



Research Article

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# TNAU Papaya CO.8 – A Dioecious Red Fleshed Papaya Variety with Higher Productivity for Commercial Cultivation in India



J Auxilia\*

Department of Horticulture, Tamil Nadu Agricultural University, India

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\*Corresponding author: J Auxilia, Department of Horticulture, Tamil Nadu Agricultural University, India Email: auxi1@rediffmail.com, auxilia@tnau.ac.in

## Abstract

Papaya's appeal lies in its delectable taste and nutritional benefits, besides commercial papain extraction and finds application in pharmaceuticals and processing industries. Red fleshed varieties hold great market potential compared to yellow fleshed, as the former is preferred by the pulping and processing industries. Whilst numerous gynodioecious varieties are red-fleshed, no red dioecious varieties exist, though they are more tolerant to abiotic stress than gynodioecious varieties. Spotting red-anthered staminate plants within the segregating population of yellow fleshed dioecious variety CO.2 resulted in development of a red-fleshed dioecious variety named TNAU Papaya CO.8. It is a red-fleshed dioecious variety with a moderate height of 2.68 m (at first harvest) and low bearing height of 96.50 cm with a high yield of 230 t/ha with 75 to 80 oblong fruits per tree at first harvest each weighing 2.20 kg. The pulp thickness is 3 cm, cavity index is 42% and TSS is 13.5 %. It is rich in antioxidants with high lycopene (2.14 mg/100g) and beta carotene contents (1.78 mg/100g). The variety is suitable for dessert, papain extraction and processing purposes.

**Keywords:** Papaya (*Carica papaya L.*); Dioecious; Red flesh; Yield; Quality; Dessert; Papain quality

## Introduction

Papaya (*Carica papaya L.*), a member of the *Caricaceae* family, has been planted in home gardens for centuries. The strong nutritional and the therapeutic value of papaya makes it as a tropical fruit of commercial significance. It contains vitamins A, B, C, and proteolytic enzymes and additionally includes fibre, K, Cu, P, Fe, Mg, carotenes, flavonoids, folate, and pantothenic acid. These vitamins and minerals work to prevent colon cancer and support a healthy cardiovascular system [1]. Various parts of the plant such as leaves, stems, seeds and other components are high in alkaloids and flavonoids having medicinal and antimicrobial properties [2]. Papain, derived from the dried latex of its immature fruits is a proteolytic enzyme extracted from *Carica papaya* [3] and this enzymatic compound finds application in enhancing meat tenderness by acting on muscle structure [4] and used for making chewing gum, cosmetics, degumming natural silk, give wool shrink resistance, stain remover, toothpaste production, beer, and cosmetic products [5]. Furthermore, it is employed in the manufacturing of paper and adhesives, sewage disposal, textile and garment cleaning and pharmaceutical sectors. Papaya earns its title as the "common man's fruit" due to its affordability

and remarkable nutritional benefits [6]. With its pharmaceutical attributes, papaya also holds the label of a "quasi-drug", having a history of being employed in traditional remedies to alleviate a range of ailments [7]. It is widely cultivated all over the world for its various benefits. India is the largest producer of Papaya worldwide. According to the 2023 (1st advance estimates) report of Ministry of Agriculture and Farmers Welfare, Govt. of India, papaya is cultivated in an area of 1.47 lakh ha with an annual production of 5.23 million MT and productivity of 35.60 MT/ha. Among different states of India, Tamil Nadu hold first position in terms of productivity (68.58 MT/ha) followed by Karnataka (66.57 MT/ha) and Gujarat (61.07 MT/ha) [8]. Papaya varieties are classified into two sex forms: dioecious and gynodioecious. Under Indian conditions, when temperature falls below 20°C or above 35° at flower initiation and development, the stamens of the bisexual flower in gynodioecious genotypes adhere to the ovarian wall, giving a mis-shaped fruit (cat-faced) or stamen carpellody [1]. Hence, dioecious varieties are preferred over gynodioecious varieties in tropical areas like Tamil Nadu, where there is a fluctuation in temperature. In the year 2012, TNAU

Papaya CO-8 was developed by Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India in the dioecious group having red-fleshed. It holds a promising potential for commercial scale cultivation which is underscored by its yielding capacity (200-230 tonnes per hectare), appealing fruit characteristics, and additional

value through papain production which enhances its commercial appeal. This cultivar stands poised to play a significant role in meeting market demands, supporting economic growth, and offering a compelling option for stakeholders seeking profitable and sustainable ventures in the papaya industry.

