International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 3786-3789

Received: 26-04-2020
Accepted: 28-05-2020

Dr. Y Sharath Kumar Reddy
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Dr. D Sreedhar
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Dr. T Nagalakshmi
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Dr. R Nagaraju
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Dr. J Dileep Babu
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Dr. Prakash Patil
Project Co-ordinator, AICRP on Fruits, Indian Institute of Horticultural Research, Bangalore, Karnataka, India

Corresponding Author:
Dr. Y Sharath Kumar Reddy
Horticultural Research Station, Anantharajupeta, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India

Evaluation of different papaya varieties for yield and quality parameters under Rayalaseema zone of Andhra Pradesh, India

Dr. Y Sharath Kumar Reddy, Dr. D Sreedhar, Dr. T Nagalakshmi, Dr. R Nagaraju, Dr. J Dileep Babu and Dr. Prakash Patil

DOI: https://doi.org/10.22271/chemi.2020.v8.i4av.10233

Abstract
Papaya (*Carica papaya* L.) is one of the most important fruits of tropical and subtropical regions of the world. It is believed to be native of Tropical America; probably Southern Mexico from where it spread to most of the Caribbean and Asian countries during the16th century. India stands first in the production of papaya in the world followed by Nigeria, Indonesia, Mexico, Ethiopia and others. The fruit has high nutritive and medicinal value especially vitamin A (2020 IU/l00g). It also possesses vitamin B, folate and pantothenic acid besides minerals like potassium and magnesium. Five papaya varieties were evaluated for yield and quality parameters under rayalseema dry zone of Andhra Pradesh. The highest yield per plant (45.57 kg) was recorded in TFCP-2 while highest estimated yield per hectare (121.62t/ha) was recorded in the variety Red Lady. Maximum fruit length (21.80 cm), maximum level of total soluble solids (14.88 ^{0}brix) was found in the variety TFCP-4. However, Highest pulp thickness (3.96 cm) was recorded in the variety Red Lady. Among five papaya varieties Red lady was found to be superior in terms of yield and quality parameters.

Keywords: Papaya, quality, yield, evaluation, dry zone

Introduction
Papaya (*Carica papaya* L.) is one of the most important fruit crops of tropical and subtropical regions of the world. Papaya fruit is an important part of the diet in many developing countries. India leads the world in papaya production and occupies an area about 114.97 thousand hectares, with annual production of 4912 MT and productivity of 42.30 t ha-1 respectively (NHB, 2015) [2]. Due to early returns, nutritional and medicinal value, its area under cultivation is increasing in all parts of Andhra Pradesh state. States which grow papaya are Andhra Pradesh, Gujarat, Maharashtra, Karnataka, Assam, Bihar, Kerala, Orissa and West Bengal. Among them, the highest share of production (27.40%) was occupied by Andhra Pradesh, followed by Gujarat (21%) and Maharashtra (8.9%) (Anon, 2015) [2].
The fruit has high nutritive and medicinal value (Azad, *et al.*, 2012) [4] especially vitamin A (2020 IU/l00g). It also possesses vitamin B, folate and pantothenic acid besides minerals like potassium and magnesium (Popenoe, 1974) [17]. It is an excellent source of beta carotene which may prevent cancer, diabetes, and heart disease (Aravind *et al.*, 2013) [3] and it is also utilized in the pharmaceutical and cosmetic industries (Retuta *et al.*, 2012) [19]. The proteolytic enzyme 'papain' obtained from raw fruit is used for tenderizing meat, preparation of chewing gum, pre shrinking of wool, degumming natural silk, in cosmetics etc.
The vegetative, reproductive and quality responses of crop varieties are influenced by agro climatic conditions of a particular region. Furthermore, morphological characters have been used to characterize accessions and define the structure of varieties collection, and also important for assessing genetic diversity and correlation in varieties collection and developing crop management strategies (Burton and Devane, 1953; Bhatt, 1973) [7, 6]. Hence, it appears, inclusion of region specific varieties of a crop plant in package of practices is much necessary. Therefore, there is need to carry out evaluation of papaya varieties for yield, physico-chemical characteristics and more net returns in all agro climatic zones of state and country.

However, no such study has been noticed related to evaluation of papaya varieties under dry zone of Andhra Pradesh. Therefore, the present investigation is planned with an objective evaluation of varieties from public institutes (Provided by AICRP of Fruits, IIHR, Bangalore) with respect to yield and quality parameters under dry zone of Andhra Pradesh.

