

**“TO STUDY INFLUENCE OF DIFFERENT ORGANIC  
MANURES ON GROWTH, YIELD, AND QUALITY OF PAPAYA  
(*Carica papaya* L.) IN CHHATTISGARH PLAINS”**

**M.sc. (Horti) Thesis**

**By**

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COLLEGE OF AGRICULTURE  
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INDIRA GANDHI KRISHI VISHWAVIDYALAYA  
RAIPUR (CHHATTISGARH)**

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**“TO STUDY INFLUENCE OF DIFFERENT ORGANIC  
MANURES ON GROWTH, YIELD, AND QUALITY OF PAPAYA  
(*Carica papaya* L.) IN CHHATTISGARH PLAINS”**

**Thesis**

**Submitted to the  
Indira Gandhi Krishi Vishwavidyalaya**

**By  
Bhavya Vishwakarma**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE  
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**In**

**Horticulture**

**(Fruit Science)**

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## CERTIFICATE – I

This is to certify that the thesis entitled “**To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya* L.) in Chhattisgarh plains**” submitted in partial fulfillment of the requirements for the degree of **Master of Science in Horticulture (Fruit Science)** of the Indira Gandhi Krishi Vishwavidyalaya, Raipur, is a record of the bonafide research work carried out by **Bhavya Vishwakarma** under my guidance and supervision. The subject of the thesis has been approved by Student’s Advisory Committee and the Director of Instructions.

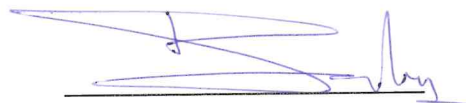
No part of the thesis has been submitted for any other degree or diploma (certificate awarded etc.) has been published/published part has been fully acknowledged. All the assistance and help received during the course of the investigations have been duly acknowledged by her.

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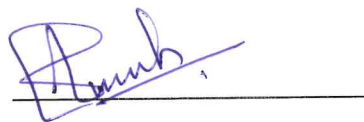
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Member (Dr. Annu Verma)



Member (Dr. R. R. Saxena)



## CERTIFICATE - II

This is to certify that the thesis entitled “**To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya* L.) in Chhattisgarh plains**” submitted by **Bhavya Vishwakarma** to the Indira Gandhi Krishi Vishwavidyalaya, Raipur in partial fulfillment of the requirements for the degree of “**Master of Science in Horticulture**” in the Department of Fruit Science has been approved by the external evaluator and student’s Advisory Committee after oral examination, under the chairmanship of Head of the Department.

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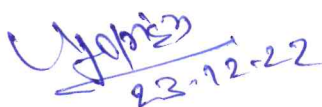
  
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23-12-22

Approved / Not approved

Director of instructions

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“When you travel with someone, the journey is easier. Particularly, interdependence is superior to independence..” I have had a lot of company and assistance. It is a pleasant feature that I got a golden opportunity to express my gratitude to all of them.

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## LIST OF NOTATIONS/SYMBOLS

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%	Per cent
<sup>0</sup> C	Degree Celsius
@	At the rate of
<i>et al.</i>	And others / co – workers
i.e.	That is
<i>Viz.</i>	For example

---

## LIST OF ABBREVIATION

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B : C ratio	Benefit – cost ratio
cm	Centimetre
CD	Critical difference
Fig.	Figure
g	Gram
ha	Hectare
hr	Hour
kg	Kilogram
m	Metre
m <sup>2</sup>	Square metre
mm	Millimetre
pH	Logarithm of the reciprocal of the H <sup>+</sup> ion activity
q	Quintal
RDF	Recommended dose of fertilizer
Rs	Rupees
SEm	Standard error of mean
t	Tonnes
ANOVA	Analysis of variance
RH	Relative humidity
kmph	Kilometer/hour
max	Maximum
min	Minimum
GA <sub>3</sub>	Gibberellic acid
ppm	Parts per million
DAT	Days after transplanting


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## THESIS ABSTRACT

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- a) Title of the Thesis : "To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya* L.) in Chhattisgarh plains."
- b) Full name of the student : Bhavya Vishwakarma
- c) Major subject : Fruit Science
- d) Name and address of the Major Advisor : Dr. G. D. Sahu (Assistant professor)  
Department of Fruit Science, CoA, IGKV,  
Raipur (C.G.)
- e) Degree to be awarded : M.Sc. (Horti.) Fruit Science

  
Signature of Major Advisor

  
Signature of the Student

Date:

  
Signature of Head of the Department

---

## ABSTRACT

The current study, "To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya* L.) in Chhattisgarh plains," was conducted from 2021 to 2022 at the research facility of the Precision Farming Development Center (PFDC), Department of Fruit Science (Horticulture), Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.).

The experiment was laid out in Randomized Block Design (RBD), with three replication and eleven treatments combination namely T<sub>0</sub> : 80% RDF + control, T<sub>1</sub> : 80% RDF + FYM (10 kg), T<sub>2</sub> : 80% RDF + Vermicompost (10 kg), T<sub>3</sub> : 80% RDF + Neem cake (10 kg), T<sub>4</sub> : 80% RDF + Castor cake (10 kg), T<sub>5</sub> : 80% RDF + Goat compost (10 kg), T<sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg), T<sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg), T<sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf

(10 kg), T<sub>6</sub>: 80% RDF + FYM (5 kg) + Leaf mold (5 kg), T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg), T<sub>8</sub>: 80% RDF + Neem cake (5 kg) Leaf mold (5 kg), T<sub>9</sub>: 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg), T<sub>10</sub>: 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg). The objective to assess the impact of different organic fertilizers on growth parameters of papaya, to estimate the yield and quality parameters of papaya and to workout B:C ratio over the treatments. Results revealed that all the parameters like plant height, number of leaves, petiole length, stem girth, number of fruits per plant, fruit length, fruit diameter, fruit weight, yield per plant, total yield, TSS, reducing sugars, non-reducing sugar, total sugar, acidity and ascorbic acid recorded highest in treatment T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg) which ultimately gave best results and superior from other treatments. The yield data like fruit weight, fruit yield plant<sup>-1</sup>, marketable fruit yield ha<sup>-1</sup> and post harvest observations like TSS, total sugar was found best under treatment T<sub>7</sub>. The maximum B:C ratio was recorded from the 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg).

## शोध सार

- अ थीसिस का शीर्षक : "छत्तीसगढ़ के मैदानी इलाकों में पपीते (कारिका पपीता एल.) की वृद्धि, उपज और गुणवत्ता पर विभिन्न जैविक खादों के प्रभाव का अध्ययन करना।"
- ब छात्रा का पूरा नाम : **भव्या विश्वकर्मा**
- स प्रमुख विषय : फल विज्ञान
- द मुख्य सलाहकार का नाम एवं पता : डॉ. जी. डी. साहू, सहायक प्राध्यापक  
फल विज्ञान, इं. गाँ. कृ. वि., रायपुर (छ.ग.)
- इ उपाधि से सम्मानित किया जाना है : एम. एस. सी. (उद्यानिकी) फल विज्ञान

मुख्य सलाहकार के हस्ताक्षर

छात्रा के हस्ताक्षर

दिनांक

विभागाध्यक्ष के हस्ताक्षर

## सारांश

वर्तमान अध्ययन, "छत्तीसगढ़ के मैदानी इलाकों में पपीते (कारिका पपीता एल.) की वृद्धि, उपज और गुणवत्ता पर विभिन्न जैविक खादों के प्रभाव का अध्ययन करने के लिए," प्रेसिजन फार्मिंग डेवलपमेंट सेंटर (पीएफडीसी) की अनुसंधान सुविधा में 2021 से 2022 तक आयोजित किया गया था।), फल विज्ञान विभाग (उद्यानिकी), इंदिरा गांधी कृषि विश्वविद्यालय, रायपुर (छ.ग.)।

प्रयोग रैंडमाइज्ड ब्लॉक डिजाइन (आरबीडी) में तीन प्रतिकृति और ग्यारह उपचार संयोजनों के साथ किया गया था, अर्थात् टी<sub>0</sub>: 80% आरडीएफ + नियंत्रण, टी<sub>1</sub>: 80% आरडीएफ + एफवाईएम (10 किग्रा), टी<sub>2</sub>: 80% आरडीएफ + वर्मीकम्पोस्ट (10 किग्रा), टी<sub>3</sub>: 80% आरडीएफ + नीम केक (10 किग्रा), टी<sub>4</sub>: 80% आरडीएफ + अरंडी केक (10 किग्रा), टी<sub>5</sub>: 80% आरडीएफ + बकरी खाद (10 किग्रा), टी<sub>6</sub>: 80% आरडीएफ + एफवाईएम (5 किग्रा) + लीफ मोल्ड (5 किग्रा), टी<sub>7</sub>: 80% आरडीएफ + वर्मीकम्पोस्ट (5 किग्रा) + लीफ मोल्ड (5 किग्रा), टी<sub>8</sub>: 80% आरडीएफ +

आरडीएफ + नीम केक (10 किग्रा), टी<sub>4</sub>: 80% आरडीएफ + अरंडी केक (10 किग्रा), टी<sub>5</sub>: 80% आरडीएफ + बकरी खाद (10 किग्रा), टी<sub>6</sub>: 80% आरडीएफ + एफवाईएम ( 5 किग्रा) + लीफ मोल्ड (5 किग्रा), टी<sub>7</sub>: 80% आरडीएफ + वर्मीकम्पोस्ट (5 किग्रा) + लीफ मोल्ड (5 किग्रा), टी<sub>8</sub>: 80% आरडीएफ + नीम केक (5 किग्रा) लीफ मोल्ड (5 किग्रा), टी<sub>9</sub> : 80% आरडीएफ + कैस्टर केक (5 किग्रा) + लीफ मोल्ड (5 किग्रा), टी<sub>10</sub>: 80% आरडीएफ + बकरी खाद (5 किग्रा) + लीफ मोल्ड (5 किग्रा)। उद्देश्य में पपीते के विकास मानकों पर विभिन्न जैविक उर्वरकों के प्रभाव का आकलन करने, पपीते की उपज और गुणवत्ता मानकों का अनुमान लगाने और उपचारों पर बी: सी अनुपात का आकलन करना शामिल है । उपज डेटा जैसे फलों का वजन, फल उपज प्रति संयंत्र, विपणन योग्य फल उपज प्रति हेक्टेयर और फसल के बाद के अवलोकन जैसे टीएसएस, कुल चीनी को उपचार टी 7 के तहत सबसे अच्छा पाया गया। अधिकतम बी: सी अनुपात टी<sub>7</sub> : 80% आरडीएफ + वर्मीकम्पोस्ट (5 किग्रा) + लीफ मोल्ड (5 किग्रा) से दर्ज किया गया था।

## CHAPTER – I

### INTRODUCTION

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The papaya (*Carica papaya* L.), often known as papaw or pawpaw, is a tropical fruit with significant commercial worth due to its great nutritional and therapeutic value. It is a big plant in the family Caricaceae. Spanish chronicler Oviedo first wrote about papaya in 1526 after discovering it on the shores of Panama and Colombia. The fruit quickly spread throughout the tropics, most likely as a result of the fruit's plentiful and highly viable seeds.

The crop has done quite well in tropical regions with rich soils and lots of rain. The seeds were brought to the Philippines, Malaysia, and India by Spanish and Portuguese mariners during the following century. Since 1600, warm climates in South and Central America, Southern Mexico, the Antilles, Bahamas, Bermuda, and Florida have produced the fruit. Pawpaw seeds were transported from India to Naples, Italy, around the same century. Hawaii began to receive the crop between 1800 and 1820. Papaya seeds were brought to Florida up to 1900, most likely from plantations in the Bahamas. Since 1911, Hawaii has been growing the Solo cultivar, which was likely imported from Barbados and Jamaica.

The cultivation of papaya began in Costa Rica and southern Mexico. Fruit output is expected to be 6 million tonnes annually throughout the world. Approximately 3 million tonnes of papaya are produced annually in India, which is the world's top producer. Brazil, Mexico, Nigeria, Indonesia, China, Peru, Thailand, and the Philippines are additional major producers.

One of the significant and delectable fruit crops grown in tropical and subtropical regions of the planet is the papaya (*Carica papaya* L.). It originated in Mexico and has since spread to practically every tropical region. The papaya is a very intriguing and productive crop. It is simple to grow as a crop for a

short time. It is used in cooking and some preparations as a raw fruit. Its latex is utilised in the culinary and pharmaceutical industries as papain. Fruit that is in season is sweet and rich in carbohydrates and vitamin A. The fruits are rich in minerals including Fe, Ca, and P and include 10% carbs, 2500 IU of vitamin A per 100g, 700 mg of vitamin C per 100g, and 0.5% protein (Yadav, 2007).

As a tropical crop, papaya benefits from high temperatures and high levels of humidity. It is quite vulnerable to hail and cold. The lengthy days are advantageous for flavour and high quality. High rainfall during flowering is harmful and seriously damages the plant.

The fruit often has a spherical to cylindrical shape, measures 75 to 500 mm (3 to 20 inches) in length or even longer, and occasionally weights up to 9 to 11.5 kg (20 to 25.5 pounds). The extremely delicious flesh has a rich yellow, orange, or crimson hue. The numerous spherical, wrinkled black seeds are adhered to the walls of the enormous central chamber.

Even though the papaya plant can grow to a height of 8 metres (26 feet), its palm-like trunk is not as woody as the name might suggest. Deeply lobed leaves that can measure 60 cm (2 ft) across and are carried on hollow petioles (leaf stalks) that are 60 cm long cover the top of the plant. Although the species is typically dioecious, with male and female flowers growing on distinct plants, there are known hermaphrodite varieties and there are several anomalies in the distribution of the sexes. On stalks 90 cm long, male flowers are produced in clusters. These funnel-shaped, whitish flowers are 2.5 mm (0.1 inch) in length and have 10 stamens in the throat. The female flowers are much larger, on very short stalks, and frequently grow alone in the leaf axils. They feature five fleshy petals that converge toward the base, a huge cylindrical or globose superior ovary, and five sessile stigmas in the form of fans on top of the ovary.

