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Studies on papaya cultivation and evaluation of different varieties and hybrids in Tripura

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ABSTRACT : Papaya (*Carica papaya* L.) is regarded as the wonder fruit of the tropics and sub tropics. It has got great importance due to its high nutritive value and production potentiality. Systematic and accurate estimate of area and production are not available in the state. But still papaya is the most important fruit crop in the state and is cultivated in about 1334.00 ha with an annual production of 18,455.00 mt with a productivity of 13.83t ha⁻¹ which is far below the national productivity of 31.69 t ha⁻¹. Eight varieties and hybrids were evaluated namely Coorg Honey Dew, Pusa Dwarf, Pusa Majesty, Pusa Nanha, Washington, Surya, RCTP-1 and local dwarf types. The Coorg Honey Dew, Pusa Majesty and local type are performing excellent with respect to yield and quality parameters. The highest plant height was observed in case of high yielding selection RCTP-1(293.55cm) and it was least in case of new local dwarf gynodioecious type (91.33 cm). The highest pulp thickness was found in new local dwarf gynodioecious type (3.37 cm) and lowest pulp thickness was recorded in case of variety Pusa Nanha (2.10 cm). The cavity index of fruits was found to vary from 22.80 per cent in local dwarf gynodioecious type to 28.27 per cent in Coorg Honey Dew. The varieties Washington, Pusa Dwarf and Surya, showed medium cavity index whereas the local dwarf gynodioecious type showed less cavity index. The highest TSS was observed in case of hybrid Surya and the lowest TSS was observed in case of variety Pusa Nanha. Most of the orchards are having the problem of water stress from December to March leads to severe moisture stress and heavy rain from April to October causes heavy soil erosion, nutrition loss from top soil. The soil across the state is acidic in nature, which hampered the availability of the important nutrients to the plants and affect the yield.

KEY WORDS : Papaya, Evaluation, Varieties and hybrids

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Papaya (*Carica papaya* L.) has emerged as an industrial fruit crop in the recent times with perceptible increase in area and production. Tripura is a small hilly and land locked state with very poor communication facilities. The economy of the state is basically agrarian and more than 70 per cent of the population depends on agriculture for its livelihood. The soil varies in reaction very strong to strong acidic with medium organic matter content and low availability of phosphorus and potash contents. The pH ranges from 4.5 to 5.5. Soil texture ranges from sandy clay loam to clay loam. The organic carbon content is medium. Area under papaya cultivation in Tripura is 1,334 ha and production is 18,455 m. t (Anonymous, 2010). Papaya grows well in a wide range of soils, from the new alluvium of plains to old alluvium of the sub-mountainous tracts as well as the

lateritic soils of the hills. 'Coorg Honey Dew' and local dwarf gynodioecious types are doing excellent performance under climatic condition of Tripura. Most of the orchards are having the problem of water stress from December to March leads to severe moisture stress and heavy rain from April to October causes heavy soil erosion, nutrition loss from top soil. The soil across the state is acidic in nature, which hampered the availability of the important nutrients to the plants and affect the yield. Depletion of nutrients by washing of rich top soil and leaching losses are causing nutritional deficiencies. The proper management practices like GAP (Good Agricultural Practices), with moisture conservation methods during stress period (December to March) will boost the production and productivity of papaya.

RESEARCH METHODS

Studies were conducted in the college of Agriculture, Lembucherra, Tripura, as well as in the farmers field near by college, Tripura, India in the year 2009-2011. Total eight varieties and hybrids including local dwarf gynodioecious type have been evaluated and data were generated in different parameters like plant height, stem diameter, plant spread (N-S), plant spread (E-W), fruit weight, fruit cavity index, titrable acidity, fruit length, fruit breadth, pulp thickness, ascorbic acid, TSS, hundred seed weight etc. The data were compiled and subjected to standard statistical processes.

Propagation:

Papaya is normally propagated by seeds, 500 g seeds will be required (200 g/ acre) for planting one hectare, the seedlings are raised in polythene bags of size 10 x 20 cm with 1 parts of sand and 1 part each of red soil and well decomposed farm yard manure, in each bag filled with pot mixture, 2 or 3 seeds should be sown, seeds germinate readily in 10 to 20 days and seedlings transplanting when they are 45-50 days old.

Planting :

May- June is the best season under climatic condition of Tripura, hot summer months should be avoided for planting, papaya are planted at 1.8 m x 1.8 m distance in pits of 45 cm³ size which are filled with decomposed FYM and top soil in 1:1 ration and 250 ml of 0.2% copper oxy chloride solution can be used to drench each pit.

RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Present status of papaya cultivation (Table 1, 2, 3 and 5):

The area, production and productivity is 95.7 thousand hectare, 3913.5 thousand tones and 40.9 mt/ hectare, respectively (Table 2). Andra Pradesh alone has highest area of 18, 8000 hectare and production 15,007,000 mt and highest productivity (180.2 mt/ha) in Tamil Nadu (Table 3). Systematic and exact judgment of area and production of various horticultural crops in the northeastern region are not available. Papaya is fourth important fruit crop next to banana, citrus and pineapple in the north-eastern region and is cultivated in about 12,700 ha with an annual production of 158,900 mt with a productivity of 12.51 t ha⁻¹ (Table 5) which is far below the national productivity (Anonymous, 2006). In Tripura papaya is the sixth most important fruit crop next to jack fruit, banana, pineapple, citrus and mango and is cultivated in about 1334 ha with an annual production 18,455 mt an average productivity of 13.83 t ha⁻¹ (Table 1) which is far below the national productivity.

Coorg honey dew:

It is a chance seedling of Honey Dew developed at Central Horticultural Experiment Station, Chethalli of IIHR. It is a gynodioecious type (Hermaphrodite and female trees are produced and no male trees). The fruits are oblong. It is

Table 1 : Area and production of papaya in Tripura (Area in Hec. Prod-in M.T Productivity-in M.T/Hec)

Year	South District		West District		Dhalai District		North District		State Total		Pdy
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.	
2007-08	344.00	3798.64	304.00	3278.65	230.00	3035.64	256.00	2213.65	1134.00	12326.58	10.87
2008-09	388.30	3975.00	310.00	3468.00	258.00	3285.20	338.00	2459.00	1294.30	13187.20	10.19
2009-10	398.00	5018.00	320.00	4563.00	268.00	4092.00	348.00	4782.00	1334.00	18455.00	13.83

Source : Director of Horticulture, Govt. of Tripura, 2009-10

Table 2 : All India area, production and productivity of papaya

Years	Area (in 000 ha)	% of total frt. area	Production (in 000 ha)	% of total frt. production	Productivity (mt/ha)
1991-92	45.2	1.6	805.3	2.8	17.8
2001-02	73.7	1.8	2590.4	6.0	35.1
2002-03	68.8	1.8	2147.2	4.8	31.6
2003-04	58.2	1.2	1692.1	3.7	29.1
2004-05	73.8	1.5	2535.1	5.1	34.4
2005-06	67.8	1.3	2139.3	3.9	31.6
2006-07	72.0	1.3	2482.0	4.2	34.5
2007-08	83.0	1.4	2909.0	4.4	35.0
2008-09	98.0	1.6	3629.0	5.3	37.0
2009-10	95.7	1.5	3913.5	5.5	40.9

(Source: National Horticulture Board Database, 2009-10)

a dwarf and high yielder. The flesh is thick (2.73cm) with good flavour. The fruits formed from female flowers are almost seedless. Fruits weight 1.00 kg to 1.5 kg. Pulp is yellow in colour, cavity large with poor keeping quality. TSS is around 11.00-12.00 °Brix, fruit length (22.13cm) and breadth (13.10 cm) (Table 4).

Pusa delicious :

This is a gynodioecious type developed at IARI, New Delhi. It starts fruiting at a height of about 80-85 cm, with in 250 days of planting with the maximum height of 215 cm. Trees are dwarf, fruits size is medium to large with excellent in taste, deep orange flesh colour having food flavour and round oblong in shape. The cavity of the fruits is 14x8 cm, pulp thickness 2.5-3 cm and T.S.S 10-12 °Brix. The weight of the fruit (1756.67g) ranges about 1-2 kg and the yield per plant is about 40-45 kg, fruit length (22.20cm) and breadth (14.37 cm) (Table 4).

Pusa dwarf :

It is also a dioecious cultivar developed from the var. Ranchi at IARI, New Delhi with dwarf stature(139.66 cm) . Trees are more precocious in bearing. The trees bear at 30-40 cm height. Fruits are oval in shape, medium in size, the weight ranging from 1 to 1.5 kg and yield per plant is 30 to 40 kg. The pulp thickness is 2.32 cm with a flesh colour red to orange and T.S.S. ranges from 9-11 °Brix (Table 4). Fruit length (19.33cm) and breadth (15.20 cm).

