.33) and P family (15.08) (Table 7). The lowest nodes were noticed in K family (13.20). However highest significant of variation arrived in A, B and K family. Significantly more error of variance observed in H and J family whereas lowest error of variance was observed in S and A family. Highest no of nodes to flowering is good sign for more yields[8].

Yield per tree (kg)

The data on fruit yield showed significant difference among families, which ranged from 15.90 to 57.90 kg/tree (Table 8). The highest yield was observed in G family (57.90) and M family (36.40) whereas lowest yield records in J family (15.90) and P family (16.78). However significant of variation at field level was highest in B, D, E, L and T families. The highest error of variance was observed in G, C and Y families among different M_2 families and lowest error of variance in terms of yield was observed in X, S and Q families[9].

Shelf life (Days)

The data on fruit shelf life showed significant difference among families are ranged from 4.75 to 6.00 days (Table 9). The highest shelf life[10] was observed in C family (6.00) and G family (5.75) whereas lowest shelf life records in J family (4.75) and P family (4.90). The highest error of variance was observed in K

and Y families among different M_2 families and lowest error of variance in terms of shelf life was observed in S and Q families[9].

Table 2: Effect of gamma radiation on days to first flowering in M2 Families of Papaya

Days @ 1st flowering	N	Mean	Std. Deviation	t-test	Sig (2 tailed)
X FAMILY	24	**153.0000	6.46058	2.275	**.033
A FAMILY	22	152.4545	7.93862	1.450	.162
B FAMILY	5	145.6000	5.54977	-1.773	.151
C FAMILY	3	147.6667	4.61880	-.875	.474
D FAMILY	5	**152.6000	4.33590	1.341	.251
E FAMILY	13	151.7692	5.01919	1.271	.228
F FAMILY	13	152.3077	4.60769	1.806	.096
G FAMILY	2	**152.5000	.70711	5.000	.126
H FAMILY	2	147.5000	.70711	-5.000	.126
I FAMILY	14	150.2857	5.16540	.207	.839
J FAMILY	2	**146.0000	1.41421	-4.000	.156
K FAMILY	5	**146.4000	1.14018	-7.060	**.002
L FAMILY	13	148.4615	4.70134	-1.180	.261
M FAMILY	10	149.8000	4.73286	-.134	.897
O FAMILY	19	148.6316	5.26213	-1.134	.272
P FAMILY	23	149.5652	3.67827	-.567	.577
Q FAMILY	24	148.0000	5.68751	-1.723	.098
R FAMILY	21	149.7619	6.44907	-.169	.867
S FAMILY	24	147.9167	5.11534	-1.995	.058
T FAMILY	24	147.6667	3.74940	-3.049	**.006
U FAMILY	17	150.8824	4.76815	.763	.457
V FAMILY	5	148.2000	6.76018	-.595	.584
W FAMILY	21	148.0000	3.61939	-2.532	**.020
Y FAMILY	3	150.3333	1.52753	.378	.742

Table 3: Effect of gamma radiation on trunk circumference in M2 Families of Papaya

Trunk circumference	N	Mean	Std.Deviation	t-test	Sig(2 tailed)
X FAMILY	24	26.5417	5.56370	-1.284	.212
A FAMILY	22	**33.9091	5.98338	4.632	.000
B FAMILY	5	31.4000	4.82701	1.575	.190
C FAMILY	3	27.0000	2.64575	-.655	.580
D FAMILY	5	29.2000	3.49285	.768	.485
E FAMILY	13	30.5385	4.21536	2.171	**.051
F FAMILY	13	26.9231	4.29072	-.905	.383
G FAMILY	2	28.0000	2.82843	0.000	1.000
H FAMILY	2	32.5000	7.77817	.818	.563
I FAMILY	14	30.5000	2.56455	3.647	**.003
J FAMILY	2	29.0000	1.41421	1.000	.500
K FAMILY	5	26.6000	5.63915	-.555	.608
L FAMILY	13	31.3077	2.89783	4.116	**.001
M FAMILY	10	**32.8000	5.53373	2.743	**.023