The papaya is seed propagated for commercial purposes. Only research labs can use the tissue culture procedure. The seeds lose viability quickly, therefore they shouldn't be kept in storage for longer than a season. The prepared seedlings are placed in polybags. The newly germinated and immature plants are carefully protected from damping off. Within 6-8 weeks, the seedlings are transplant-ready.

The virus diseases that are spread by insect vectors can affect papayas. To stop the disease from spreading further, the rouging off is closely followed. In addition, insecticidal sprays are used to combat aphids, white flies, and other pests that feed on plant sap. Providing wind breaks, well-drained conditions to the soil, avoiding planting papaya after papaya, and following a suitable crop rotation are some of the methods that will help to keep the papaya crop in good health condition. Other steps include keeping the field clean and weed-free.

In order to ensure optimal fruit set, male trees should be removed following the appearance of inflorescence, keeping one male tree for every 20 female plants. Only one strongly growing female or hermaphrodite tree should be left in each pit, and all other vegetation should be taken out. Keep one hermaphrodite type/pit in gynodioecious types like (Co 3 & Co 7) and cut down female trees.

Approximately 3 million tonnes of papaya are produced annually in India, which is the world's top producer. Brazil, Mexico, Indonesia, China, Peru, Thailand, and the Philippines are additional top producers.

Cancer is one of the diseases that papaya is used to treat. According to research, eating papaya may lower your risk of developing colorectal and gallbladder cancer. Diabetes - According to preliminary studies, taking

fermented papaya every day for two months can lower blood sugar levels in those who have diabetes. Infection with the human papillomavirus (HPV). Consuming papaya may lower your chances of HPV infection, according to research. Parasitic infections and issues with the stomach and intestines.

India saw a 63% rise in papaya cultivation area from 45.2 thousand ha in 1991–1992 to 73.7 thousand ha in 2001–2002, and a 26% increase in production from 8 lakh tonnes to 26 lakh tonnes. The states of Andhra Pradesh, Karnataka, Gujarat, Orissa, West Bengal, Assam, Kerala, Madhya Pradesh, and Maharashtra are where papaya is primarily grown.

In the past year, Andhra Pradesh has seen a daily increase in the area planted with papaya. Gujarat is the state with the most land planted in papaya, and Andhra Pradesh leads the way in terms of production, with Tamil Nadu having the highest levels of productivity. Currently, there are 143000 hectares, 5980000 million tonnes of production, and a productivity of 42.6 million tonnes per hectare. (NHB, 2019-20)

One of the more sophisticated irrigation techniques is the drip system, which delivers water straight to the roots of the crop at a very slow rate (between 2 and 20 litres per hour), using only the quantity necessary for the crop. The device drastically decreases water use and nutrient leaching. (Narayanamoorthy, 2004). Productivity of papaya can be increased by 80% using drip irrigation (Bar Yosef, 1991).

Papaya requires a lot of nutrients to continue growing vegetatively, fruit, and blossom, so chemical fertilisers are used to augment it. These fertilisers are not only expensive, but they also affect the soil and ground water. The majority of farmers are small-scale and impoverished, and therefore cannot afford the expensive chemical fertilisers that are needed in significant

quantities to meet the crop's ongoing nutrient needs. Additionally, the usage of chemicals has caused multinutrient deficits, nutrient imbalances, and a gradual decline in the health and productivity of the soil. (Nambiar and Abrol, 1989).

Mulching is a procedure used to maintain soil temperature, stop soil moisture buildup, limit weed development, prevent soil erosion, reduce soil salinity, enhance soil structure, increase water infiltration rates, and manage pest and disease occurrence. These elements all promote plant development (Singh, 2008) and fruit production (Prasad, 2005; Chattopadhyay, 2007). In the past 60 years, the development of synthetic materials has changed the practices and advantages of mulching, which previously involved a variety of organic materials such as compost, leaf, straw, and dead leaves. The hydrothermal regime is improved, a significant amount of organic carbon is supplied, and a significant number of microbes are encouraged in the soil via grass mulching. (Srivastava *et. al.* 2002).

Considering this situation the present investigation with title “**To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya* L.) in Chhattisgarh plains**” was planned with following objectives :

1. To assess the impact of different organic fertilizers on growth parameters of papaya.
2. To estimate the yield and quality parameters of papaya.
3. To workout B:C ratio over the treatments.

## REVIEW OF LITERATURE

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Any study needs to be well-planned, and excellent planning requires current knowledge of previous research. With this in mind, an effort has been made to gather the pertinent material and present it in this chapter under pertinent themes. The information on the effects of using organic manures and combining organic and inorganic nutrient sources on papaya and other fruit crop growth, yield, and quality is few; as a result, the pertinent literature in various crops has been evaluated and given in this chapter.

### **2.1 Effects of various organic manure sources combined with inorganic fertilisers on papaya growth, yield, and quality attributes.**

#### **2.1.1 Nutrient management**

Jeyakumar *et al.* (2001), observed that fertigation with 13.5 g urea and 10.5 g ph MoP per week and soil application of super phosphate @ 278 g per plant at fortnightly intervals increased papaya development characteristics.

Bindu (2003 a) discovered that applying nitrogen, phosphate, and potassium to papaya plants boosted plant height, girth, and leaf number. The highest plant height was achieved by applying 200 g N, 300 g P, and 500 g K per plant per year, whereas the highest plant girth was achieved by applying 250 g N, 300 g P, and 500 g K per plant per year. The largest number of leaves was obtained with a combined application of 300 g N, 250 g P, and 500 g K per plant per year. Flowering took the shortest time for plants given a dose of 250 g nitrogen, 300 g phosphorus, and 500 g potassium. The use of a combination of 250 g of nitrogen per plant, 250 g of phosphorus per plant, and 500 g of potassium per plant cut the time it took to harvest the first fruit in half. Nitrogen, phosphorus, and potassium were applied to increase fruit weight, number of

fruits per plant, yield per plant, and papain production. The maximum yield was obtained with an annual application of 250 g N, 250 g P, and 500 g K per plant.

Harthi and Yahyai (2009) used three levels of chemical fertilizers in Banana: N (300, 600, 900 g plant<sup>-1</sup> year<sup>-1</sup>), P (50, 100, and 150 g plant<sup>-1</sup> year<sup>-1</sup>), and K (250, 500, and 750 g plant<sup>-1</sup> year<sup>-1</sup>), as well as a non-fertilized control (no NPK applied) treatment. The results showed that non-fertilized plants had lower vegetative growth characteristics (leaf number, leaf area, stem height, and stem circumference) than fertilized plants. N (600 g plant<sup>-1</sup> year<sup>-1</sup>), P (100 g plant<sup>-1</sup> year<sup>-1</sup>), and K (500 g plant<sup>-1</sup> year<sup>-1</sup>) make up the fertilizer treatment T3. In comparison to other treatments, quantitatively altered the yield and fruit attributes of the Williams' banana, such as total bunch weight, middle-hand weight, and number of fingers per middle hand. Williams' banana, such as total bunch weight, middle-hand weight, and number of fingers per middle hand.

Kumar *et al.* (2010) studied the effects of four graded levels of potash fertilizer (0, 150, 300, 450 K<sub>2</sub>O g plant year) as well as N 300 and P<sub>2</sub>O<sub>5</sub> 300 g plant year on growth, yield, and quality in Cvs. CO 2 and CO 7 in five distinct locations in Tamil Nadu, India. In four locations, potassium nutrition had no effect on stem girth, but in one location, potassium nutrition had a considerable impact on stem girth. With the administration of potassium nutrition ranging from 300 g per plant<sup>-1</sup> year<sup>-1</sup> in one site to 450 g per plant per year in two locations, the leaf number was dramatically altered. According to the findings of the studies, balanced fertilization with N 300, P<sub>2</sub>O<sub>5</sub> 300 K<sub>2</sub>O 300 kg per ha per plant is advised for papaya to increase output and quality latex.

Rajbhar *et al.* (2010) conducted a field experiment on Cv. Pant papaya 1 with three doses of Nitrogen (200, 250, and 300 g) and two doses of Phosphorus and Potash (200 and 250 g per plant) in varied combinations. The treatment N<sub>3</sub> P<sub>2</sub> K<sub>2</sub> (300 g N and 250 g each of P and K per plant) produced the highest plant height (144.11 cm), average fruit weight (1298.88 g), and average number of fruits (44.66) among the treatments.

Singh Kirad *et al.* (2010) In Papaya Cv. Surya, found that 755 + 25% vermicompost + rhizosphere bacteria culture produced the most leaves, trunk girth, and fruit shelf life, while 100 percent RDF alone produced the most plant height and petiole length.

Santos *et al.* (2015) used four nitrogen doses (320, 400, 480, and 560g of N per plant) and four potassium doses (980, 475, 570, and 665 g of K<sub>2</sub>O per plant) in a randomised block experiment with four replications of three papaya plants each. Fruit mass, titrable acidity, soluble solids, pulp pH, and fruit length and width were all reported. As a result, they discovered that the nitrogen and potassium content of papaya leaves influences fruit quality. The higher the soluble solids, pH, fruit length, and fruit mass, the higher the concentration of leaf N (45.30 g per Kg) and leaf K (35.55 g per Kg).

Emanoela *et al.* (2015) investigated "Growth and Efficiency of Water Use of Papaya Cultivars (*Carica Papaya* L.) under Doses of Bovine Biofertilizer in Hydroponics Cultivation" and found that the papaya cultivars were evaluated for growth, dry matter accumulation, and water use efficiency in relation to their biofertilizer doses during the first 60 days after sowing. In compared to the Sunrise Solo cultivar, Tainung-01 has a stronger capacity for growth, biomass accumulation, and water efficiency. For the cultivars Sunrise Solo and Tainung-01, doses of bovine biofertilizer of 25 and 35 percent (v/v) encouraged increased growth and dry matter accumulation, respectively.

According to Panigrahi *et al.* (2015), fertigation with water soluble fertilisers had a significant impact on papaya plant vigour, flowering and fruit set, yield, and quality. Different growth and yield parameters such as stem girth (51.72 cm), number of fruits per plant (76.27), fruit weight (1.42 kg), and yield (145.23 t per ha) were found to be maximum under 100 percent RDF through fertigation, while days required to first flowering and fruiting were found to be minimum under the same treatment.

Bindu (2015 b) observed that adding 200 g of nitrogen per plant, 250 g of phosphorus per plant, and 500 g of potassium per plant increased the overall sugar content of papaya fruits. The main effect of 200 g of nitrogen per plant, 300 g of phosphorus per plant, and 500 g of potassium per plant, as well as their interaction, enhanced reducing sugars in papaya fruits, which improved the fruits' organoleptic quality. The majority of the treatments had light yellow peels, orange pulp, and firm flesh, but none of these factors affected the non-reducing sugar level.

Prajapati *et al.* (2017) investigated the effect of fertigation on growth parameters and physiological features, which led to increased yield. In fertigation with 100% RDF + Plastic mulch+ Vermiwash + Neemseed extract, the maximum fruit weight (1.01kg) was recorded. T10 (.981kg), T3 (.912kg), T6 (.911kg), T2 (.899kg), T9 (.890kg), and T5 (.877kg) were all on par, however T12 had the smallest weight of fruit (0.691 kg). Because of the increased fruit weight and number of fruits per plant (28.11kg), the overall fruit production per plant increased (28.29kg plant<sup>-1</sup>). Agrawal *et al.* reported similar findings (2010). T11 produced the largest fruit production ha<sup>-1</sup> (87.31MT).

Kanwar *et al.* (2020) In treatment T8 (75 percent RDF + 10 kg Vermi-compost + 100 g Azotobacter + 100 g PSB/Plant), focused on growth attributing measures such as plant height, plant spread, number of leaves, petiole length, and days to first flowering, fruiting, and maturity.

Agrawal *et al.* (2020). the fruit output per plant (38.95 kg) and per ha (116.86) were found to be substantial in papaya plants provided with RDF + Azospirillum@ 10 gm / plant + PSB @ 10 gm / plant. In terms of quality parameters, the treatment RDF+ FYM@ 10kg /plant +Azospirillum @ 10 gm / plant + PSB @ 10 gm / plant had the lowest titratable acidity (0.015 percent) and the highest content of total soluble solids(8.00 Brix), total sugars (9.73 percent), and the treatment RDF+ FYM@ 10kg /plant +Azospirillum @ 10 gm RDF +Azospirillum@ 10 gm /plant + PSB @ 10 gm

/plant produced the best net realisation of Rs.711911.00 per hac and the highest benefit cost ratio (6.7). Similarly, poor performance was reported in the control group.

### **2.1.2 Effect of organic manure**

Kaur *et al.* (2007) , In Litchi Cv. Rose scented, found that the FYM 100 kg per tree boosted plant spread, stem girth and panicle length, maximum fruit set, minimum fruit drop, and minimum fruit cracking.

Rai *et al.* (2009) used 40 kg vermicompost per tree per year for two years in pear CV. Gola, which resulted in significant increases in fruit weight (220 g and 221.19 g), fruit yield (78.63 kg per tree and 80.98 kg per tree), yield efficiency (1.22 kg per metre cube), TSS (13.00 percent and 12.10 percent), ascorbic acid content, and yield efficiency (1.22 kg per metre cube) (9.66 mg pr 100 g and 10.31 mg per 100 g).

Singh *et al.* (2010) in Strawberry, found that applying 10 t per ha of vermicompost enhanced plant spread (16.1%), leaf area (31.4%), and dry matter (17.7%) and required only 86 days to blossom, number of fruit per plant (30.5), individual berry weight (13.4 g), and overall fruit output (387.5 g per plant). However, 7.5 t per hectare of vermicompost yielded fruits with a high TSS (7.42%), lower acidity (1.10%), and increased ascorbic acid content (50.8 mg per 100 g pulp).