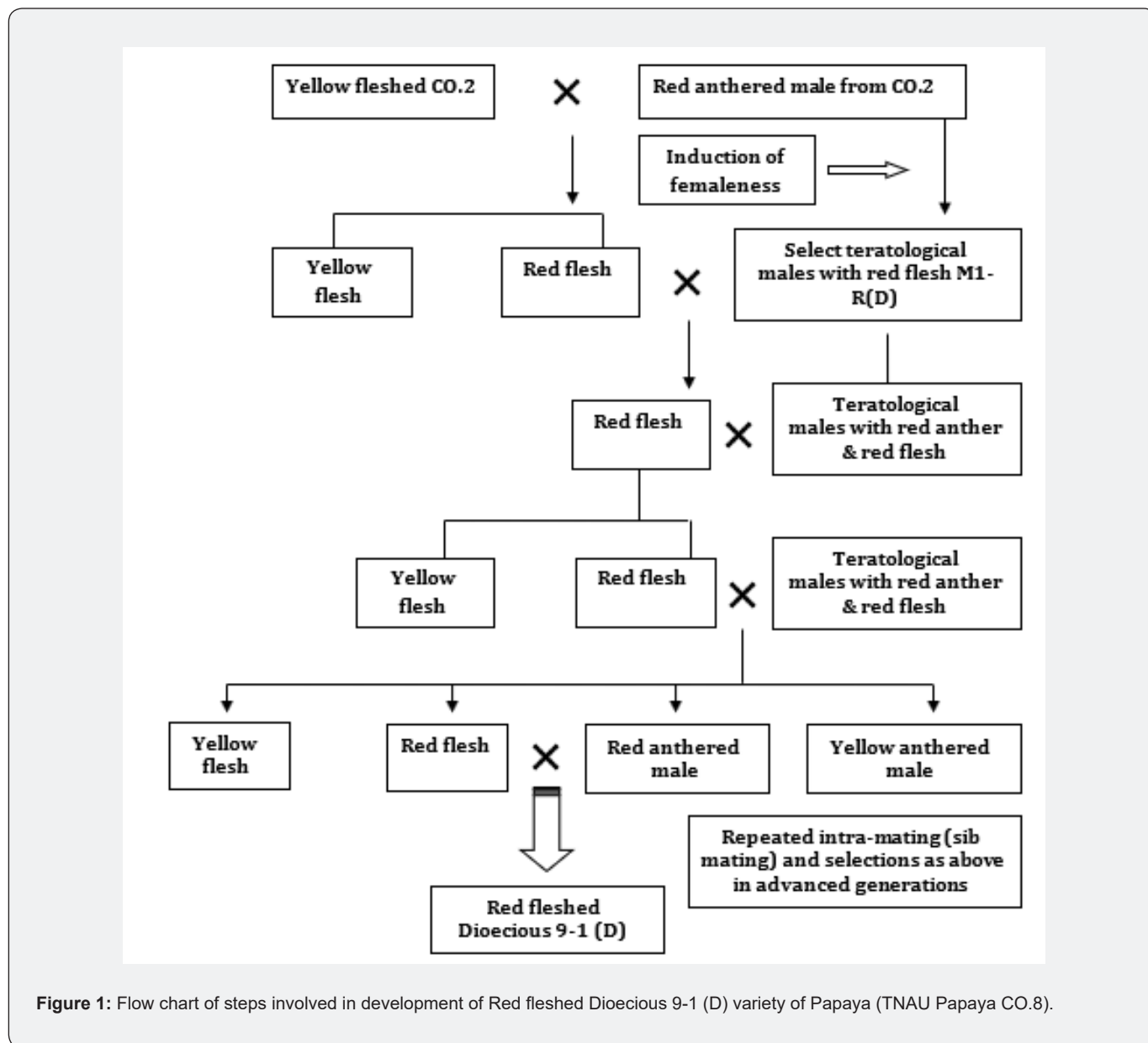


Figure 1: Flow chart of steps involved in development of Red fleshed Dioecious 9-1 (D) variety of Papaya (TNAU Papaya CO.8).

### Methodology

A papaya culture named “9-1(D)” was derived as a red pulped segregant by crossing CO.2 papaya, a dioecious variety with yellow pulp colour, as female parent with pollen from a red-anthered teratological male heterozygous for anther colour. For purifying 9-1 (D), red anthered teratological male with low bearing height

and deep red pulp colour was repeatedly involved in hybridization to incorporate genes for red colour in earlier four generations. Later red-anthered males identified in segregating population in each generation were used for Sib mating with select females having red flesh colour. Such repeated crossing and selection after intra mating over seven generations has resulted in the red fleshed papaya culture and released as TNAU Papaya CO.8 (Figuer1).

### Characteristics of the Variety

At first harvest, the plant reaches an approximate height of 265-270 cm and can reach up to 4.5 to 5.0 m at the end of cropping period (2 years). It resembles CO.2 papaya variety for morphological traits except for the fruit flesh colour. While the flesh colour of CO.2 is yellow, the developed variety produces red pulp. The variety is recommended as it possesses attractive red flesh along with all the other desirable attributes like CO.2 papaya in respect of stature, fruit yield and quality. The variety is also suitable for papain extraction. It reaches maturity in 270-300 days from sowing (135 days from flowering). Both the varieties have been compared for its growth and yield attributing characters in addition to papain and quality attributes (Table 1). Incidence of Papaya Ring Spot Virus is noticed at a moderately lesser level as compared to gynodioecious varieties. It is susceptible to Papaya mealy bug; but the pest incidence can be easily managed using

the bio control agent *Acerophagus papaya*. It does not tolerate moisture stress and hence assured irrigation is required. Dioecious papaya varieties are generally recommended for dessert purpose and papain extraction, besides pulping industries, owing to its high productivity and pulp recovery. Pulping industries prefer varieties with red pulp to be added in the jam, juice etc., and so far, no red fleshed variety in dioecious types are available. Hence, the developed variety is a red- fleshed dioecious type, have great scope for cultivation exclusively for the pulping industries. Besides, red pulp has high consumer appeal. The variety is highly acceptable for table purpose. M/s. Senthil Papain and Food Products Pvt. Ltd., Coimbatore has rated the papain from this variety as very good. Organoleptic test of this variety (CO.8) has given an acceptable result as given in Table 2. This variety is highly suitable for dessert purpose, papain extraction, preparation of jam, RTS and juice and fruits after papain extraction can be used for pulping or for processing to tutti-fruity.

**Table 1:** Growth and Yield Parameters of TNAU Papaya Co.8 culture in comparison with Co.2 at Coimbatore, Tamil Nadu, India.