Materials and Methods

Present investigation was conducted at Horticultural Research Station, Anantharajupeta, Dr. YSR Horticultural University, Andhra Pradesh during 2015-16. Seeds of five papaya cultivars *viz.* TFCP-1, TFCP-2, TFCP-3, TFCP-4, and Red Lady were collected from Indian Institute of Horticultural Research, Bangalore. The seeds of these varieties were sown in polyethylene bags and there after attaining 45 days age (DAP), same were transplanted in the main field. The experiment was laid out in randomized block design with four replications. The seedlings were transplanted at spacing of 1.8 m X 1.8 m in fertile clay loam soil. Twenty five plants were maintained in each replication. Observations on growth, yield and yield contributing characters were recorded. Data were subjected to statistical analysis as methods suggested by Panse and Sukhatme (1985) [16].

Five plants were randomly selected for taking observations from each replication by excluding outer row of plants. From the selected plants, five fruits were randomly selected from each plant of each replication of variety for average weight of fruit. The mean value of fruit weight (kg) was calculated. Length of five fruits in each varietal treatment was measured from proximal end to distal end and expressed in centimeter (cm), middle portion of fruit was selected for measurement of diameter of fruit and measured with the help of measuring tape then average value of five fruits was worked out, single halved papaya fruits cavity diameter was measured by using thread from middle of cutted fruit then average value of five fruits was worked out and expressed in centimetre (cm), the total soluble solids was recorded with the extracted juice using a hand refractometer at room temperature and expressed in ^{o}Brix. After cutting the fruits into two halves, the pulp thickness was measured at mid region and expressed in centimetre (cm).

Titratable acidity

The method described by Ranganna (1979) [18] was adopted for estimation of titratable acidity. To obtain acidity (%), 10 g of homogenized pulp was taken in a 100 ml volumetric flask and the volume was made up with distilled water to a known amount. After thirty minutes, the suspension was filtered through Whatman No. 1 filter paper and 10ml of filtrate was taken by pipeting and titrated against 0.1 N NaOH by using phenolphthalein as an indicator. Appearance of colourless to pink colour denotes the end point. The reading of burette was noted.

Results and discussion

Yield and yield contributing characters

The yield attributes in case of papaya can be measured in terms of average fruit weight, fruit yield per plant, yield per hectare, fruit length, fruit breadth, fruit diameter and cavity diameter. Maximum fruit length and fruit cavity length was recorded with TFCP-4 (21.80cm and 21.12 cm) respectively and minimum fruit length and fruit cavity length was recorded in variety TFCP-3 (16.22 and 16.10 cm) respectively (Table-1). The variation in fruit length might be based on the fact that every genotypes has its own nature in development of fruits which may be varied due to various physiological phenomenon, that takes place in the plant body. These results are in contrast with Tyagi *et al.,* (2015) [20].

Among the varieties, TFCP-3 recorded maximum fruit diameter (47.10 cm) and minimum was recorded in the variety TFCP-2 (35.10 cm). The variation in fruit diameter might be based on the fact that every genotype has its own nature in development of fruits which may be varied due to various physiological phenomenon. These results are in contrast with Goenaga *et al.,* (2001) [10] and Tyagi *et al.,* (2015) [20]. As mentioned above, the fruits from pistillate flowers were oval, while an oblong shape was found in the fruits derived from hermaphrodite flower. The fruits of TFCP-1, TFCP-2 and TFCP-4 variety were oval shape, this may be because TFCP-1, TFCP-2 and TFCP-4 are dioecious varieties with only pistillate flowers on female plant, where as, TFCP-3 and Redlady of exhibited an oval and oblong shape.

Cavity diameter was recorded maximum with the variety TFCP-3 (16.06 cm) and minimum was found in the TFCP-2 (10.82 cm). These results are in contrast with Tyagi *et al.,* (2015) [20] the variations among the varieties may be attributed to their genetic constitution. The differential ability of photosynthetic rate per unit leaf area per unit time can also be responsible for the varied fruit weight. Table 1, depicts the variety TFCP-3 recorded the maximum average fruit weight (1.30 kg) and minimum was found in variety TFCP-2 (0.98 kg). This might be due to the genetical characters. These results are in accordance with the findings of Chalak *et al.,* (2016) [8], Kumar *et al.,* (2015) [12], Meena *et al.,* (2012) [13] and Jana *et al.,* (2010) [11].