Singh and Singh (2011) conducted an experiment at the Horticultural Research Station, Birauli (RAU, Bihar) to investigate the effect of fertigation on papaya (Pusa Delicicious). They found that fruit characteristics of papaya were superior with 100 percent fertigation, followed by 80 percent and 60 percent fertigation treatments.

Yadav *et al.* (2011), using 30 kg FYM + 100 percent NPK + 25 g azotobacter resulted in the highest fruit weight number of fruits per plant yield kg plant and q ha in papaya cv. Pusa Dwarf.

Rani *et al.* (2013) told that by applying FYM 150 kg per tree to Litchi Cv. Rose scented, observed the maximum tree height, tree spread, tree volume, and panicle length, as well as fruit set (38.13 percent and 42.87 percent) and fruit retention (37.64 percent and 41.86 percent) and higher yield (98.99 and 94.91 kg per tree).

Mohit Kumar and Rajesh Kumar (2014) observed that by applying 75 kg of vermicompost per tree to mango trees resulted in the highest TSS, titrable acidity, total sugars, and ascorbic acid concentration in the fruit. While applying 25 kg of vermicompost per tree resulted in the highest quantity of reducing sugars, applying 50 kg of poultry manure per tree resulted in higher non-reducing sugar content in mango fruit.

Shivakumar *et al.* (2007) studied "Effect of Organic Cultivation of Papaya on Yield, Economics, and Soil Nutrient Status,". The study found that using FYM equivalent to 100 percent recommended dose of nitrogen (RDN) (154.3t/ha) resulted in a significantly higher fruit yield of 173.9 t/ha than using RDF and other organic manure treatments, with the exception of agrigold equivalent to 100 percent RDN (33.32 t/ha) and vermicompost, sheep manure, and bhumilabha in combination with FYM treatments each equivalent to 50 percent RDN. With the use of FYM equivalent to 100 percent RDN, higher gross and net returns were achieved, and the benefit-to-cost (B:C) ratio was at its highest. Organic carbon, DTPA-extractable Cu, and Mn levels in the soil following the harvest of the papaya crop showed no significant differences between the treatments. When DTPA extractable Zn and Fe in combination with FYM and vermicompost each corresponding to 50 percent RDN were used as RDF, available main nutrients (NPK) were significantly higher.

Pranesh *et al.* (2016) told that the vegetative growth parameters such as plant height, stem girth, number of leaves per plant, canopy spread, and physiological parameters such as leaf area index, light interception, and chlorophyll content were influenced significantly by different treatments,. The use of 7.5 kg vermicompost + RDF was proven to improve papaya growth and yield. The treatment 7.5 kg

vermicompost + RDF had the highest plant height (3.56 m) and stem girth (16.11 cm), number of leaves per plant (39.42), canopy spread (E-W 3.16 and N-S 3.19m), leaf area index (4.35), light interception (91.14 percent), and chlorophyll content (53.81). Similarly, the treatment 7.5 kg vermicompost + RDF had the highest number of fruits (43.55), fruit diameter (13.46 cm), average fruit weight (1.13 kg), yield per plant (43.75 kg), and yield per hectare (132.34 t). However, the treatment 15 kg FYM with RDF had the highest net return (7,03,113.33 ha<sup>-1</sup>) and benefit cost ratio (3.09). (T3).

#### **2.1.2.1. Effect of farm Yard manure**

Farm yard manure (FYM) appears to be directly responsible for enhancing crop yields via speeding up the respiratory process, increasing cell permeability through hormonal activity, or a combination of these activities. It provides accessible forms of nitrogen, phosphorus, potassium, and sulphur to plants through biological breakdown. It enhances soil physical qualities such as aggregation, permeability, and water retention capacity indirectly.

##### **2.1.2.1.1 Growth parameters**

Lal (1998) found that applying 10 kg FYM, 450 g N, 300 g P, and 300 g K per plant to kinnow mandarin resulted in increased plant height (2.90 m), trunk girth (23.00 cm), and plant spread (8.73 sq. m).

Goramnagar *et al.* (2000) discovered that Nagpur orange plants treated with FYM (15 kg), N (360 g), and P (180 g) per plant had the highest plant height and spread.

Marimutha *et al.* (2001) found that applying FYM (50 kg) with 100 percent RDF per palm every year resulted in more bunches, buttons, and a higher proportion of nuts set.

Tirkey *et al.* (2002) noted increased plant height and girth of pseudostem (30 Kg). when banana plants Cv. Dwarf cavendish were fed 100 percent RDF and FYM.

Hirwale *et al.* (2004) noted that the application of organic manure coupled with approved NPK fertilizers resulted in a larger tree spread and canopy volume of acid lime crop.

Malik *et al.* (2011) discovered that increasing sweet orange plant height (55.65 cm), number of branches (6.61), and plan spread by applying nitrogen 150 kg, phosphorus 120 kg, and potash 60 kg per ha with FYM 40 t per ha was more effective (44.50 cm).

Bisth *et al.* (2012) told that Plant height, stem girth, and number of leaves in papaya were highest at FYM 30 kg, 300 N, 240 P, and 150 K.

Garhwal *et al.* (2014), applied FYM (80 kg per plant) to mandarins enhanced trunk diameter (9.47 percent), plant height (12.48 percent), plant spread (North-South, 13.60 percent; East-West, 14.17 percent), and reduced the number of days to 75 percent blooming and fruit set commencement.

Tandel *et al.* (2014), reported that by applying 25% RDN (recommended dose of nitrogen) through bio compost, 25% RDN through castor cake, and 50% RDN through inorganic fertilizer to papaya favours greater values of growth features such as plant height, stem girth, and number of leaves. The physiological parameters of photosynthetic rate, total chlorophyll content, transpiration rate, and leaf temperature were also affected by this therapy.

Srinu *et al.* (2017) investigated the use of organic, inorganic, and biofertilizers in the integrated management of nutrients on papaya. By applying a recommended fertilizer dose of 75 percent + 10 kg vermi compost + 100g azotobacter + 100G PSB per plant, they found the maximum value on growth characteristics such as plant height, tree trunk, petiole width, number of leaves per plant, early flowering initiation, and minimum days required to fruit maturity. This method of management has been found to be an excellent way to improve soil fertility and growth characteristics.

### 2.1.2.1.2 Yield parameters and yield

Muhammad *et al.* (2000), observed that by applying 50% RDF with 80 kg FYM to guava provided the best yield, 63.58 kg. It also enhanced the average fruit weight and size substantially.

Jayasudara and Huruggmuwa (2005) said better fruit yield and decrease of in step with cent of small end result in step with tree (40.five kg tree<sup>-1</sup> and 6.9% respectively) in papaya with the encouraged dose of NPK tiers with farm animals manure.

Marathe and Bharambe (2007) When plants were given FYM (to supply 50 percent N) and 50 percent RDF, reported more fruits per plant, fruit length, fruit width, fruit weight, fruit skin thickness, and yield per ha of sweet orange fruits.

Marathe *et al.* (2009), told that the maximum fruit yield of sweet orange was achieved by using 100% N as FYM and the recommended quantity of chemical fertilizer.

Muhammad *et al.* (2009) Maximum yield per plant, weight of a single fruit, and diameter of guava fruit were determined using 40 kg FYM with 1 kg NPK per plant.

According to Kumar *et al.* (2010), applying N 300, P<sub>2</sub>O<sub>5</sub> 300, and K<sub>2</sub>O 300 kg/year to papaya cvs CO-2 and CO-7 resulted in the highest single fruit weight and fruit yield in yellow and red fleshed cultivars of papaya.

In papaya, Bisth *et al.* (2012) found that the highest yield (62.12 kg per plant) was achieved at FYM 30 kg with 300 N, 240 P, and 150 K.

Shivakumar *et al.* (2012) found that using FYM equivalent to 100% RDN (154.3 t ha<sup>-1</sup>) in papaya improved fruit length (15.3 cm), number of fruits per plant (84 Nos), yield per plant (56.36 kg plant<sup>-1</sup>), and yield per ha (173.9 t ha<sup>-1</sup>), all while having a smaller cavity volume (105 ml) and cavity index (16.54 percent).

In Banana, Patel *et al.* (2012) discovered that applying 10 kg FYM with 180 g N in organic form (castor cake), 90 g P, and 180 g K per plant resulted in the greatest fruit output of 17.50 kg per plant.

According to Vandana Dwivedi (2013), applying 50% NPK with 25 kg FYM and 5 kg vermicompost per tree resulted in the highest yield (90 q ha<sup>-1</sup>) in guava.

Sharma *et al.* (2013) found that combining 25% N from FYM with 75% N from inorganic fertilizer significantly boosted guava yield and yield parameters such as fruit length, breadth, and weight.

According to Garhwal *et al.* (2014), applying 80 kg FYM per plant to Mandrin boosted fruit output (25.22 kg tree<sup>-1</sup>), fruit number (212.75 fruits tree<sup>-1</sup>), average fruit weight (118.22 g), fruit diameter (5.96 cm), and fruit length (5.58 cm).

#### **2.1.2.1.3 Fruit quality parameters**

Muhammad *et al.* (2000) noted that guava had a high total soluble solids content (9.3% Brix) due to the combination of NPK fertilizer with FYM.

Jayasundara and Huruggamuwa (2005) found that the combination of NPK fertilizer and cow dung increased the pulp yield (83.6%), TSS (15.3%) and TSS acidity (19.87%) of papaya.

Maity *et al.* (2006) has the highest ascorbic acid content (145 mg per 100 g pulp) when treated with 50 percent RDF (130: 160: 130 g N: P: K per plant) and 50 percent FYM 17.35 kg per plant. Reported that it showed. Among the organic sources, FYM produced 34.7 kg per plant of better quality fruit.

Marathe and Bharambe (2007) reported maximum juice recovery and total sugar content when 50% RDF was given to FYM (to provide 50% N) to sweet orange trees.

Muhammad *et al.* (2009) reported a high proportion of TSS (11.35 Brix) per fruit and pulp weight (190.04 g) per guava fruit, combined with 40 kg FYM per plant using 1 kg of inorganic NPK fertilizer.

Patel *et al.* (2012) When 10 kg of FYM was applied with caster cake, bone meal and squeezed mud, it was found that the physiological weight loss of bananas was significantly minimized (10.04%).

Sharma *et al.* (2013) TSS, total sugar and minimal physiological weight loss (14.29%) were reported to be observed in plants treated with 25% N per tree by FYM and 75% N per tree by inorganic morphology.

Garhwal *et al.* In (2014), a significant increase in tangerine TSS, ascorbic acid, total sugar, reducing sugars, and non-reducing sugars was observed by applying 80 kg FYM per plant, but the acidity of fruit juice was Reported a decline.

#### **2.1.2.2. Effect of vermicompost**

Hopp and Slater were the first to report on the use of vermicompost in agriculture (1949). They also measured the crop's response to earthworms in terms of yield. According to Sadegh *et al.* (2015), vermicompost increased soil porosity, aeration, and water holding capacity, as well as the surface area, which resulted in strong nutrient absorbability and retention, as well as the ability to retain more nutrients for a longer period of time. The bulk density of soil modified with vermicompost was found to be considerably lower. According to Shrikande and Pathak (1948), vermicompost contained more organic matter than soils that had been turned over by ants and termites.

##### **2.1.2.2.1. Growth parameters**

According to Athani *et al.* (2005), guava plants fed with 75 percent RDF and 10 kg vermicompost had considerably greater total chlorophyll content (1.698 mg g<sup>-1</sup>).

According to Naik and Babu (2007), the guava plant treated with vermicompost 10 kg per plant produced the most shoots per tree (220), the longest shoot (100.32 cm), and the most leaves per shoot (79.35).

According to Singh *et al.* (2011), N P K 8:13:10 kg per ha with vermicompost 3.75 t per ha, 4 cm thick mulch of dried crop residue, and 50% irrigation treatments increased French bean shoot growth traits such as shoot length, number of primary branches, shoot fresh weight, and shoot dry weight by 28-63 percent.

Nandi *et al.* (2013) found that using enriched 10 kg vermicompost per plant with 75 and 100 percent RDF in pomegranate resulted in substantial improvements in plant height, canopy spread East-West, and North-South.

In papaya, Bhardwaj and Bajpai (2015) found that applying 10 kg vermicompost with 300:300:300 g NPK per plant per year led in the maximum plant height (269.90 cm), stem girth (48.50 cm), number of leaves (48.30), and leaf area (9.54 meter<sup>2</sup>).

#### **2.1.2.2.2 Yield parameters and yield**

According to Athani *et al.* (2005), guava trees fed with 75 percent RDF and 10 kg vermicompost per plant produced fruits with considerably larger diameter (7.55 cm), fruit weight (221.00 g), fruit volume (218.50 m<sup>3</sup>), pulp thickness (2.33) cm, and pulp weight (2.33) cm (143.00 g).

In guava plants treated with vermicompost 10 kg per plant, Naik and Babu (2007) recorded the largest number of fruits per shoot (4.0) and highest yield per plant (40.25 kg).

Nandi *et al.* (2013) found that adding 10 kg vermicompost per plant to pomegranate plants with 75 and 100 percent RDF boosted fruit volume and weight, as well as the quantity of fruits per plant and fruit output per plant.

Das *et al.* (2015) found that applying vermicompost at 5 kg per plant with FYM 20 kg per plant resulted in the maximum number of fruit per plant (289), highest yield per plant (40.82 kg plant<sup>-1</sup>), and highest yield per ha (11.34 t ha<sup>-1</sup>) in guava.

In sweet orange, Makode (2015) found that applying 10 kg vermicompost per plant resulted in a considerably higher number of fruit, fruit weight (165.4 g), and yield (40t per ha).