Pusa nanha:

Dwarf mutant of 106.54 cm height. Dioecious and bears fruit at a height of 30 cm above the ground. Fruits are medium sized (963.33 g), pulp is thin (2.10cm) and yellow in colour, TSS is about 8.13 °Brix and cavity is low (26.53 %). About

6,400 plants can be accommodated per hectare with spacing of 1.25x1.25 m². It is highly suitable for high density planting (Table 4).

Local dwarf gynodioecious type:

Plant height is very dwarf with a height of 91.33 cm. It is dwarf local gynodioecious type found in Tripura with good performance with out any infection of papaya ring spot virus and other problems. The first flowering height is 15-20 cm from the ground level. The fruit are medium to large with an average weight (1990 g), pulp is thick (3.37cm) and yellow in colour, TSS is about 8.30 °Brix and cavity is low (22.80 %). About 7,000 plants can be accommodated per hectare with spacing of 1.25 x 1.25 m². It is most ideal for high density planting. The flowering and fruiting started four month onwards with a annual yield of 25-30kg per plant (Table 4 and Fig. 1 and 2).



Fig. 1 : Local dwarf gynodioecious type

Table 3 : Statewise area, production and productivity of papaya

State	Area (000 ha)			Production (000mt)			Productivity mt/ha		
	2007-08			2008-09			2009-10		
	Area	Prodn.	Pdy	Area	Prodn.	Pdy	Area	Prodn.	Pdy
Andra pradesh	14.9	1195.	80.0	19.8	1581.2	80.0	18.8	1500.7	80.0
Gujarat	11.2	489.5	43.7	14.1	721.7	51.1	15.3	832.9	54.3
Karnataka	05.2	389.5	74.7	5.5	409.0	74.7	5.8	419.3	72.3
West bengal	10.7	308.6	28.8	10.8	314.3	29.0	11.1	321.8	29.1
Chhatisgarh	07.4	136.1	18.4	8.1	148.1	18.4	9.3	211.7	22.7
Madhapradesh	0.8	28.3	35.4	1.6	53.8	33.9	1.7	192.9	115.6
Assam	07.0	107.1	15.3	7.1	128.5	18.1	7.2	119.1	16.5
Kerala	18.5	80.6	4.4	17.7	80.7	4.6	17.7	80.7	4.6
Tamil nadu	0.4	66.4	166.0	0.4	72.3	182.2	0.4	73.9	180.2
Tripura	1.1	12.3	10.9	1.3	13.1	10.2	1.3	18.5	13.83
Others	6.7	107.4	16.1	12.7	119.2	9.4	8.4	160.5	19.2
Total	83.9	2920.9	34.8	98.0	3641.0	37.2	97.0	3932.0	40.5

Source: National Horticulture Board Database, 2009-10



Fig. 2 : Local dwarf gynodioecious type in garden

Surya:

Advanced generation hybrid from the cross between 'Sun Rise Solo' and 'Pink Flesh Sweet'. It is gynodioecious

variety developed at IIHR, Bangalore. It provides medium sized fruits each weighing on an average 600-900 g (943.70g) with red pulp. The fruits are sweet with good shelf-life. It is quite promising for fruit industry. Pulp is deep pink to red in colour and firm. TSS ($^{\circ}$ Brix) is about 13-15 $^{\circ}$ Brix (14.67 $^{\circ}$ B) pulp thickness 2.6 cm with a fruit cavity index (23.03%) (Table 4). Same result was reported by Anonymous (1999), IIHR, Bangalore. Dinesh and Yadav (1998) also reported similar results in the variety "Surya" under Bangalore condition.

RCTP-1:

It is a dioecious new high yielding selection in Tripura. It was developed at ICAR Research complex, Tripura. The average height of the plant 293.55 cm with a stem girth of 32.86cm. The average fruit weight 2023.33 g with fruit length 23.57 and breadth 13.33 cm. The pulp thickness is 2.43 cm with TSS 11.570 Brix, fruit yield 60-62 kg/plant (Table 4). It was also supported by Prakesh *et al.* (2010) ICAR (RC) for NEH Region, Tripura Centre, Tripura (Table 4).