Among the varieties, maximum yield per plant was recorded in the variety TFCP-2 (45.57 kg) followed by Redlady (44.23 kg) and minimum was recorded in TFCP-1 (38.14 kg). These results are in contrast with Meena *et al.,* (2012) [13] the variations in yield attributes of papaya might be due to expression of genetic characters under a particular set of environment. Moreover, yield performance of any variety is considered as a cumulative effect of yield attributes. Similar findings were found in Tyagi *et al.,* (2015) [20], Anh *et al.,* (2011) [1]. Fruit yield per plant had significant positive association with plant height at flowering, petiole length, number of leaves at flowering, fruit length, fruit girth, central cavity, pulp thickness, TSS and number of fruits per plant both at genotypic and phenotypic level respectively.

The variety Redlady recorded the maximum yield per hectare (121.62 t/ha) due to gynodioecious nature and minimum was recorded in the variety TFCP-4 (71.36 t/ha) due to its dioecious nature some of the plants are male which could not yield fruits. Highest yield per hectare was recorded in variety Redlady was mainly due to translocation of photosynthates from source to sink and photo-respiration that took place in the plant body and different genetic constitution of varieties, which are responsible for expression of genetic characters under a particular set of environment. Fruit yield per plant had significant positive both association with plant height at flowering, petiole length, number of leaves at flowering, fruit length, fruit girth, central cavity, pulp thickness, TSS and number of fruits plant^{-1} both at genotypic and phenotypic level respectively Kumar *et al.,* (2015) [12].

Fruit quality attributes

Quality parameters like TSS, titratable acidity and fruit colour were significantly different among the varieties. As shown in table 2, the maximum TSS was recorded in the variety TFCP-

4 (14.88^{0}brix) followed by Redlady (11.14^{0}brix) and minimum was recorded in TFCP-2 (6.50 ^{0}brix). Similar findings was recorded by Tyagi *et al*., (2015) [20] which might be attributed to its high photosynthetic efficiency and fast rate of diversion of sugars from source (leaf) to sink (fruit), in comparison to other varieties.

Fruit size, shape, smooth skin and absence of blemishes, skin and flesh colour are the major characteristics that determine the market price and export grades for fruits (Barrett *et al*., 2010; Zhou *et al*., 2014) [5, 22]. The evaluation fruit characters revealed that among all the varieties Red Lady recorded attractive orange pulp colour, where as remaining varieties recorded orange red pulp colour. Fruit colour gives the first impression of the fruits to the consumers and is an indicator of freshness and flavor quality. Hence, an attractive product can stimulate the desire of purchasing while an inappropriate colour indicates loss of freshness or lack of ripeness (Okoth *et al*., 2013; Barrett *et al*., 2010) [15, 5]. In papaya, most female plants produce large round-shaped fruits of good quality with a large seed cavity while hermaphrodite plants produce small to medium elongated fruits of good quality but with a smaller seed cavity (Villegas, 1997; Nakasone and Paull, 1998) [21, 14].

The high amount of total soluble solids in TFCP-4 and Red Lady may be attributed to its high sugar content. In contrast, the variety TFCP-2 recorded the lowest amount of total soluble solids (6.50°Brix). These results are in contrast Jana *et al*., (2010) [11] and Chalak *et al*., (2016) [8]. The variation in TSS in varieties might be due to their genetic makeup and its own nature of variety which govern the chemical composition of the fruits. TFCP-4 recorded the minimum acidity (0.21%) and maximum found in variety TFCP-1 (0.33%). This was mainly due to genetical character of variety and positive correlation with the total soluble solids. Similar finding was recorded by Das and Dinesh (2014) [9].

Among the varieties maximum pulp thickness was recorded in the variety Redlady (3.96 cm) and minimum was recorded in the variety TFCP-1 (3.01 cm). Similar findings was recorded by Meena *et al*., (2012) [13] according to them the variation in pulp thickness might be based on the fact that every genotypes has its own nature in development of fruits which may be varied due to various physiological phenomenon, *viz*. photosynthetic efficiency, rate of translocation of photosynthates from source to sink and photo-respiration that takes place in the plant body. These results are in contrast with Jana *et al*., (2010) [11], Chalak *et al*., (2016) [8] and Das and Dinesh (2014) [9].