According to Bhardwaj and Bajpai (2015), applying 10 kg vermicompost per plant per year with 300 g N, 300 g P, and 300 g K resulted in highest fruit set (46.45). In papaya, the greatest fruit weight (2.19 kg fruit<sup>-1</sup>) and yield per plant (92.28 kg) are the highest.

#### **2.1.2.2.3 Fruit quality parameters**

Athani *et al.* (2005) found considerably higher values for TSS (10.83<sup>0</sup> Brix), ascorbicoacid (208.6 mg 100 g<sup>-1</sup>), and total sugars (8.62 percent), when guava was cultivated with 75 percent RDF and 10 kg of vermicompost per plant.

According to Nandi *et al.* (2013), 10 kg vermicompost per plant with 75 and 100 percent RDF boosted TSS, vitamin C, total and reducing sugars content in pomegranate juice.

Das *et al.* (2015) found that guava fruits with vermicompost 5 kg per plant and FYM 20 kg per plant had the highest TSS (10.40 Brix), total sugars (7.39%), reducing sugars (4.11%), non-reducing sugars (3.28%), and ascorbic acid (163.41 mg 100 g<sup>-1</sup>), as well as the lowest 0.21 percent acidity.

In papaya, Bhardwaj and Bajpai (2015) found that applying 10 kg vermicompost with 300:300:300 g NPK per plant per year resulted in the highest TSS (13.5<sup>0</sup> Brix) and the best maintaining quality (7.62 days).

### **2.1.2.3 Effect of neem cake**

According to Lokananadhan *et al.* (2012), Neem seed cake acts as a soil enricher, reduces the growth of soil pests and bacteria, provides macro nutrients essential for all plant growth, helps to increase plant yield in the long run, is biodegradable and environmentally friendly, and is an excellent soil conditioner.

#### **2.1.2.3.1 Growth parameters**

Dhomane *et al.* (2011) showed that tree height (39.7 cm), tree spread (EW, 38.0 cm and NS, 49.7 cm), trunk circumference (5.30 cm), shoot length (24.82 cm), maximum number of flowers (17.97), urea Early fruiting (9.08) and minimum days to fruit maturity on Guava trees were found when treated with 75% nitrogen from and 25% nitrogen from Neemcake.

#### **2.1.2.3.2 Yield parameters and yield**

Dhomane *et al.* (2011) observed the highest number of fruit (11.8) per square m and fruit set (65.57 percent), as well as the highest weight of fruit (243.80 g), yield per tree (58.1 kg), and yield per ha (23.26 t) when guava trees were treated with 75 percent nitrogen through urea and 25 percent nitrogen through neem cake,

According to Dhomane and Kadam (2013), Guava trees treated with 75 percent nitrogen by urea and 25 percent nitrogen through neem cake had the maximum weight of individual fruit (243.80 g), yield per tree (58.1 kg), and yield per hectare (23.26 t), 2.1.2.4.3 Quality parameters.

#### **2.1.2.3.3 Quality parameters.**

According to Maity *et al.* (2013) told that by applying 2.5 kg neem cake with 50% RDF per plant per year to guava enhanced total sugars (7.15 percent of fresh weight) while lowering sugars (4.18 percent of fresh weight).

## **2.2 Effect of different organic manures with inorganic fertilizer on economics.**

Dhomane and Kadam (2013) found that applying 75 percent nitrogen through urea and 25 percent nitrogen through neem cake resulted in the highest gross returns (Rs. 2,32,700 ha<sup>-1</sup>), net returns (Rs. 2,06,690 ha<sup>-1</sup>), and highest B: C ratio (8.94) in guava.

According to Bhardwaj and Bajpai (2015), the application of 10 kg vermicompost with 300 g N, 300 g P, and 300 g K per plant per year had the highest net return (Rs. 9.50 lakh ha<sup>-1</sup>) and Benefit: Cost ratio (4.68) in papaya.

## CHAPTER – III

### MATERIALS AND METHODS

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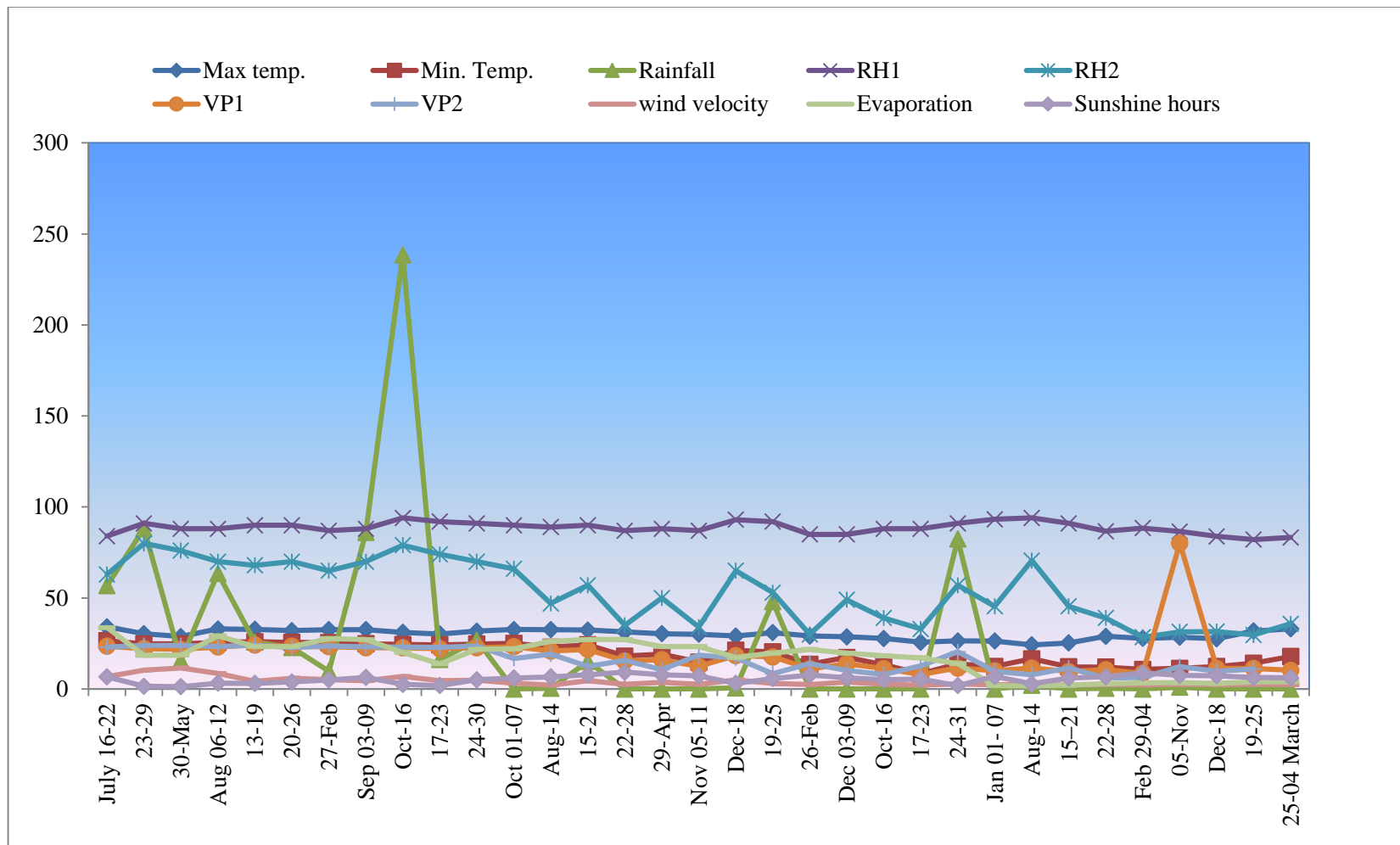
An investigation was done on “To study influence of organic manures on growth, yield and quality attributes of Papaya (*Carica papaya L.*)” at precision farming development center (PFDC) , Department of fruit science, Indira Gandhi krishi vishvavidyalaya, Raipur (C.G.) during the year 2021-22. The outline of the materials and techniques used in this work is as follows

#### 3.1 Experimental Site

The experiment was done at the precision farming development center (PFDC) , Department of fruit science, Indira Gandhi krishi vishvavidyalaya, Raipur (C.G.)

#### 3.2 Location and climate

Raipur is located at 21.16<sup>0</sup> N latitude and 81.36<sup>0</sup> E longitude with an altitude of 289.56 meter above the sea level located in the central part of Chhattisgarh having a dry sub-humid agro-climatic condition region at eastern part of India as capital of Chhattisgarh state. At an average the rainfall of this region is 1200-1400 mm with a coefficient of variance of 23.4 percent. Most of the rainfall take place from the month of June to September with a great variance every year, whereas in October to February less amount of rainfall occurs. December is observed as the coolest and May as the hottest month of the city. A temperature variation of 46<sup>0</sup> in summer and 6<sup>0</sup> in winter is observed. During June to October period high atmospheric humidity is observed. During the crop growth period, the meteorological data is given in the Fig. 3.1 and Appendix A.



**Fig. 3.1 Weekly meteorological data during crop period of papaya (July 16 to 05 March, 2021 - 22**

### 3.3 Experimental details

Following are the experiment details employed for the investigation :

**Table 3.1 Experimental details**

➤ Name of Crop	: Papaya ( <i>Carica papaya l.</i> )
➤ Family	: Caricaceae
➤ Design of experiment	: Randomized block design
➤ Number of Treatments	: 11
➤ Number of Replications	: 03
➤ Number of plants per treatment	: 4 per treatment
➤ Spacing between two plants	: 1.5 X 1.5 (HDP)
➤ Total number of plants	: 132

### 3.4 Treatment details

The experiment was conducted in Randomized Block Design with three replication. The details of treatment details of the experiment is depicted through Table 3.2

S.No.	Notations	Treatments combinations
1.	T <sub>0</sub>	80% RDF (Control)
2.	T <sub>1</sub>	80%RDF + FYM (10 kg)
3.	T <sub>2</sub>	80%RDF + Vermicompost (10 kg)
4.	T <sub>3</sub>	80% RDF + Neem cake (10 kg)
5.	T <sub>4</sub>	80%RDF + Castor cake (10 kg)
6.	T <sub>5</sub>	80%RDF + Goat compost (10 kg)
7.	T <sub>6</sub>	80%RDF + FYM (5 kg) + Leaf mold (5 kg)
8.	T <sub>7</sub>	80%RDF + Vermicompost (5 kg) + Leaf mold

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		(5 kg)
9.	T <sub>8</sub>	80% RDF + Neem cake (5 kg) + Leaf mold (5 kg)
10.	T <sub>9</sub>	80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)
11.	T <sub>10</sub>	80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)

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[80% RDF – Recommended dose of fertilizers NPK – 250:300:400 g/plant (Common for all)]

### **3.5 Cultural operations**

#### **3.5.1 Land preparation**

To expose the weed seed and root stubbles, the experimental field was ploughed with a tractor-drawn mould board plough. Harrowing was used to break up the clods, followed by cultivator criss - cross ploughing. Before the trenches were dug, the field was pulverised with a rotavator. With the use of measuring tape, rope, and bamboo pegs, the experiment was laid out according to design. Pits with a diameter of 60x60x60 cm and a spacing of 1.8x1.8 m were dug. After preparing the planting area, pits were excavated with the intention of leaving the middle of the pit untouched. The top dirt and subsoil from the dug pit were separated and stored in two heaps next to the pit.

#### **3.5.2 Filling of pits**

The dug pits were exposed to the sun for at least 15 days before being filled with well-decomposed farm yard manure in equal parts top soil and sub soil. At the bottom of the pit, the top soil mixture is first filled. The trenches were filled to a height of 15cm above ground level. In each pit, 2 gramme copper-based fungicide was used.

### **3.5.3 Raising of papaya nursery**

Papaya seedlings were cultivated in 22 X 15 cm 300 gauge black polyethylene bags. These poly-bags were filled with an equal mix of well-rotten FYM, soil, and sand. To promote early and proper germination, papaya seeds were treated with 200 ppm gibberrellic acid and 3g/kg carbendazim. Seeds were sown in each poly-bag, which were then lightly watered.

### **3.5.4 Transplanting of papaya seedlings**

Thirty-five-day-old seedlings were placed at a specified area in the evening. Each pit received one seedling, which was then watered lightly. For the year, papaya seedlings were transplanted on July 15<sup>th</sup>.

### **3.5.5 Plant Protection**

During the crop's growth stage, plant protection measures were implemented as needed. Carbendazim (12%) + WP mancozeb (63%) To suppress the yellow virus of papaya, 1 litre per ha was given to papaya fields at 15-day intervals until flowering to reduce aphid infestation.

### **3.5.6 Drip Irrigation**

The papaya plant needs enough moisture during its whole growing cycle. The best irrigation method for maintaining a consistent moisture supply is drip irrigation. After the plants are transplanted, the first irrigation is given. According to the crop's water needs, drip irrigation was used to irrigate the experimental plots.

Using a variety of techniques, the estimated irrigation water requirement and irrigation schedule were created. However, the Pan "A" evaporation method was the one that was most frequently used. This method used the following calculation to determine how much water was needed each day:

Daily water requirement = A x b x C x D x E Litre/day/plant

Where,

A = Pan evaporation

B = Pan factor

C = Crop factor

D = Percent wetted area

E = Spacing between row to row and plant to plant

### **3.5.7 Specification of drip irrigation system'**

Below is information about the drip irrigation system used for experimentation :

(A) Control head

- 1) Pump – 7 hp
- 2) Filter – screen filter

(B) Distribution network

- 1) Type of main line – PVC
- 2) Size of main line – 75 mm
- 3) Type of sub-main line – PVC
- 4) Size of sub-main line – 63 mm
- 5) Type of lateral – LDPE
- 6) Size of lateral – 16 mm
- 7) Spacing between laterals – 1.8 m
- 8) Type of emitters - Long path on line type
- 9) Discharge of emitters – 2 LPH, 4 LPH, 8 LPH
- 10) Operating head – 1.0 kg cm<sup>2</sup> 20

## **3.6 Harvesting**

Papayas are considered fully grown when their green colour turns yellowish green. Individually, hand-picked ripe fruits were collected, taking care to avoid any potential harm. By twisting or turning the mature fruits upward from the stem, the

separation from stem is simple. Early in the morning, the fruits were harvested and stored in shade.