Table 4 : Physico-chemical characters of different varieties, hybrids and local type grown in Tripura

Varieties/ Hybrids	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃
Coorg Honey Dew	198.55	32.69	191.17	192.43	1089.43	22.13	13.10	28.27	2.73	11.67	0.17	67.37	1.36
RCTP-1	293.55	32.86	190.38	191.60	2023.33	23.57	13.33	28.133	2.43	11.57	0.17	62.43	1.28
Pusa Delicious	191.53	27.30	189.34	187.93	1756.67	22.20	14.37	27.47	2.47	11.40	0.16	60.73	1.28
Pusa Dwarf	139.66	29.34	157.70	156.22	1380.23	19.33	15.20	26.93	2.32	9.58	0.16	66.47	1.27
Washington	181.52	30.68	236.55	231.87	827.43	15.50	10.40	27.60	2.20	11.87	0.22	61.57	1.22
Surya	212.72	36.33	166.68	169.30	943.70	13.43	10.73	23.03	2.60	14.67	0.13	59.63	1.38
Pusa Nanha	106.54	25.23	182.43	183.35	963.33	14.03	13.43	26.53	2.10	8.13	0.16	60.933	1.30
Local dwarf gynodioecious type	91.33	23.63	181.40	182.0	1990.00	22.47	11.35	22.80	3.37	8.30	0.14	62.47	1.37
S.E. (\pm)	0.92	0.91	0.59	1.65	45.85	00.20	0.39	0.39	0.11	0.33	0.01	0.40	0.05
C.D. (P=0.05)	2.79	2.75	1.80	5.03	139.09	00.62	1.19	1.89	0.34	0.99	0.02	1.21	0.15

X₁: Plant height (cm)

X₂: Stem diameter (cm)

X₃: Plant spread (E-W)(cm)

X₄: Plant spread (N-S)(cm)

X₅: Fruit weight (g)

X₆: Fruit length (cm)

X₇: Fruit breadth (cm)

X₈: Fruit cavity index (%)

X₉: Pulp thickness (cm)

X₁₀: TSS (Brix)

X₁₁: Titrable acidity (%)

X₁₂: Ascorbic acid (mg/100g)

X₁₃: Hundred seed weight (g)

Table 5 : Area, production and productivity of papaya in north-eastern State

States	Area (.000ha)	Production (.000mt)	Productivity (t ha ⁻¹)
Arunachal Pradesh	-	-	-
Assam	8.1	130.5	16.10
Manipur	1.9	11.0	5.79
Meghalaya	0.7	5.8	8.28
Mizoram	0.3	0.8	2.66
Nagaland	0.7	0.7	1.00
Sikkim	-	-	-
Tripura	1.0	10.1	10.10
Total (Northeast)	12.7	158.9	12.51

Source: National Horticulture Board Database, 2006-07

Washington:

It is a dioecious cultivar with pink petiole. Fruits are medium to large, each fruit weighing about 850 g to 1 kg. The fruits are sweet with good keeping quality (Table 4).

The highest plant height was observed in case of high yielding selection RCTP-1(293.55cm) and it was least in case of new local dwarf gynodioecious type (91.33 cm). The highest pulp thickness was observed in case of new local dwarf gynodioecious type (3.37 cm) and lowest pulp thickness was recorded in case of variety Pusa Nanha (2.10 cm). Ghanta (1994) recorded the pulp thickness of 3.10 cm in the variety Ranchi. The cavity index of fruits was found to vary from 22.80 per cent in local dwarf gynodioecious type to 28.33 per cent in Coorg Honey Dew. The varieties Washington, Pusa Dwarf and Surya, showed medium cavity index whereas the local dwarf gynodioecious type showed less cavity index. Similar type of observation was recorded in the previous study in the variety "Surya" under Bangalore condition (Anonymous, 1999). The highest TSS was observed in case of hybrid Surya and the lowest TSS was observed in case of variety Pusa Nanha. Similar type of observation was recorded by Auxilia and Sathiamoorthy (1999).

Evaluation of eight varieties and hybrids including local dwarf gynodioecious type for physico-chemical characteristics in papaya revealed that varieties Coorg Honey Dew, Pusa Dwarf, Washington, Surya and Pusa Nanha had medium sized fruits. The lower cavity index was observed in local dwarf gynodioecious type and Surya. The highest TSS

was found in case of Hybrid Surya and lowest in Pusa Nanha. The hybrids, varieties and local dwarf gynodioecious type mentioned above could be used as potential parents in breeding for respective quality characters. All the hybrids, varieties and local dwarf gynodioecious type studied under climatic condition of Tripura, local dwarf gynodioecious type, Coorg Honey Dew and Surya showed best performance in quality and yield. There is tremendous scope to popularize these fruit in non-traditional areas and it may earn lot of foreign currency in the state in near future.

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