Table 1: Fruit Quality Traits of Different Papaya Varieties

Varieties	Fruit weight (kg)	Fruit Length (cm)	Fruit diameter (cm)	Fruit volume (ltrs)	Fruit cavity length (cm)	Fruit cavity width (cm)	Fruit cavity diameter (cm)	Pulp Colour	Pulp thickness (cm)	TSS (º B)	Acidity (%)
TFCP-1	1.23	18.52	37.9	1.69	17.45	11.87	10.52	Orange	3.01	6.80	0.33
TFCP-2	0.98	21.04	35.1	1.24	19.88	10.82	10.26	Orange Red	3.04	6.50	0.30
TFCP-3	1.30	16.22	47.1	1.85	16.10	14.14	16.06	Orange Red	3.87	7.90	0.31
TFCP-4	1.09	21.80	37.1	1.39	21.12	11.74	11.14	Orange Red	3.63	14.88	0.21
Red Lady	0.99	18.88	39.2	1.12	17.74	12.80	11.82	Orange	3.96	11.14	0.24
C.D (5%)	0.24	2.04	4.48	0.35	1.35	1.03	1.82	-----	1.12	1.57	0.62
SE(m)	0.07	0.65	1.43	0.11	0.43	0.33	0.59	-----	0.36	0.50	0.20

Table 2: Yield and yield attributes of Different Papaya Varieties

Varieties	Fruit weight (kg)	Marketable fruits	Unmarketable fruits (**)	Total no of fruits per plant	Yield (Kg/Plant)	Yield (t/ha)
TFCP-1	1.23	31.01	18.50	45.51	38.14	89.21*
TFCP-2	0.98	46.50	32.95	79.45	45.57	92.73*
TFCP-3	1.30	30.05	13.00	43.86	39.06	107.41
TFCP-4	1.09	38.05	20.84	59.40	41.86	71.36*
RED LADY	0.99	44.23	12.19	56.43	43.78	121.62
C.D (5%)	0.24	3.45	1.71	3.29	2.99	2.87
SE(m)	0.07	1.10	0.55	1.05	0.96	0.92

(*) TFCP-1,2 and 4 are dioecious types. Hence while calculating yield/ha, only yield of female plants was calculated. (**) indicates immature, diseased and deformed fruits.