### **3.7 Observations recorded**

For the purpose of the current experiment, plants were placed at random in the north, south, east, and west directions in order to analyze several characters, including growth, yield, and quality attributes.

#### **3.7.1 Growth parameters:**

Thirty, Ninety, One Fifty, and Two Seventy days after transplantation, the effects of various organic manures on various growth metrics were investigated.

##### **3.7.1.1 Plant height (cm)**

Using a measuring scale, the height of randomly chosen plants from each replication was measured in centimeters from the ground up to the top of the first freshly emerged leaf of the growing shoot. The mean value of these measurements served as the basis for calculating the mean plant height.

##### **3.7.1.2 Stem girth (cm)**

Randomly chosen plants were measured for their stem girth in centimeters as circumference at a marked location 15 cm above ground level, and an average was calculated.

##### **3.7.1.3 Petiole length (cm)**

The petiole length was calculated by measuring the distance in centimeters between the base of the petiole and the base of the leaf lamina.

#### **3.7.1.4 Number of leaves per plant**

On the plant, the number of leaves (when completely opened) was counted.

### **3.7.2 Yield parameters**

#### **3.7.2.1 Number of fruits per plant**

Each tagged plant's total fruit production was counted after each harvest. Following the final harvest, each picking's number of fruits was counted, and an average was calculated.

#### **3.7.2.2 Fruit length (cm)**

After harvest, the length of a random sample of five fruits was measured using a measuring scale in centimeters from the base to the tip of the fruit, and the average was computed.

#### **3.7.2.3 Fruit diameter (cm)**

Five selected fruits from each treatment were chosen from the harvested fruits. With the use of a measuring tape, the diameter of the fruit was measured at the middle of the fruit.

#### **3.7.2.4 Fruit weight (gram)**

Five fully grown fruits were chosen, weighed (in gram) on a pan balance, and their average was calculated.

#### **3.7.4.5 Fruit yield per plant (gram)**

Five plants were chosen at random, and the fruit production per plant on various dates was noted and totaled. By dividing the total weight of the fruits by the number of plants, the yield was computed.

### **3.7.2.6 Fruit yield per hectare (q/ha)**

The data of yield per net plot was recorded and multiplied by multiple factor computed on area basis to give the final data for total yield in quintal per hectare.

### **3.7.3 Quality parameters**

#### **3.7.3.1 Total soluble solids (° Brix)**

A hand refractometer with a range of 0 to 30 percent at 28<sup>0</sup> C at room temperature was used to measure the percentage of total soluble solids after the juice had been extracted and strained through a muslin cloth. This instrument was available at the preservation lab of the Department of Horticulture, IGKV, Raipur. The average values in terms of juice's total soluble solids (°Brix).

#### **3.7.3.2 Acidity (%)**

The acidity of fruit pulp has been calculated using Ranganna's method (1997). The maximum acid content was measured using phenolphthalein as a marker by titrating 10ml of fruit juice to 0.1 NaOH. The end point emerged as a shade of light pink.

Acidity = Normality of alkali x Volume made up x Equivalent wt. of acid x 100

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$$\frac{\text{Volume of sample taken for estimation} \times \text{Wt. or volume of sample taken} \times 1000}{\text{Volume made up} \times \text{Equivalent wt. of acid}}$$

#### **3.7.3.3 Sugars (%)**

Sugars have been identified in accordance with Ranganna's (1997) description in "Lane and Eynon."

1. Fehling solution (A): 1 litre of volume was created from 69.28 g of copper sulphate.
2. Fehling solution (B) was prepared using 346 g of potassium sodium tartrate and 100 g of sodium hydroxide (NaOH).
3. 1 percent aqueous methyl blue is the Methylene Blue Indicator.
4. Lead acetate neutral solution (45 percent ).  
Potassium oxalate solution, number five (45 percent).
6. A 100 ml volume of the standard invert sugar solution was created using 9.5 g of AR sucrose and 5 ml of HCl concentrate.

This formulation could be utilised for testing for several months and was kept at 20 to 25<sup>0</sup> C for an inversion for an additional three days. Put 50 ml of distilled water and 25 ml of the inverted solution in a flask, then neutralise the mixture with 20 percent NaOH while using phenolphthalein as a marker until the solution turns pink. 1 N HCL had acidified this till the pink colour was completely gone. (1 ml = 2.5 mg invert sugar) The volume was prepared up to the distilled water mark.

#### **3.7.3.3.1 Total Sugars**

Using a 50 ml aliquot of cleared and delead solution in a 250 ml volumetric flask, the total amount of sugar was determined. It received 5 ml of HCl and was let to stand for 24 hours at room temperature. With concentrated NaOH solution, this was neutralised and the volume increased to 250 ml. Total sugars were calculated as invert sugars from an aliquot.

$$\text{Total sugar as invert sugar} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Weight or volume of the sample} \times 1000}$$

### 3.7.3.3.2 Reducing sugars

Using 25 ml of filtered juice, 100 ml of distilled water, and 1 N NaOH to neutralise the mixture, the amount of reducing sugar was calculated. It was then given a 2 ml addition of lead acetate solution. It was shaken for ten minutes while standing. A solution of potassium oxalate in a volume of 2 ml was then added. Water that had been filtered filled the volume. To reach a clearer solution, this process wasn't essential.

In a 250 ml conical flask, 5 ml of the Fehling's solution A and B were added. The solution of clarified sugar was placed in the burette. An open flame was used to heat the conical flask. Methylene blue indicator was added along with two to four cc of sugar solution. Now, sugar solution was added to this solution and it was heated. The terminal point has a brick-red appearance. The following formula was used to compute the reducing sugar, which was given in percentages:

$$\text{Reducing sugar (\%)} = \frac{\text{Invert sugar (mg)} \times \text{Dilution} \times 100}{\text{Titre} \times \text{Weight or volume of sample taken} \times 1000}$$

### **3.7.3.3.3 Non – reducing sugars**

By deducting the value of reducing sugar from total sugar, non-reducing sugar was calculated.

### **3.7.3.4 Ascorbic acid**

The method described by Ranganna was used to determine the ascorbic acid content of the fruit pulp (1997).

Reagents :

1. 3% aqueous meta - phosphoric acid ( $\text{HPO}_3$ ).
2. Ascorbic acid standard : 1% L - ascorbic acid in meta - phosphoric solution.
3. Dye solution : 2,6 Dichlorophenol - indophenols in alkaline solution.

### **Estimation**

Titrated with the same amount of  $\text{HPO}_3$  and 5 ml of L-ascorbic acid solution in comparison to 2, 6-dichlorophenol-indophenol. The pale pink's hue decided where it would terminate. These are the dye factors:

Dye factor =  $0.5 / \text{Titre}$

The dye solution was titrated against a standard ascorbic acid and  $\text{HPO}_3$  solution until the pink colour emerged.

### **Procedure**

In a pestle and mortar, 15 ml (3%) meta-phosphoric acid was appropriately combined with a known weight of final, chopped flesh. The material was transferred to a 100 ml volumetric flask after maceration, and 3 percent meta - phosphoric acid was prepared up to the mark. A reported amount

of aliquota, 6-Dichlorophenol-indophenol color solution was present for 15 seconds at a pink end point.

Mg of ascorbic acid per 100g of sample =

$$\frac{\text{Titre} \times \text{Dye factor} \times \text{volume made up} \times 100}{\text{Aliquot of extract taken for estimation} \times \text{weight or volume of taken from estimation}}$$

### 3.8 Benefit : Cost ratio

The cost of cultivation, in terms of treatment, was calculated. The cost of cultivation per hectare was determined, and the total amount spent on crop management and cultivation was reported in terms of rupees. The gross financial returns per hectare were computed using the average current papaya price of Rs. 25 per kg, the net financial returns were determined by deducting the cost of cultivation from the gross financial returns, and the B: C ratio was determined using the following formula:

$$\text{Benefit : Cost Ratio (BCR)} = \frac{\text{Net return}}{\text{Cost of cultivation}}$$

### 3.9 Statistical analysis

To determine the degree of variation among all the treatments, the analysis of variance of various variables was done. By using statistical software created by the Department of Agricultural Statistics and Social Science (Language), IGKV, Raipur, the data were analysed. The following is the breakdown of the analysis of variance table:

**Table 3.3 Skeleton of analysis of variance**

Source of variation	Degree of freedom	Sum of squares	Mean sum of squares	F (cal) (5%)
Replications	$(r - 1)$	RSS	RMS	
Treatment	$(t - 1)$	TrSS	TrMS	
Error	$(r - 1)(t - 1)$	ErSS	ErMS	
Total	$rt - 1$	$rt - 1$	TSS	

Where,

$r$  = Number of replications

$t$  = Number of Treatments

RSS = Sum of square due to replication

TrSS = Sum of square due to treatment

ErSS = Sum of square due to error

TSS = Total sum of square

RMS = Replication mean of squares

TrMS = Treatment mean of squares

ErMS = Error mean of squares



**Fig. 3.2 General View of experimental field**



**Fig. 3.3 Papaya plant**



**Fig. 3.4 Flowers in papaya plant**



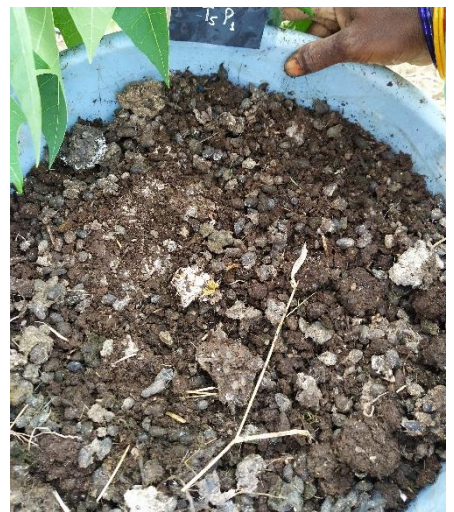
**Fig. 3.5 Application of Fertilizers**



**Fig. 3.6 Planting of papaya seedling**



**Fig. 3.7 Manual application of fungicide**



**Fig. 3.8 Various organic manures used in the experiment**

# RESULT AND DISCUSSION

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The current study, "To Study Influence of Different Organic Manures on Growth, Yield, and Quality of Papaya (*Carica papaya* L.) in Chhattisgarh Plains," was conducted in 2021–2022, at the Precision Farming Development Center (PFDC), Department of Fruit Science, IGKV, Raipur. The results are presented in this chapter with the aid of tables, figures, illustrations, and graphical representation, and are properly discussed.

Data on numerous growth, yield, and quality indicators collected during the experiment were statistically analyzed using a Randomized Block Design. The following headings are used to present the results and statistical inferences in this chapter:

4.1 Growth parameters

4.2 Yield parameters

4.3 Quality parameters

4.4 B:C ratio

### **4.1 Growth parameters**

This chapter presents observations on growth characteristics like plant height (cm), stem girth (cm), petiole length (cm), and number of leaves.

#### **4.1.1 Plant height (cm)**

In all eleven treatments with three replications, observations on plant height were made at thirty, Ninty, one fifty and two ten days after transplanting. The results are provided in Table 4.1 and visually represented in Fig. 4.1. The statistics demonstrate that various types of manures have a substantial impact on plant height.

The range of height at 30 days post-transplantation ranged from a maximum of 35.58 cm (T<sub>7</sub>) to a minimum of 21.03 cm in the case of T<sub>0</sub> or control. T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) had a maximum height of 35.58 cm and were significantly superior to most treatments, with the exception of three treatments, namely T<sub>8</sub> (35.11 cm), T<sub>10</sub> (32.05 cm), and T<sub>9</sub> (31.13 cm).

All eleven treatments' plants ranged in height from a maximum of 96.36 cm (T<sub>7</sub>: 80 percent RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) to a minimum of 71.37 cm 90 days after transplanting (T<sub>0</sub>). With the exception of T<sub>8</sub>, which recorded a plant height of 94.91 cm, which was on par with T<sub>7</sub>, T<sub>7</sub>'s maximum plant height of 96.36 cm in this case was much higher than all other treatments. With a height of 71.37 cm, the control T<sub>0</sub> had the shortest plant.

At 150 days after transplanting, the plant height varied from a maximum of 133.08 cm (T<sub>7</sub>) to a minimum of 111.33 cm (T<sub>0</sub>), with T<sub>7</sub> being noticeably superior to all other treatments except T<sub>8</sub> (131.71 cm), T<sub>10</sub> (130.70 cm), and T<sub>9</sub> (129.94 cm).