O FAMILY	19	31.0000	1.91485	6.829	.000
P FAMILY	23	31.0000	2.08893	6.887	.000
Q FAMILY	24	31.7500	4.54207	4.045	**.001
R FAMILY	21	29.4286	2.39940	2.728	**.013
S FAMILY	24	**32.6667	2.37133	9.641	.000
T FAMILY	24	29.6667	2.83866	2.876	**.009
U FAMILY	17	29.0000	2.66927	1.545	.142
V FAMILY	5	30.0000	2.34521	1.907	.129
W FAMILY	21	29.3810	1.96153	3.226	**.004
Y FAMILY	3	30.6667	.57735	8.000	.015

Table 4: Effect of gamma radiation on canopy spread (E-W) in M2 Families of Papaya

Canopy spread	N	Mean	Std.Deviation	t-test	Sig(2 tailed)
X FAMILY	24	131.5833	5.07266	3.461	**.002
A FAMILY	22	129.2273	10.31842	.558	.583
B FAMILY	5	133.8000	11.16692	1.161	.310
C FAMILY	3	**143.3333	6.65833	3.989	.057
D FAMILY	5	136.2000	7.39594	2.479	.068
E FAMILY	13	125.6923	10.58603	-.786	.447
F FAMILY	13	**139.0769	16.43909	2.429	**.032
G FAMILY	2	**140.5000	9.19239	1.923	.305
H FAMILY	2	134.5000	10.60660	.867	.545
I FAMILY	14	134.5714	15.36086	1.601	.133
J FAMILY	2	114.0000	9.89949	-2.000	.295
K FAMILY	5	134.2000	9.95992	1.392	.236
L FAMILY	13	130.8462	8.75449	1.172	.264
M FAMILY	10	134.4000	13.02306	1.554	.155
O FAMILY	19	131.0000	15.50269	.844	.410
P FAMILY	23	128.8261	15.94209	.249	.806
Q FAMILY	24	124.2917	17.60800	-1.032	.313
R FAMILY	21	130.9048	14.25098	.934	.361
S FAMILY	24	120.1250	10.76755	-3.583	**.002
T FAMILY	24	126.3750	17.47996	-.455	.653
U FAMILY	17	138.0588	14.86384	2.790	**.013
V FAMILY	5	136.6000	14.29336	1.345	.250
W FAMILY	21	137.7619	14.76450	3.030	**.007
Y FAMILY	3	133.0000	14.73092	.588	.616

Table 5: Effect of gamma radiation on Canopy spread (N-S) in M2 Families of Papaya

Canopy spread	N	Mean	Std.Deviation	t-test	Sig(2 tailed)
X FAMILY	24	130.0833	4.93362	.083	.935
A FAMILY	22	124.0455	10.22824	-2.731	**.013
B FAMILY	5	127.4000	10.11435	-.575	.596
C FAMILY	3	**142.6667	12.42310	1.766	.219
D FAMILY	5	135.4000	13.01153	.928	.406
E FAMILY	13	124.6154	6.78894	-2.860	**.014
F FAMILY	13	**146.2308	10.86396	5.387	.000
G FAMILY	2	136.0000	4.24264	2.000	.295
H FAMILY	2	121.5000	9.19239	-1.308	.416
I FAMILY	14	136.5000	11.42703	2.128	*.053
J FAMILY	2	110.5000	14.84924	-1.857	.314
K FAMILY	5	**141.8000	14.46375	1.824	.142
L FAMILY	13	127.1538	9.01708	-1.138	.277
M FAMILY	10	134.7000	8.40701	1.768	.111
O FAMILY	19	125.4211	13.10350	-1.523	.145
P FAMILY	23	128.3913	14.65277	-.527	.604
Q FAMILY	24	119.5417	13.71758	-3.735	**.001
R FAMILY	21	127.1429	17.57636	-.745	.465
S FAMILY	24	116.3750	13.59608	-4.909	.000
T FAMILY	24	125.6250	19.69951	-1.088	.288
U FAMILY	17	133.3529	18.52681	.746	.466
V FAMILY	5	126.4000	16.47119	-.489	.651
W FAMILY	21	136.4286	19.98392	1.474	.156
Y FAMILY	3	135.0000	7.00000	1.237	.342

Table 6: Effect of gamma radiation on No of leaves @ first flowering in M2 Families of Papaya