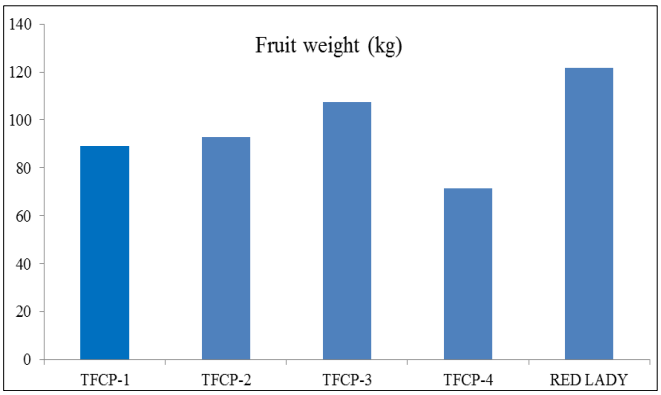

Fig 1: Fruit weight of different papaya varieties

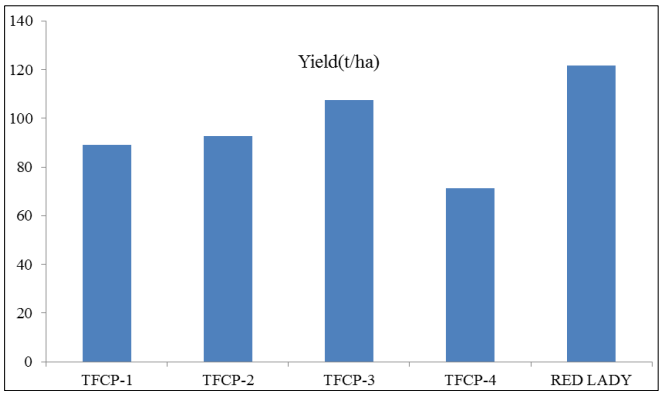

Fig 2: Yield of different papaya varieties

References

1. Anh NT, Trang PN, Hong NTB, Hoan NG. Evaluating agronomic characteristics of twelve local papaya (*Carica papaya* L.) varieties in Viet Nam. Bull. Inst. Trop. Agr. 2011; 34:15-22.
2. Anon, 2015, Indian Horticulture Database-2015. http: //www. Nhb. gov.in.
3. Aravind G, Bhowmik D, Duraival S, Harish G. Traditional and Medicinal uses of *Carica papaya*. Journal of Medicinal Plant Studies. 2013; 1(1):7-15.
4. Azad MAK, Rabbani MG, Amin L. Plant regeneration and somatic embryogenesis from immature embryos derived through interspecific hybridization among *Carica* species. International Journals of Molecular Sciences. 2012; 13:17065-17076.
5. Barrett DM, Beaulieu JC, Shewfelt R. Color, flavor, texture, and nutritional quality of fresh-cut fruits and vegetables: Desirable levels, instrumental and sensory measurement, and the effects of processing. Critical Reviews in Food Science and Nutrition. 2010; 50(5):369-389.
6. Bhatt GM. Significant path coefficient analysis in determining the nature of characters association. Euphytica. 1973; 22(2):338-343.
7. Burton GW, Devane EH. Estimated heritability in tall fescue (*Fescue arundinacea*) from replicated clonal material. Agron. J. 1953; 45:478-480.
8. Chalak SU, Kamble AB, Bhalekar SG. Evaluation of different papaya cultivars for yield, quality and papaya ring spot disease under pune conditions. J Krishi Vigyan. 2016; 5(1):60-63.
9. Das SC, Dinesh MR. Studies on fruit set and germination in some papaya cultivars. Acta Hort. 2014; 1022:87-90.
10. Goenaga R, Irizarry H, Amadora R. Yield and fruit quality of papaya fruits grown at two locations in Puerto and Rico. J Agric. Univ PR. 2001; 85(3-4):127-134.
11. Jana BR, Rai M, Nath V, Das B. Promising papaya (*Carica papaya* L.) varieties for Subtropical Plateau Region of Eastern India. Acta Hort. 2010; 851:131-136.
12. Kumar M, Prasad Y, Kumar M, Prakash S, Kumar S. Evaluation of genetic variability, genetic advance, heritability and character association for yield and its contributing traits in papaya (*Carica papaya* L.). Society Plant Research. 2015; 28(2):99-102.
13. Meena BS, Varma LR, Mehta RS. Evaluation of papaya varieties under North Gujarat conditions. Indian J Hort. 2012; 69(1):114-116.
14. Nakasone HY, Paull RE. Papaya. In: Tropical fruits. CAB International, Wallingford, 1998, 239-269.
15. Okoth EM, Sila DN, Onyango CA, Owino WO, Musyimi SM, Mathooko FM. Evaluation of chemical and nutritional quality attributes of selected mango varieties at three stages of ripeness, grown in lower Eastern province of Kenya - part 2. Journal of Animal and Plant Sciences. 2013; 17(3):2608-2618.
16. Panse VG, Sukhatme PV. Statistical methods for Agricultural workers. ICAR, New Delhi, 1985, 158-162.
17. Popenoe W. Manual of Tropical and Sub tropical Fruits, Hafner Press, 1974, 225-269.
18. Ranganna S. Handbook of analysis and their quality control for fruits and vegetable products.2nd Edn. Tata McGraw-Hill publishing co. Ltd. New Delhi, India, 1979, 9-82.
19. Retuta. Biochemical characteristics of papaya, Processing of the XV Eucarpia meeting on genetics and breeding of papaya, 2-4 september, 2013, torino-Italy, 2012.
20. Tyagi M, Singh H, Jawandha SK. Performance of papaya cultivars grown under protected conditions. Indian J Hort. 2015; 72(3):334-337.
21. Villegas VN. *Carica papaya* L., in: Verheiji EWM, Cornel RE (Eds.) Plant resources of South East Asia. 2: Edible fruits and nuts, Prosea Found, Bryor, Indones, 1997.
22. Zhou L, Paull RE, Chen NJ. Papaya: Postharvest quality maintenance guidelines. Fruit, nut and beverage crops, 2014. https://www.ctahr.hawaii.edu/oc/freepubs/pdf/F_N-34.pdf