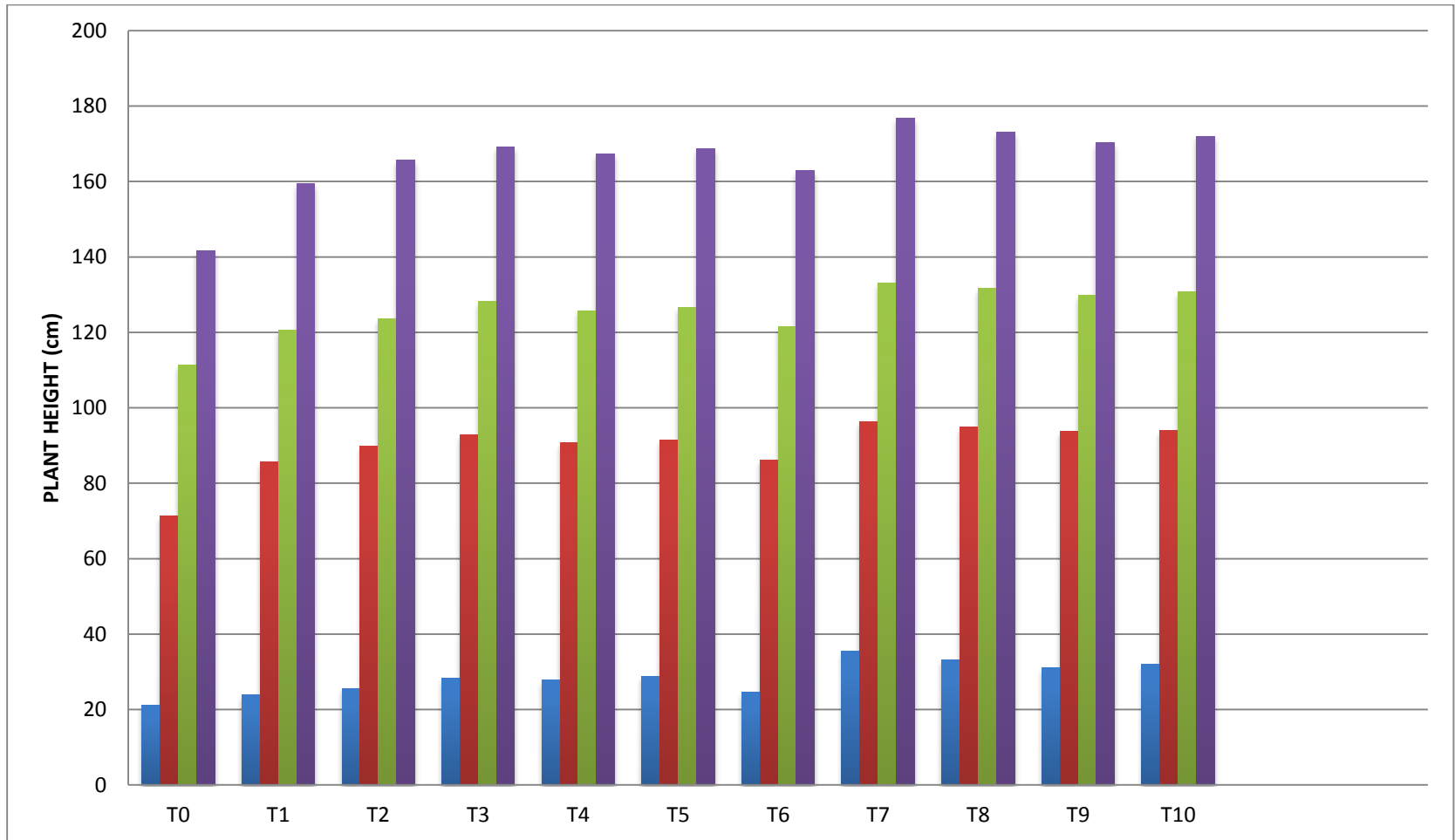
The range in height at 210 days after transplanting was found to be from a maximum of 176.83 cm (T<sub>7</sub>) to a minimum of 141.55 cm (T<sub>0</sub>), following a similar trend that T<sub>7</sub> was significantly superior to all other treatments with the exception of T<sub>8</sub> (173.06 cm), T<sub>10</sub> (172.04 cm), and T<sub>9</sub> (170.37 cm).

It is noteworthy to observe that on all four dates—30, 90, 150, and 210 days after transplanting—the plant height followed a similar pattern in that T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) recorded the highest plant height, followed by T<sub>8</sub> (80%RDF + Neem cake (5 kg) + Leaf mold (5 kg)), T<sub>10</sub> (80%RDF + Goat compost (5 kg) + Leaf mold (5 kg)), and T<sub>9</sub> (80%RDF + Castor cake (5 kg) + Leaf mold (5 kg)) in decreasing order. After transplanting, at the 30, 90, 150, and 210-day marks, the control T<sub>0</sub> had the lowest plant height.

Similar findings were also noted by Shivakumar *et al.* (2007), Srinu *et al.* (2007) and Kanwar *et al.* (2020). The organic manures had an enhancing effect on the nutrient uptake that resulted in increased plant height.

**Table 4.1 Effect of different organic manures on plant height (cm) of papaya (*Carica papaya* L.)**

TREATMENTS	PLANT HEIGHT (cm)			
	30 DAT	90 DAT	150 DAT	210 DAT
T <sub>0</sub> : 80% RDF + control	21.03	71.37	111.33	141.55
T <sub>1</sub> : 80% RDF + FYM (10 kg)	23.86	85.68	120.58	159.38
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	25.67	89.95	123.58	165.66
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	28.34	92.80	128.20	169.07
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	27.94	90.78	125.73	167.20
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	28.70	91.33	126.57	168.60
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	24.50	86.22	121.46	162.94
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	35.58	96.36	133.08	176.83
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) + Leaf mold (5 kg)	33.11	94.91	131.71	173.06
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	31.13	93.70	129.94	170.37
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	32.05	94.02	130.70	172.04
SE ( $\pm$ m)	0.554	0.575	0.512	0.539
CD at 5%	1.644	1.707	1.521	1.602



**Fig. 4.1** Effect of different organic manures on plant height (cm) of papaya (*Carica papaya* L.)

#### 4.1.2 Number of leaves

The number of leaves per plant was observed at thirty, Ninety, one fifty and two ten days following transplanting. The results are shown in table 4.2 and graphically presented in fig. 4.3.

The number of leaves ranged from maximum of 5.00 at T<sub>7</sub> to minimum of 3.00 in T<sub>0</sub>. T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) was followed by T<sub>8</sub> (5.00), T<sub>10</sub> (4.66) and T<sub>9</sub> (4.66) at 30 days after transplanting.

At 90 days after transplanting, number of leaves were found maximum in T<sub>7</sub> which was 9.66 and minimum was found in T<sub>0</sub> which was 4.66 with T<sub>7</sub> observed as superior to all the other treatments.

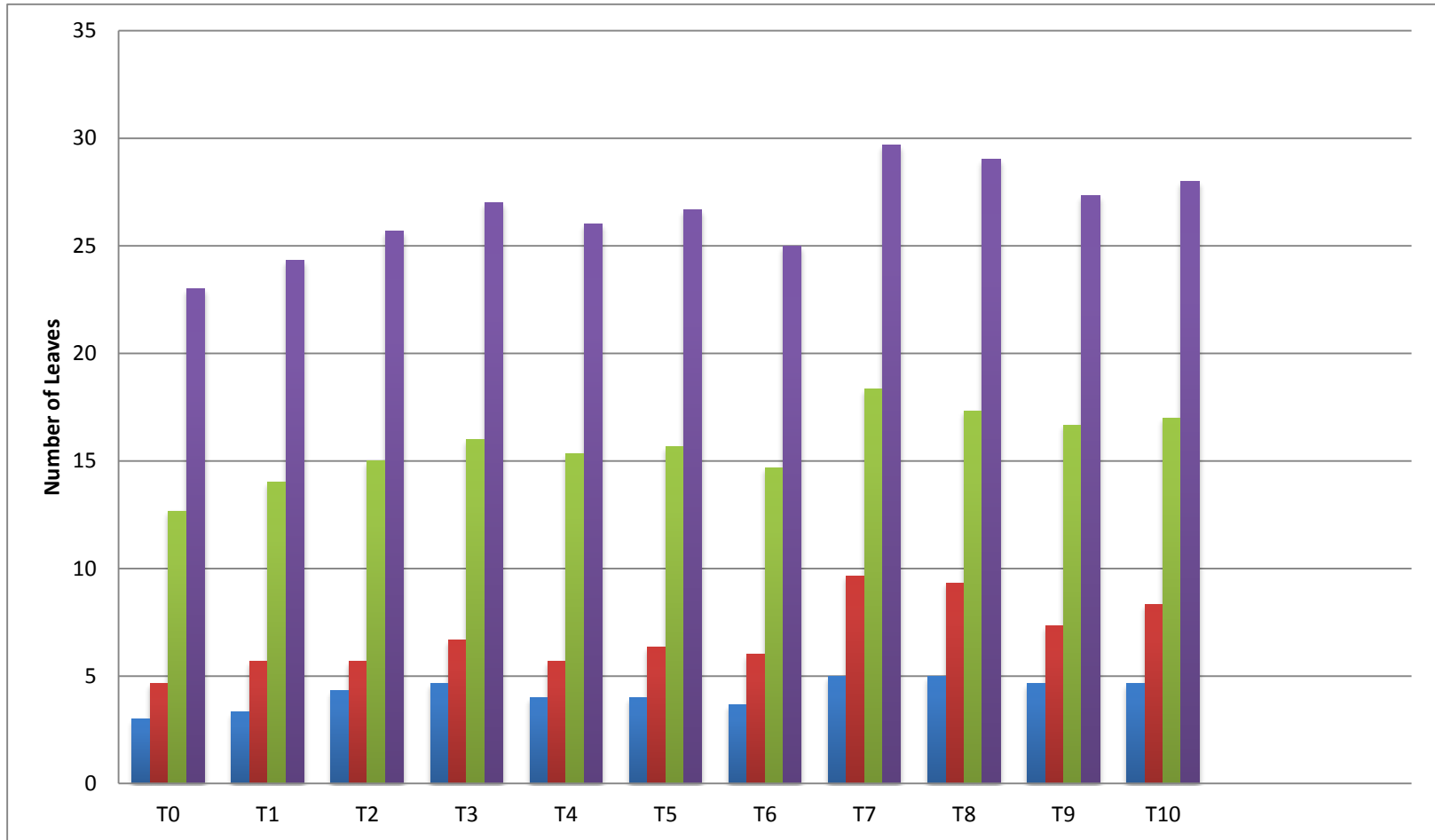
The range in number of leaves at 150 days after transplanting was found to be from a maximum of 18.33 (T<sub>7</sub>) to a minimum of 12.66 (T<sub>0</sub>), following a similar trend that T<sub>7</sub> was significantly superior to all other treatments with the exception of T<sub>8</sub> (17.33), T<sub>10</sub> (17.00), and T<sub>9</sub> (16.66).

The range in number of leaves at 210 days after transplanting was found to be from a maximum of 29.66 (T<sub>7</sub>) to a minimum of 23.00 (T<sub>0</sub>), following a similar trend that T<sub>7</sub> was significantly superior to all other treatments with the exception of T<sub>8</sub> (29.00), T<sub>10</sub> (28.00), and T<sub>9</sub> (27.33).

The higher number of leaves was observed on using the organic manures. The treatment T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) gave the highest number of leaves followed by T<sub>8</sub> (80%RDF + Neem cake (5 kg) + Leaf mold (5 kg)), T<sub>10</sub> (80%RDF + Goat compost (5 kg) + Leaf mold (5 kg)), and T<sub>9</sub> (80%RDF + Castor cake (5 kg) + Leaf mold (5 kg)) in decreasing order. The results were in close confirmity with the findings of Shivakumar *et al.* (2007), Pranesh *et al.* (2016).

**Table 4.2 Effect of different organic manures on Number of leaves of papaya.**

TREATMENTS	NUMBER OF LEAVES			
	30 DAT	90 DAT	150 DAT	210 DAT
T <sub>0</sub> : 80% RDF + control	3.000	4.667	12.667	23.000
T <sub>1</sub> : 80% RDF + FYM (10 kg)	3.333	5.667	14.000	24.333
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	4.333	5.667	15.000	25.667
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	4.667	6.667	16.000	27.000
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	4.000	5.667	15.333	26.000
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	4.000	6.333	15.667	26.667
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	3.667	6.000	14.667	25.000
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	5.000	9.667	18.333	29.667
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	5.000	9.333	17.333	29.000
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	4.667	7.333	16.667	27.333
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	4.667	8.333	17.000	28.000
SE ( $\pm$ m)	0.764	0.659	0.523	0.637
CD at 5%	N/A	1.958	1.554	1.893



**Fig. 4.2 Effect of different organic manures on number of leaves of papaya.**

### 4.1.3 Petiole length (cm)

At thirty, Ninty, one fifty and two ten days following transplanting, observations on petiole length were made in all eleven treatments with three replications. The outcomes are listed in Table 4.3 and graphically displayed in Fig. 4.3. The figures show that different types of manures significantly affect plant height.

All eleven treatments' plants ranged in petiole length from a maximum of 46.96 cm (T<sub>7</sub>: 80 percent RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) to a minimum of 35.66 cm (T<sub>0</sub>) at 30 days after transplanting. With the exception of T<sub>8</sub>, which recorded a petiole length of 44.29 cm, which was on par with T<sub>7</sub>, T<sub>7</sub>'s maximum plant height of 46.96 cm in this case was much higher than all other treatments. With a height of 35.66 cm, the control T<sub>0</sub> had the shortest plant.

At 90 days after transplanting, the petiole length varied from a maximum of 65.88 cm (T<sub>7</sub>) to a minimum of 50.30 cm (T<sub>0</sub>), with T<sub>7</sub> being noticeably superior to all other treatments except T<sub>8</sub> (63.56 cm), T<sub>10</sub> (61.77 cm), and T<sub>9</sub> (60.65 cm).