No. of leaves @ 1st flowering	N	Mean	Std. Deviation	t-test	Sig(2 tailed)
X FAMILY	24	15.5417	2.43130	3.106	**.005
A FAMILY	22	14.9091	1.47710	2.887	**.009
B FAMILY	5	15.2000	1.30384	2.058	.109
C FAMILY	3	**18.0000	1.00000	6.928	**.020
D FAMILY	5	17.0000	2.23607	3.000	**.040
E FAMILY	13	14.5385	1.56074	1.244	.237
F FAMILY	13	17.2308	2.08782	5.579	.000
G FAMILY	2	**19.0000	1.41421	5.000	.126
H FAMILY	2	17.0000	2.82843	1.500	.374
I FAMILY	14	16.5714	2.17377	4.426	**.001
J FAMILY	2	14.0000	.00000[a]	2.236	.089
K FAMILY	5	16.0000	2.00000	3.102	**.009
L FAMILY	13	15.3846	1.60927	3.096	**.013
M FAMILY	10	15.4000	1.42984	1.690	.108
O FAMILY	19	15.1579	2.98632	2.011	.057
P FAMILY	23	15.0870	2.59217	2.752	**.011
Q FAMILY	24	14.9583	1.70623	6.220	.000
R FAMILY	21	**17.2381	2.38547	1.446	.162
S FAMILY	24	14.5833	1.97631	3.864	**.001
T FAMILY	24	16.3333	2.95865	5.335	.000
U FAMILY	17	16.7647	2.13686	1.633	.178
V FAMILY	5	16.0000	2.73861	5.567	.000
W FAMILY	21	17.2857	2.70449	5.196	**.035
Y FAMILY	3	17.0000	1.00000	4.123	0.109

Table 7: Effect of gamma radiation on No. of nodes @ first flowering in M2 Families of Papaya

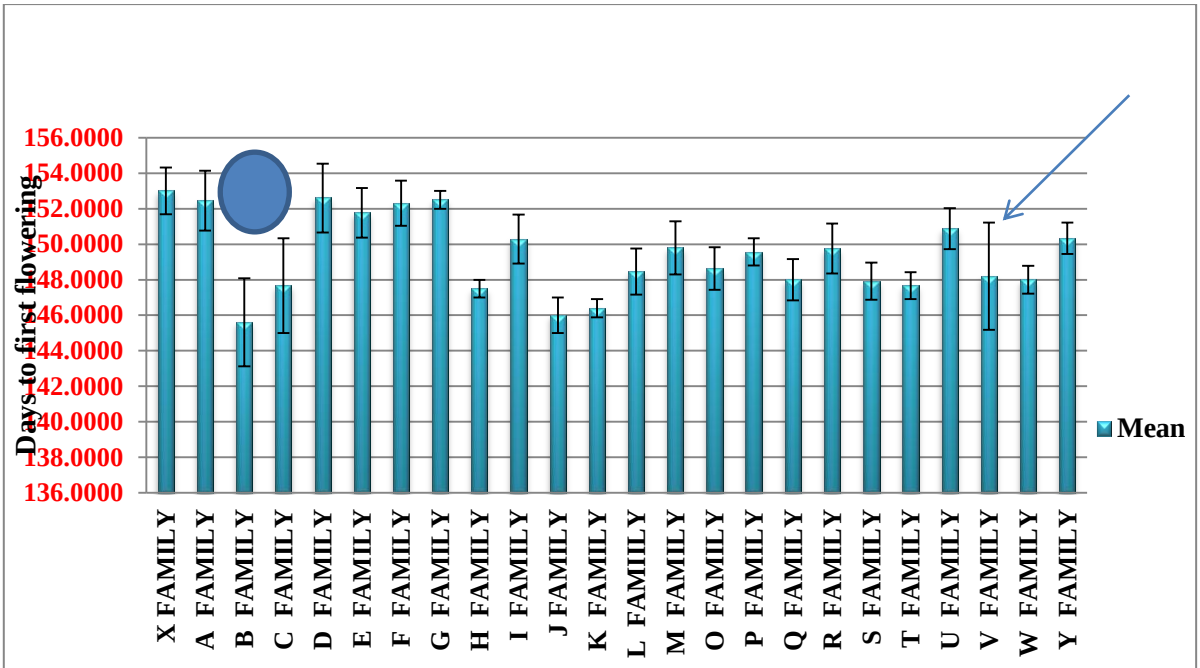
No. of nodes @1st flowering	N	Mean	Std.Deviation	t-test	Sig (2tailed)
X FAMILY	24	14.4167	2.48328	-1.151	.262
A FAMILY	22	14.0000	1.69031	-2.775	**.011
B FAMILY	5	13.4000	1.14018	-3.138	**.035
C FAMILY	3	**15.3333	.57735	1.000	.423
D FAMILY	5	14.4000	2.30217	-.583	.591
E FAMILY	13	13.8462	2.11527	-1.967	.073
F FAMILY	13	14.6923	2.05688	-.539	.600
G FAMILY	2	15.5000	.70711	1.000	.500
H FAMILY	2	14.5000	4.94975	-.143	.910
I FAMILY	14	15.0000	2.03810	0.000	1.000
J FAMILY	2	13.5000	2.12132	-1.000	.500
K FAMILY	5	13.2000	1.48324	-2.714	.053
L FAMILY	13	14.4615	1.85362	-1.047	.316
M FAMILY	10	14.4000	2.41293	-.786	.452
O FAMILY	19	14.4737	2.22032	-1.033	.315
P FAMILY	23	**15.0870	2.85901	.146	.885
Q FAMILY	24	14.5000	2.32192	-1.055	.302
R FAMILY	21	14.9048	2.02249	-.216	.831
S FAMILY	24	14.4583	1.91059	-1.389	.178
T FAMILY	24	**15.0000	2.26505	0.000	1.000
U FAMILY	17	14.6471	2.73727	-.532	.602
V FAMILY	5	14.6000	2.30217	-.389	.717
W FAMILY	21	14.4286	2.52134	-1.039	.311
Y FAMILY	3	**15.0000	1.00000	0.000	1.000