S.No.	Characters	TNAU Papaya Co.8	CO.2
1.	Plant height at first harvest (m)	2.68	2.6
2.	First bearing height(cm)	96.5	92
3.	Number of fruits/trees at 1st harvest	75-80	70-75
4.	Fruit weight (kg)	2.2	2.25
5.	Fruit yield / tree (kg)	198.5	160
6.	Estimated Yield /ha	230 t	220t
7.	Fruit shape	oblong	oblong
8.	Fruit length (cm)	33.3	30.6
9.	Fruit girth (cm)	46	42
10.	Fruit volume(ml)	2060	2700
11.	Cavity index (%)	42	43.48
12.	Flesh thickness (cm)	3	2.9
13.	Flesh colour	Red	Yellow
14.	Suitability for processing	suitable	suitable
15.	Papain yield	800-1000 kg	800-1000 kg
16.	Papain activity in latex	138 TU/mg	142 TU/mg
17.	Papain quality	Very Good	Very Good
18.	T.S.S of pulp (%)	13.5	13
19.	Acidity (%)	0.1	0.12
20.	Ascorbic acid (mg / 100g)	42	41.65
21.	Total sugars (%)	12.3	12.35
22.	Reducing sugars (%)	9.17	8.85
23.	Non – reducing sugars (%)	3.13	3.55
24.	Lycopene (mg/100g)	2.145	0.232
25.	Beta carotene (mg/100g)	1.784	2.284

**Table 2:** Organoleptic test of CO.8.

Parameters	Ratings
Colour	Highly Acceptable to Excellent
Flavour	Acceptable to Highly Acceptable
Texture	Acceptable to highly acceptable
Taste	Acceptable to Highly Acceptable
Overall acceptability	Acceptable to Highly Acceptable

## Packages of Practices for TNAU Papaya CO.8

### Soil and Climate

It is a tropical fruit and grows well in regions with a temperature range of 25°C 38°C. Well drained soils of uniform texture are preferable. If drainage is not adequate, collar – rot disease may occur.

### Sowing

500 g of seeds is required for planting one hectare of area. June-September is the best season for planting in many parts of Tamil Nadu. Avoid planting in rainy season.

### Nursery

Dibble five to six seeds in polythene bags in depth not exceeding one cm. Provide partial shade. Water the bags in rose can. Seedlings will be ready for planting in about 45-60 days.

### Planting

Plant the seedlings at 1.8 m x 1.8 m spacing in pits of 45 cm<sup>3</sup> size.

### Irrigation

Irrigate copiously after planting. Irrigate the field once in a week in flood irrigated condition.

### Application of Fertilizers

Apply FYM 10 kg/plant as basal. Apply 50 g in each of N, P and K per plant at bi-monthly intervals from the third month of planting after removing unwanted sex forms. Apply 20 g in each of Azospirillum and Phosphobacterium at planting, again six months after planting.

### Fertigation

Application of 10 -15 litres of water/day + 13.5g urea and 10.5 g muriate of potash/week through fertigation and soil application of super phosphate (275 g / plant) at bimonthly interval is recommended.

### Thinning

Male trees should be removed after the emergence of inflorescence maintaining one male tree for every 20 female trees

for proper fruit-set. In each pit only one vigorously growing female tree should be retained and other plants should be removed.

### Micronutrients

Spray ZnSO<sub>4</sub> 0.5% + H<sub>2</sub>BO<sub>3</sub> 0.1% during 4th and 8th month to increase growth and yield characters.

### Plant Protection

**Nematodes:** In the nursery, apply carbofuran 3 G @ 1 g/ polybag 30 days after germination.

**Papaya Mealy Bug:** Release of mealy bug Parasitoid *Acerophagus papayae* 100 Nos./block or village can be highly helpful.

**Root Rot and Wilt:** In water stagnated areas root-rot may appear. It is advisable to drench the soil with 0.2% copper oxy chloride or 1 % Bordeaux mixture or Metalaxyl 0.2%, 2 or 4 times at fortnightly intervals. Good drainage is vital.

**Papaya Ring Spot Virus:** Raising Papaya seedlings in insect proof net house+ raising two rows of border crop maize+ spraying Dimethoate @1.5ml/lit at monthly interval up to 5 Months after planting +Spraying ZnSo<sub>4</sub> (0.5%) + Boron (0.1%) at 4th and 7th month + Application of FYM @10kg/plant is recommended for papaya ring spot virus management.

### Crop Duration

Under optimal conditions the crop can be economically maintained for 24 – 28 months.

### Harvest

Fruits should be picked at colour break stage.

**Yield:** 220-230 t/ha.

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