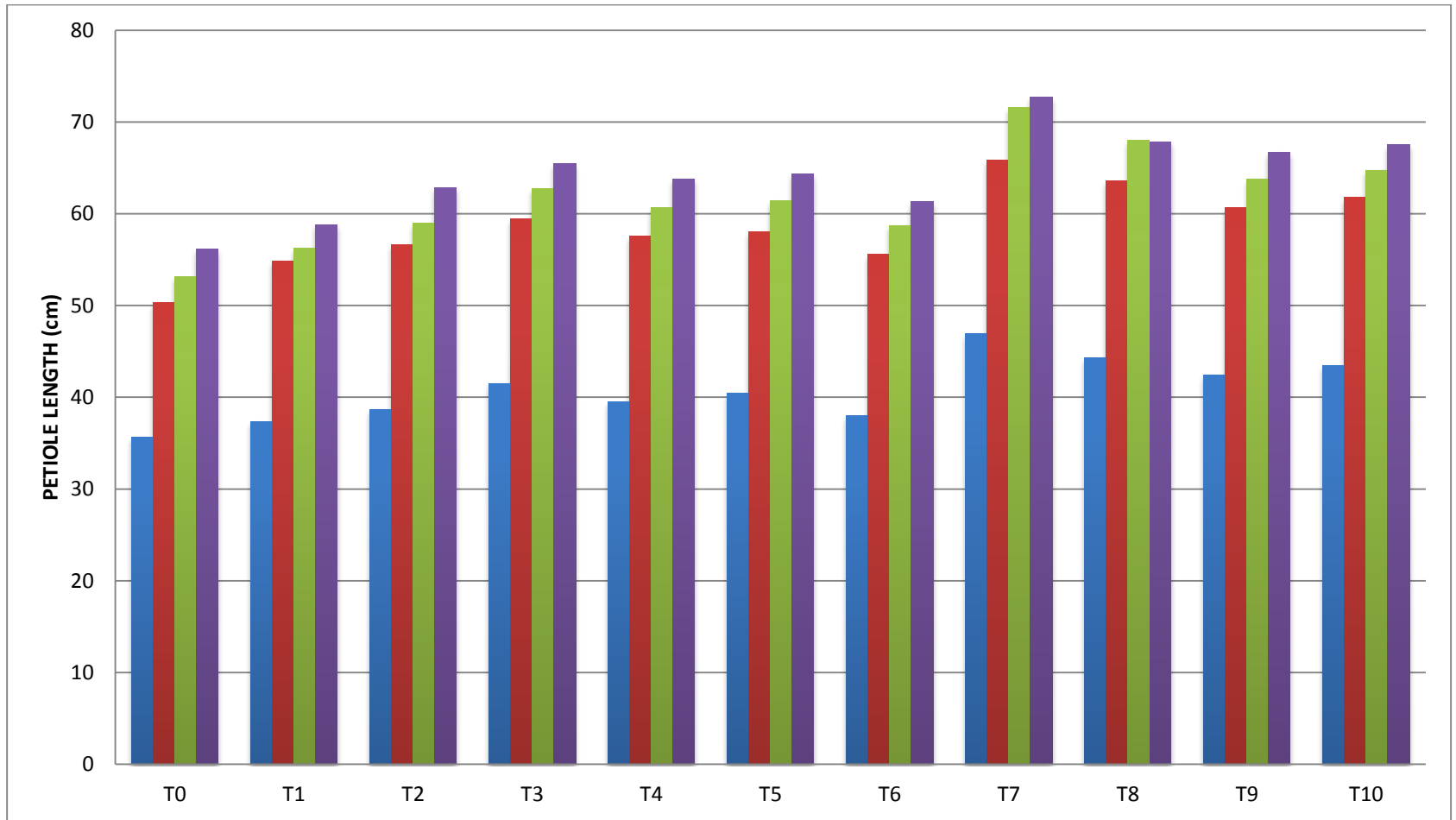
The range in petiole length at 150 days after transplanting was found to be from a maximum of 71.57 cm (T<sub>7</sub>) to a minimum of 53.11 cm (T<sub>0</sub>), depicting that T<sub>7</sub> was significantly superior to all other treatments with the exception of T<sub>8</sub> (67.99 cm), T<sub>10</sub> (64.77 cm), and T<sub>9</sub> (63.73 cm).

The range of petiole length was determined to be from a high of 72.69 cm (T<sub>7</sub>) to a minimum of 56.15 cm (T<sub>0</sub>), following a similar trend that T<sub>7</sub> was significantly better than all other treatments with the exception of T<sub>8</sub> (67.87 cm), T<sub>10</sub> (67.49 cm), and T<sub>9</sub> (66.70 cm) at 210 days after transplanting.

It is evident from the pooled data that organic manure had an significant effect on petiole length of papaya. Similar findings were given by Pranesh et al. (2017), Srinu et al. (2017) in papaya.

**Table 4.3 Effect of different organic manures on Petiole length (cm) of papaya.**

TREATMENTS	PETIOLE LENGTH (cm)			
	30 DAT	90 DAT	150 DAT	210 DAT
T <sub>0</sub> : 80% RDF + control	35.663	50.307	53.117	56.157
T <sub>1</sub> : 80% RDF + FYM (10 kg)	37.357	54.877	56.253	58.840
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	38.697	56.613	59.013	62.800
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	41.533	59.473	62.763	65.453
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	39.473	57.557	60.663	63.817
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	40.480	58.063	61.423	64.340
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	38.013	55.607	58.747	61.357
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	46.967	65.887	71.573	72.693
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	44.290	63.567	67.997	67.870
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	42.403	60.657	63.733	66.707
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	43.407	61.777	64.773	67.493
SE ( $\pm$ m)	0.341	0.604	0.554	0.380
CD at 5%	1.013	1.794	1.645	1.129



**Fig. 4.3 Effect of different organic manures on petiole length (cm) of papaya.**

#### 4.1.4 Stem girth (cm)

At thirty, Ninety, one fifty and two ten days following transplanting, observations on stem girth were made in all eleven treatments with three replications. The outcomes are listed in Table 4.4 and graphically displayed in Fig. 4.4.

The range of stem girth at 30 days post-transplantation ranged from a maximum of 15.01 cm (T<sub>7</sub>) to a minimum of 10.39 cm in the case of T<sub>0</sub> or control. T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) had a maximum height of 15.01 cm and were significantly superior to most treatments, with the exception of three treatments, namely T<sub>8</sub> (14.50 cm), T<sub>10</sub> (14.27 cm), and T<sub>9</sub> (13.74 cm).

At 90 days after transplanting, the stem girth varied from a maximum of 25.57 cm (T<sub>7</sub>) to a minimum of 12.74 cm (T<sub>0</sub>), with T<sub>7</sub> being noticeably superior to all other treatments except T<sub>8</sub> (24.58 cm), T<sub>10</sub> (24.08 cm), and T<sub>9</sub> (22.75 cm).

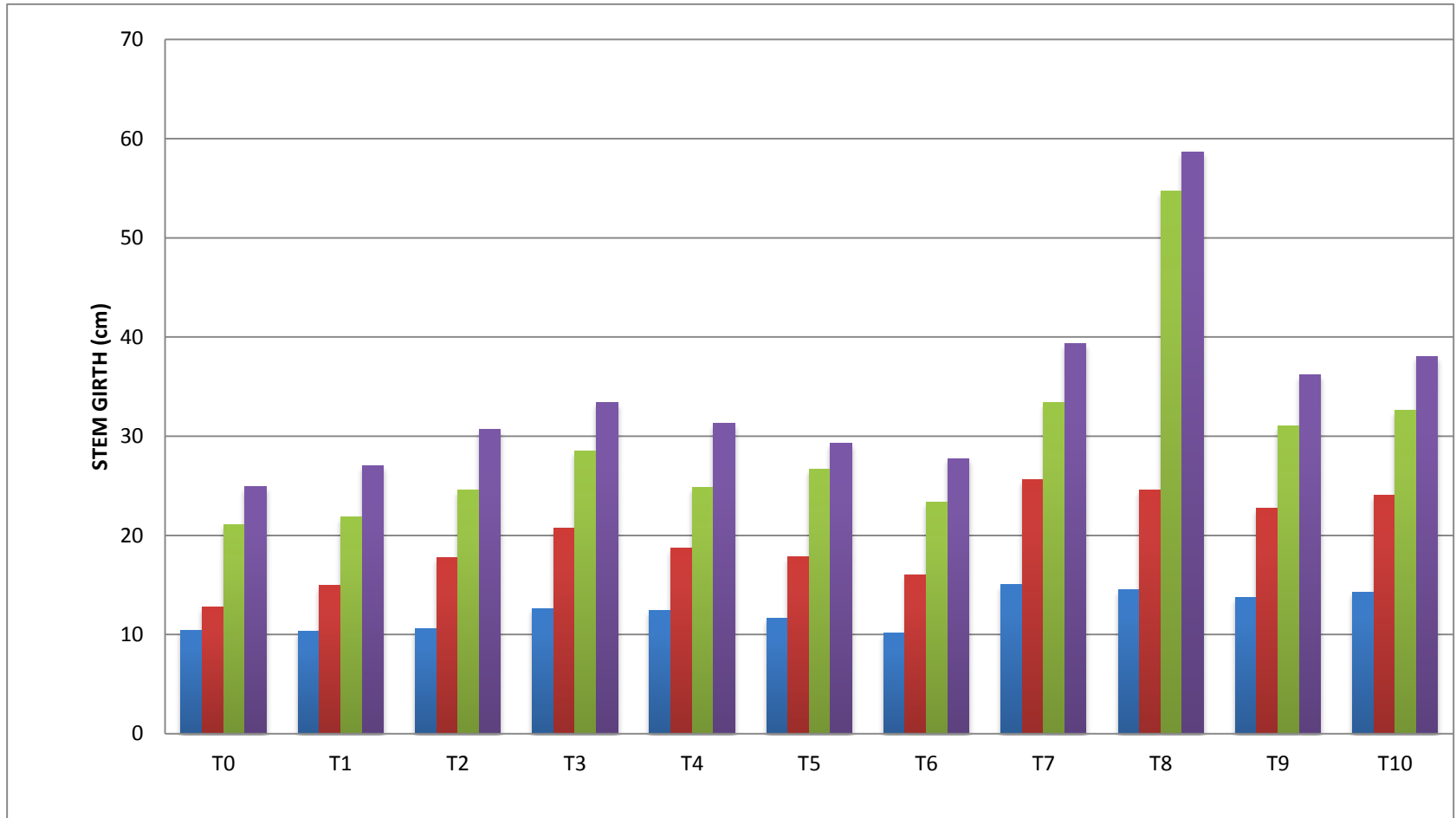
All eleven treatments plants ranged in girth from a maximum of 54.68 cm (T<sub>8</sub>: 80% RDF + neem cake (5 kg) leaf mold (5 kg)) to a minimum of 21.10 cm (T<sub>0</sub>) at 150 days after transplanting. With the exception of T<sub>7</sub>, which recorded a stem girth of 33.41 cm, which was on par with T<sub>8</sub>, T<sub>8</sub>'s maximum stem girth of 54.68 cm in this case was much higher than all other treatments. With a girth of 21.10 cm, the control T<sub>0</sub> had the thinnest plant.

The range in girth at 210 days after transplanting was found to be from a maximum of 58.68 cm (T<sub>8</sub>) to a minimum of 24.93 cm (T<sub>0</sub>), depicting that T<sub>8</sub> was significantly superior to all other treatments with the exception of T<sub>7</sub> (39.31 cm), T<sub>10</sub> (38.06 cm), and T<sub>9</sub> (36.17 cm).

It was observed that the stem girth was found maximum in the treatment T<sub>7</sub> (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). This might due the nutrients present in adequate amount in the soil. Similar work has been reported by Pranesh *et al.* (2016), Shivakumar *et al.* (2007).

**Table 4.4 Effect of different organic manures on stem girth (cm) of papaya.**

TREATMENTS	STEM GIRTH (cm)			
	30 DAT	90 DAT	150 DAT	210 DAT
T <sub>0</sub> : 80% RDF + control	10.390	12.747	21.107	24.937
T <sub>1</sub> : 80% RDF + FYM (10 kg)	10.337	14.933	21.820	26.990
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	10.620	17.770	24.567	30.670
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	12.647	20.693	28.513	33.373
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	12.447	18.700	24.863	31.310
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	11.600	17.803	26.667	29.303
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	10.170	15.977	23.327	27.750
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	15.017	25.570	33.417	39.317
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	14.503	24.580	54.687	58.683
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	13.740	22.750	31.000	36.177
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	14.270	24.083	32.570	38.060
SE ( $\pm$ m)	0.591	0.309	6.656	5.965
CD at 5%	1.755	0.917	N/A	17.722