Table 8: Effect of gamma radiation on plant yield in M2 Families of Papaya

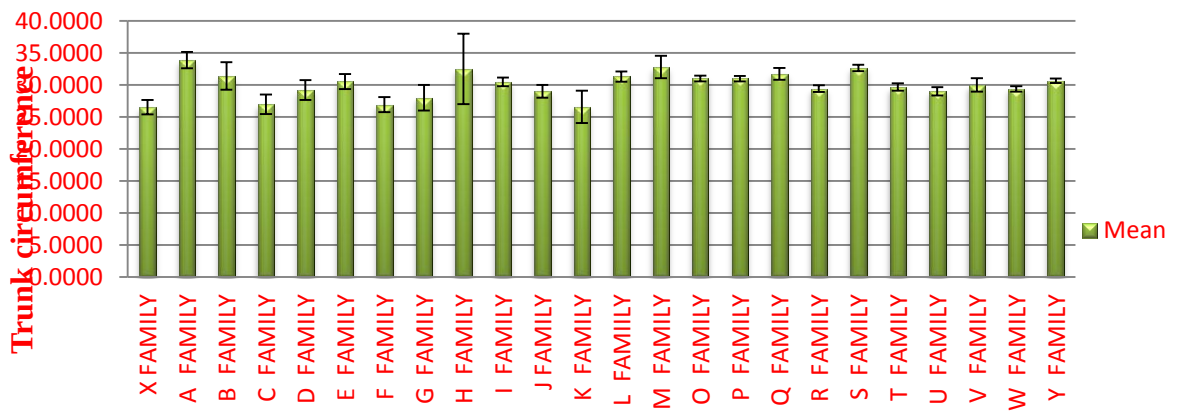
Yield	N	Mean	Std.Deviation	t-test	Sig(2 tailed)
X FAMILY	24	22.3938	4.74127	-13.026	.000
A FAMILY	22	24.6259	6.96693	-6.984	.000
B FAMILY	5	23.9800	4.29034	-5.743	**.005
C FAMILY	3	30.6533	12.97014	-.580	.620
D FAMILY	5	23.1400	8.38439	-3.163	**.034
E FAMILY	13	26.7769	6.89201	-4.302	**.001
F FAMILY	13	31.6846	9.80976	-1.219	.246
G FAMILY	2	**57.9000	13.15219	2.462	.246
H FAMILY	2	31.8250	5.19723	-.864	.546
I FAMILY	14	30.4393	9.70852	-1.758	.102
J FAMILY	2	15.9000	4.80833	-5.618	.112
K FAMILY	5	25.1600	18.99126	-1.159	.311
L FAMILY	13	24.3192	14.17503	-2.717	**.019
M FAMILY	10	**36.4600	11.62929	.397	.701
O FAMILY	19	31.2421	9.86944	-1.660	.114
P FAMILY	23	31.8348	9.95703	-1.525	.142
Q FAMILY	24	16.7875	5.71819	-15.603	.000
R FAMILY	21	**33.9429	11.74366	-.413	.684
S FAMILY	24	22.6854	6.62754	-9.103	.000
T FAMILY	24	29.8396	11.00858	-2.296	**.031
U FAMILY	17	33.0529	10.87986	-.738	.471
V FAMILY	5	29.3800	6.10795	-2.057	.109
W FAMILY	21	25.2714	8.28668	-5.380	.000
Y FAMILY	3	32.0667	16.70489	-.304	.790

Table 9: Effect of gamma radiation on Shelf life in M2 Families of Papaya

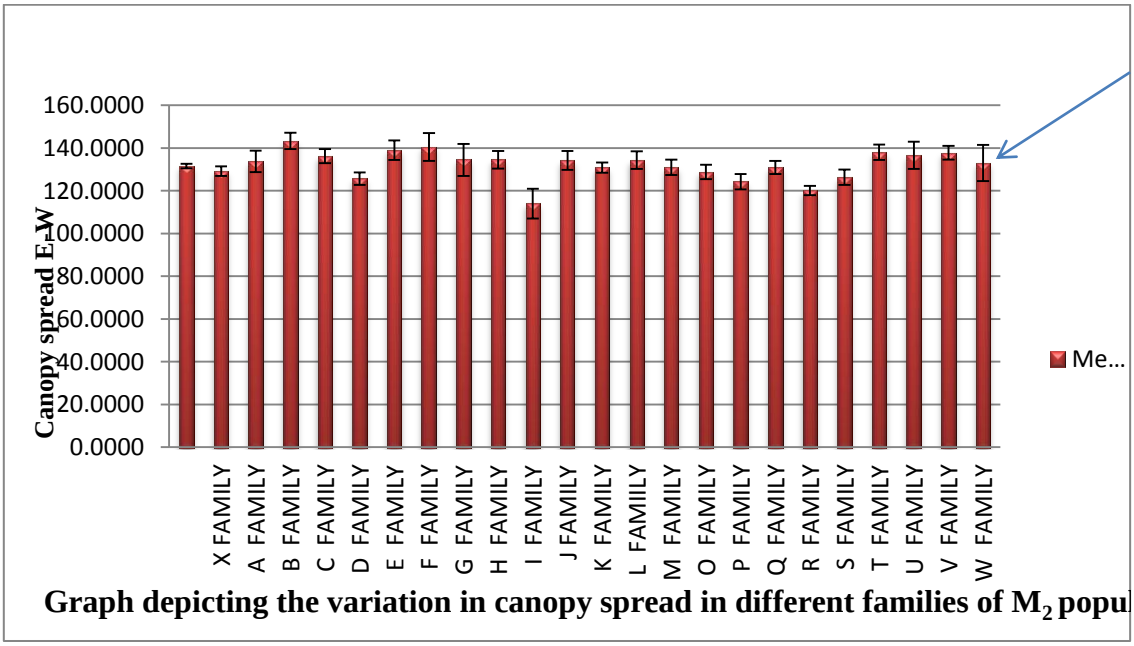
Shelf life	N	Mean	Std.Deviation	t-test	Sig (2 tailed)
X FAMILY	24	5.4292	.48047	4.376	.000
A FAMILY	22	5.2727	.55048	2.324	**.030
B FAMILY	5	5.5000	.50000	2.236	.089
C FAMILY	3	**6.0000	.50000	3.464	.074
D FAMILY	5	5.3500	.41833	1.871	.135
E FAMILY	13	5.4231	.53409	2.856	**.014
F FAMILY	13	5.2731	.61122	1.611	.133
G FAMILY	2	**5.7500	.35355	3.000	.205
H FAMILY	2	5.1250	.17678	1.000	.500
I FAMILY	14	4.9286	.38516	-.694	.500
J FAMILY	2	4.7500	.35355	-1.000	.500
K FAMILY	5	5.6000	.82158	1.633	.178
L FAMILY	13	4.9038	.58219	-.595	.563
M FAMILY	10	5.3250	.31292	3.284	**.009
O FAMILY	19	5.2500	.42492	2.565	**.019
P FAMILY	23	4.9022	.51533	-.910	.372
Q FAMILY	24	4.9938	.21331	-.144	.887
R FAMILY	21	5.2619	.44354	2.706	**.014
S FAMILY	24	5.1250	.29488	2.077	**.049
T FAMILY	24	5.3021	.48330	3.062	**.006
U FAMILY	17	5.6324	.40618	6.419	.000
V FAMILY	5	5.5000	.46771	2.390	.075
W FAMILY	21	5.1190	.39226	1.391	.180
Y FAMILY	3	5.2500	.66144	.655	.580



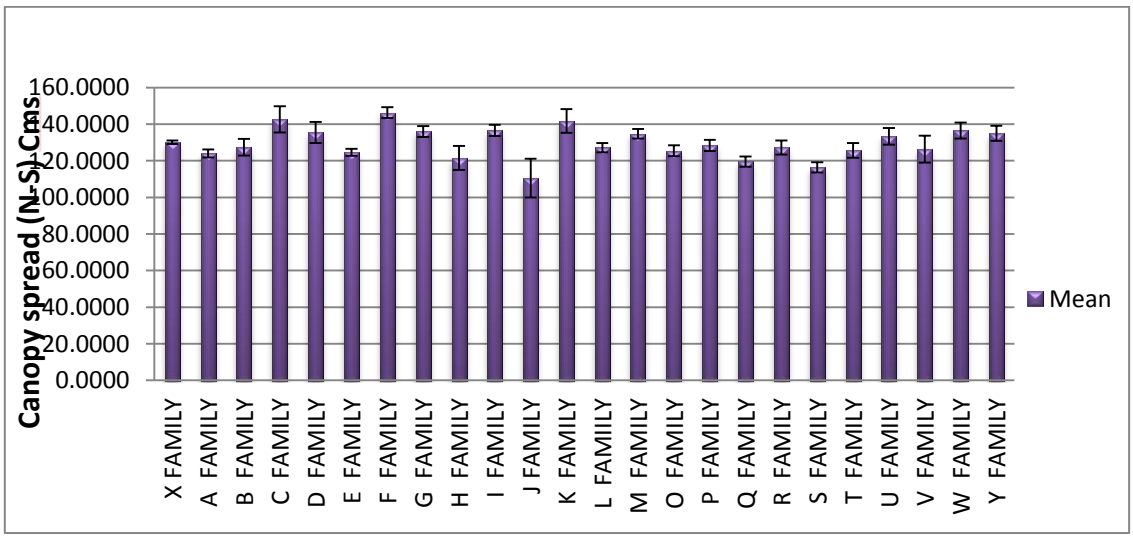
Graph depicting the variation in days to first flowering in different families in Papaya



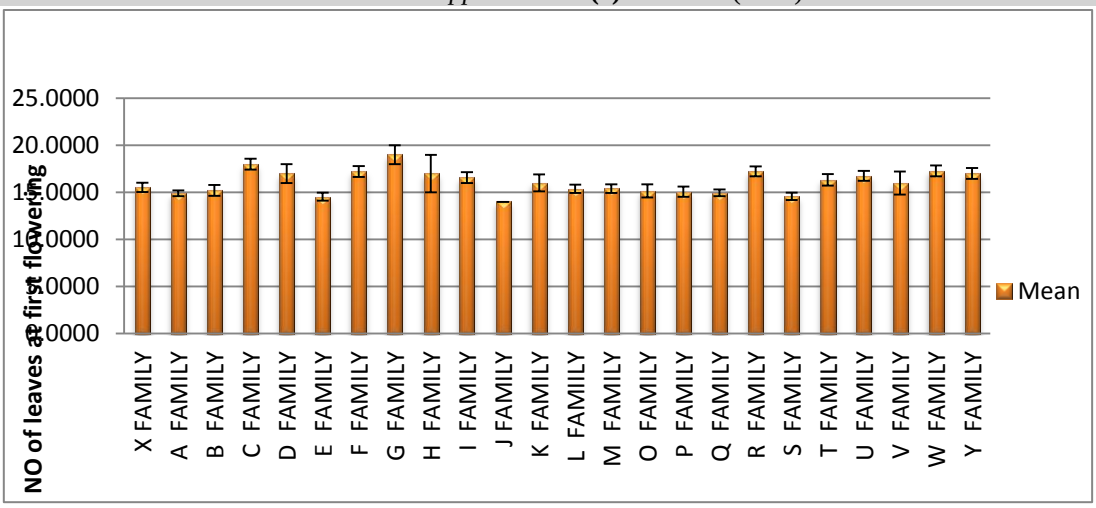
Graph depicting the variation in trunk circumference in different families of M_2 population in



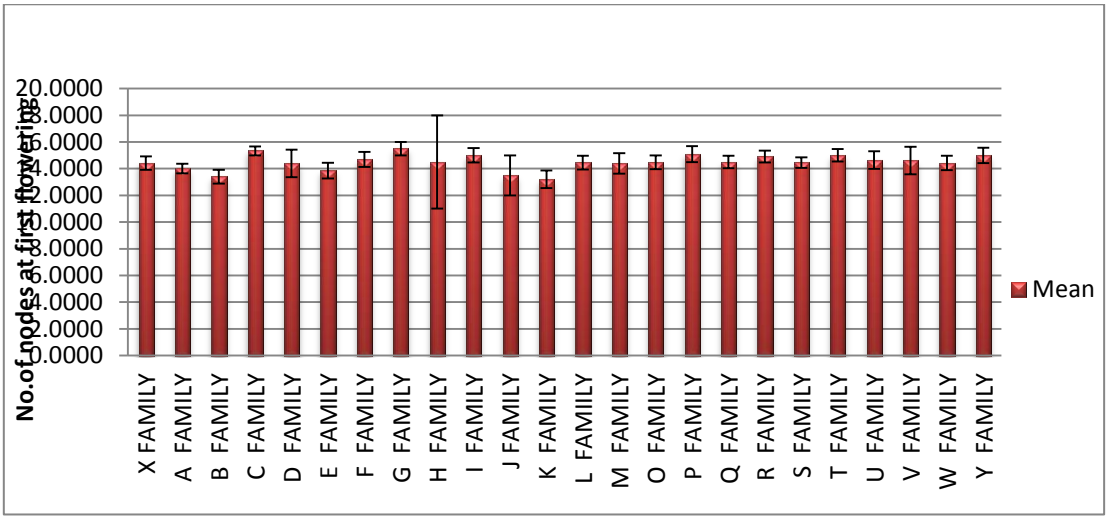
Graph depicting the variation in canopy spread in different families of M_2 popu



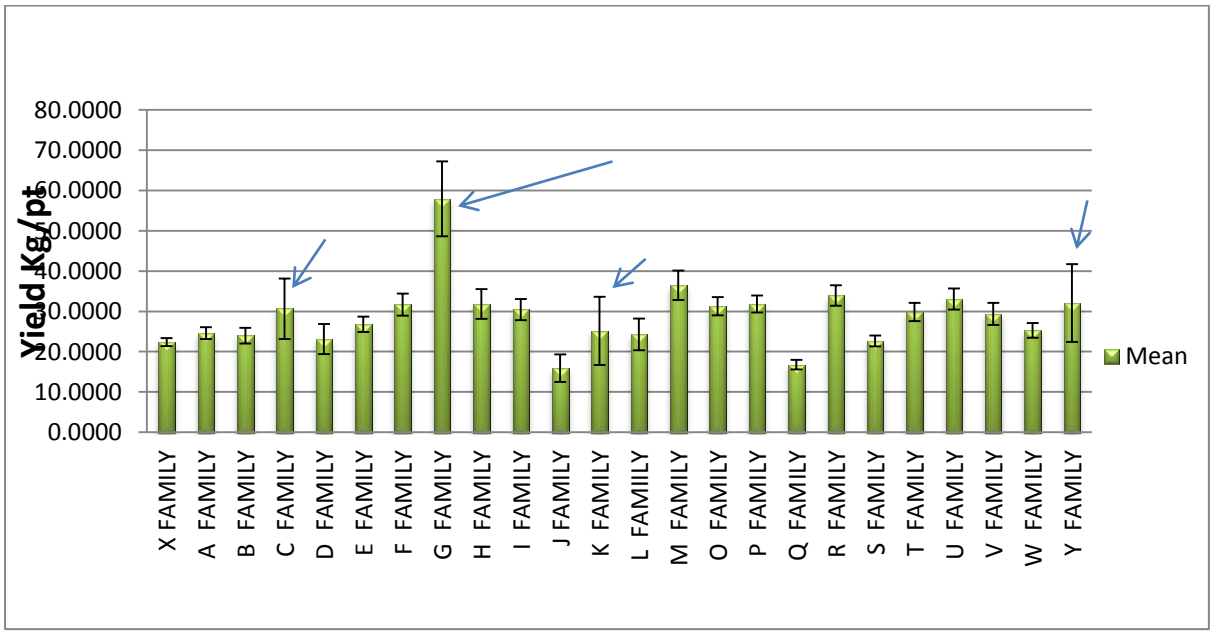
Graph depicting the variation in canopy spread in different families of M_2 population of Papaya



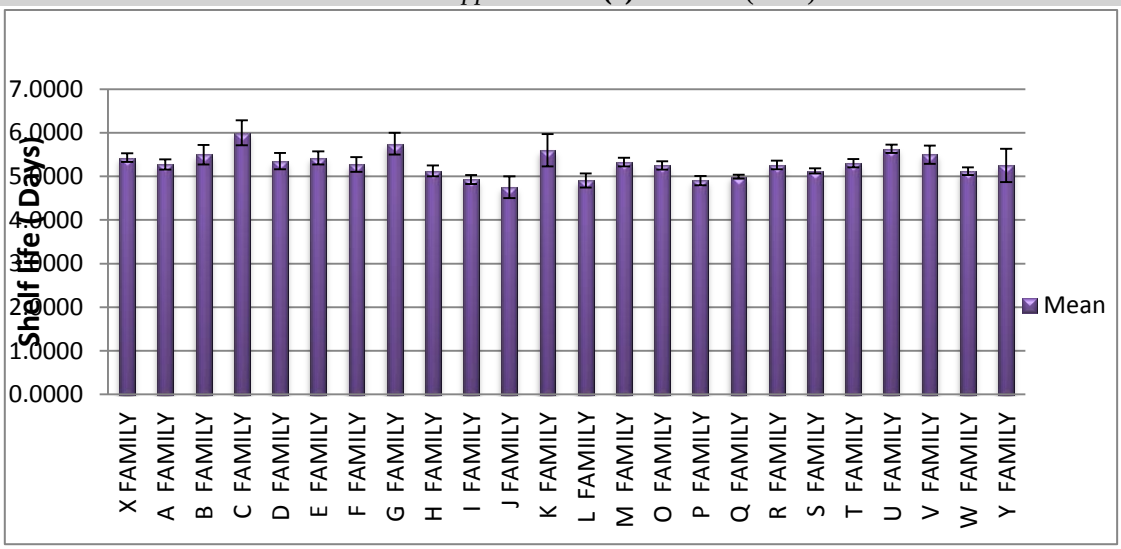
Graph depicting the variation in No.of leaves at first floweringin different families of M_2 of Papaya



Graph depicting the variation in No.of nodes at first flowering in different families of M_2 of Papaya



Graph depicting the variation in plant yield at fruiting in different families of M_2 of Papaya



Graph depicting the variation in shelf life in different families of M_2 of Papaya

Drip irrigation facility

Ariel view of M2 papaya field

Ultra dwarf segregants

Variation in leaf morphology

M2 plants showing variation in fruit types and branching habit

Breaker stage fruits of hermaphrodite plants

Orange and yellow colour pulp

Castor leaf mutant

Promising M2 plants Yield of Papaya Var. Arka Prabhath@ IIHR -Hessaraghatta

CONCLUSION

Mutation was induced to create variability for plant height, shelf life, PRSV resistance and other desirable traits. Studies revealed that, significant variation was observed for all characters studied among mutant progenies. Different desirable traits were observed *viz*., ultra-dwarf nature, perfect hermaphrodite, erect growth nature, broad leaved plants, yellow pulp fruit, branched plants and green petiole. Plants with desirable traits were selfed and sib-mated and were forwarded for next generation.

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