**Fig. 4.4** Effect of different organic manures on stem girth (cm) of papaya.

## 4.2 Yield parameters

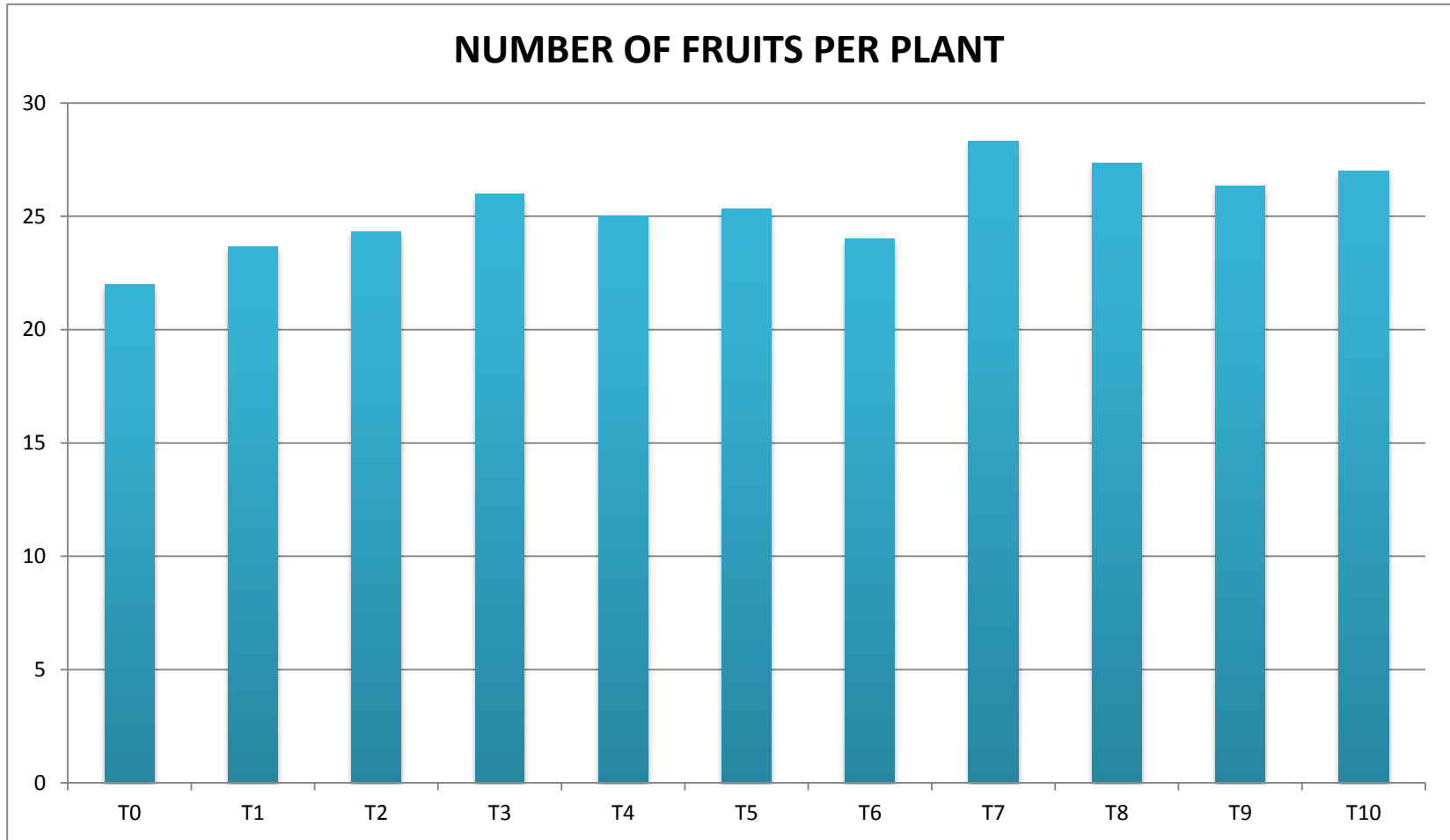
### 4.2.1 Number of fruits per plant

Table 4.5 displays the observations made on the quantity of fruits during the experiment. And in Fig. 4.5 visually. The amount of papaya fruits produced under various treatments, manures, and mixtures varied significantly. With treatment T<sub>7</sub>, there were much more fruits (28.33). Additionally, it was determined that the treatments T<sub>8</sub> (27.33), T<sub>10</sub> (27), and T<sub>9</sub> (26.33) were statistically equal to one another. T<sub>0</sub> produced the lowest number of fruits result (22), which is control.

The availability of organic manures encouraged lush plant growth since they improved nutrient uptake, which in turn led to greater fruit growth and development and, eventually, increased output. These results are in accordance with findings of Pranesh *et al.* (2016), Prajapati *et al.* (2016).

**Table 4.5 Effect of different organic manures on number of fruits per plant**

TREATMENTS	NUMBER OF FRUITS PER PLANT
T <sub>0</sub> : 80% RDF + control	22.000
T <sub>1</sub> : 80% RDF + FYM (10 kg)	23.667
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	24.333
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	26.000
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	25.000
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	25.333
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	24.000
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	28.333
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	27.333
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	26.333
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	27.000
SE ( $\pm$ m)	0.752
CD at 5%	2.234



**Fig. 4.5 Effect of different organic manure on number of fruits per plant**

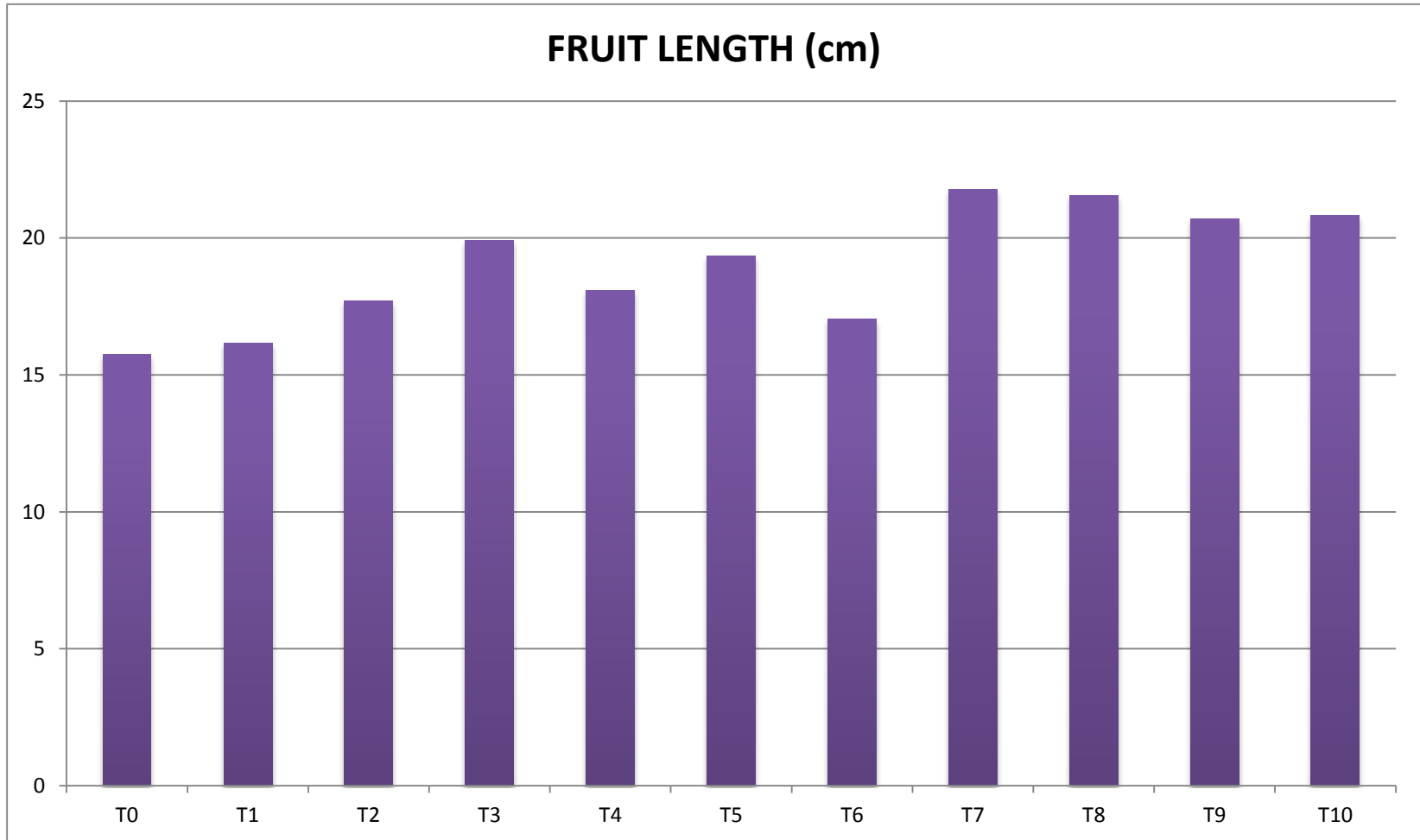
#### 4.2.2 Fruit length

It is clear from the Table 4.6 And Fig. 4.6 that the fruit length of all the treatments under the study were significantly different and ranged from 15.73 to 21.76 cm.

**Table 4.6 Effect of different organic manures on Fruit length (cm) of papaya**

TREATMENTS	FRUIT LENGTH (cm)
T <sub>0</sub> : 80% RDF + control	15.733
T <sub>1</sub> : 80% RDF + FYM (10 kg)	16.167
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	17.700
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	19.900
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	18.100
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	19.333
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	17.033
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	21.767
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	21.547
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	20.713
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	20.817
SE ( $\pm$ m)	0.313
CD at 5%	0.929

Maximum fruit length was reported in T<sub>7</sub> (21.76 cm), which was statistically comparable to T<sub>8</sub> (21.54 cm), T<sub>10</sub> (20.81 cm), and T<sub>9</sub> (20.71 cm), whereas smallest fruit length was noted in T<sub>0</sub> (15.73 cm). Under the treatment T<sub>7</sub> (80% RDF + vermicompost (5 kg) + leaf mould (5 kg)) manured plants, much longer fruits were seen, and it is possible that this was because there were more leaves, which produced more photosynthates and improved sink transfer. Similar findings were noted by Prajapati *et al.* (2016) and Kanwar *et al.* (2020).



**Fig. 4.6 Effect of different organic manures on Fruit length (cm) of papaya**

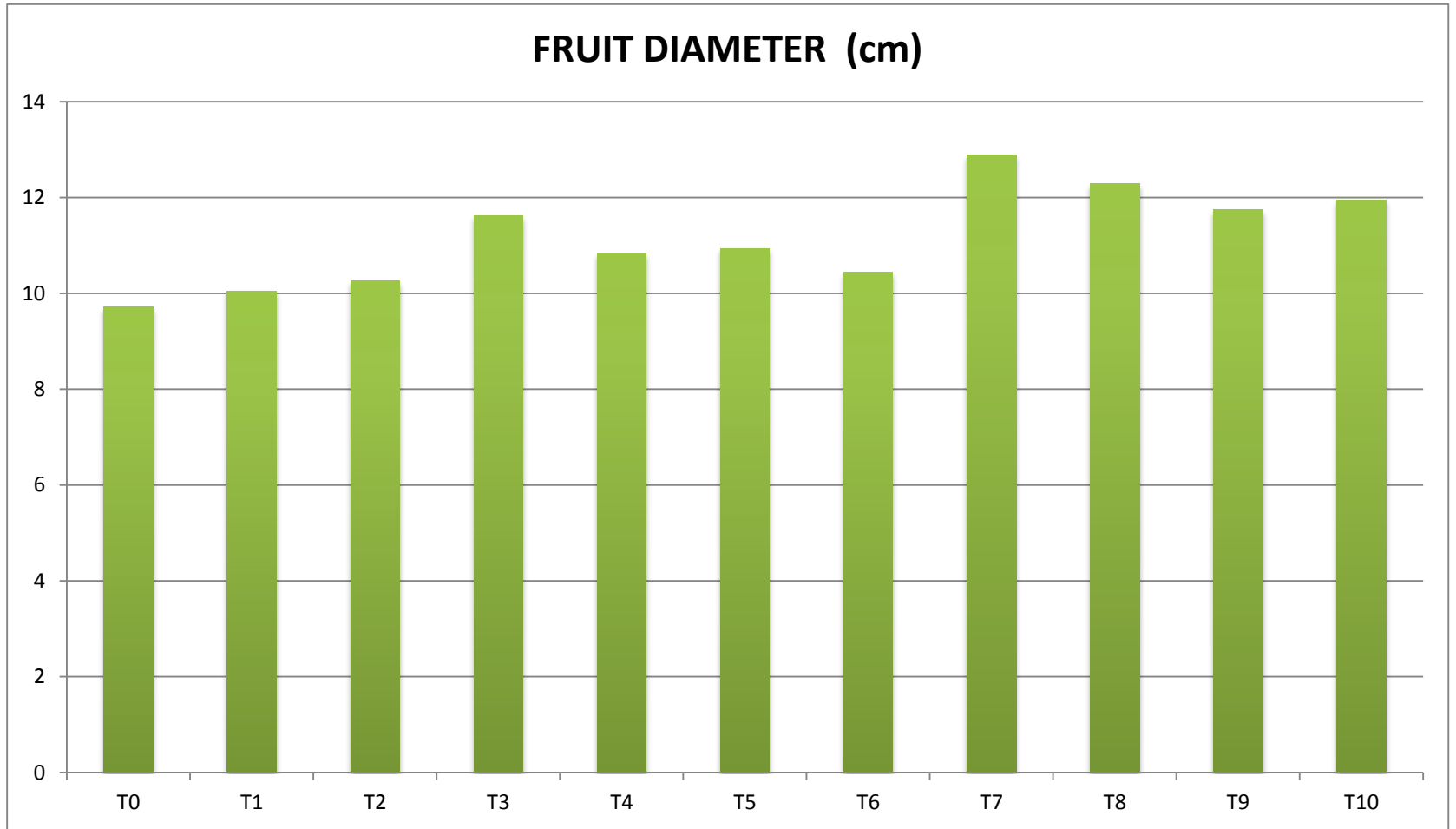
### 4.2.3 Fruit diameter (cm)

The data on the effect of organic manure on fruit diameter is shown in Table 4.7 And depicted graphically in Fig. 4.7.

**Table 4.7 Effect of different organic manures on Fruit diameter (cm) of papaya**

TREATMENTS	FRUIT DIAMETER (cm)
T <sub>0</sub> : 80% RDF + control	9.713
T <sub>1</sub> : 80% RDF + FYM (10 kg)	10.053
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	10.267
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	11.623
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	10.840
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	10.940
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	10.433
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	12.893
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	12.297
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	11.750
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	11.953
SE ( $\pm$ m)	0.260
CD at 5%	0.771

The findings clearly show that the largest fruit diameter was obtained under treatment T<sub>7</sub> (12.89 cm), followed by treatment T<sub>8</sub> (12.29 cm), and that the least fruit diameter was recorded under treatment T<sub>0</sub> (9.71 cm). It was presumably caused by the plant using its nutrients more effectively and moving more nitrogen to the top. Similar results were also reported by Kanwar *et al.* (2020), Pranesh *et al.* (2016).



**Fig. 4.7 Effect of different organic manures on Fruit diameter (cm) of papaya**

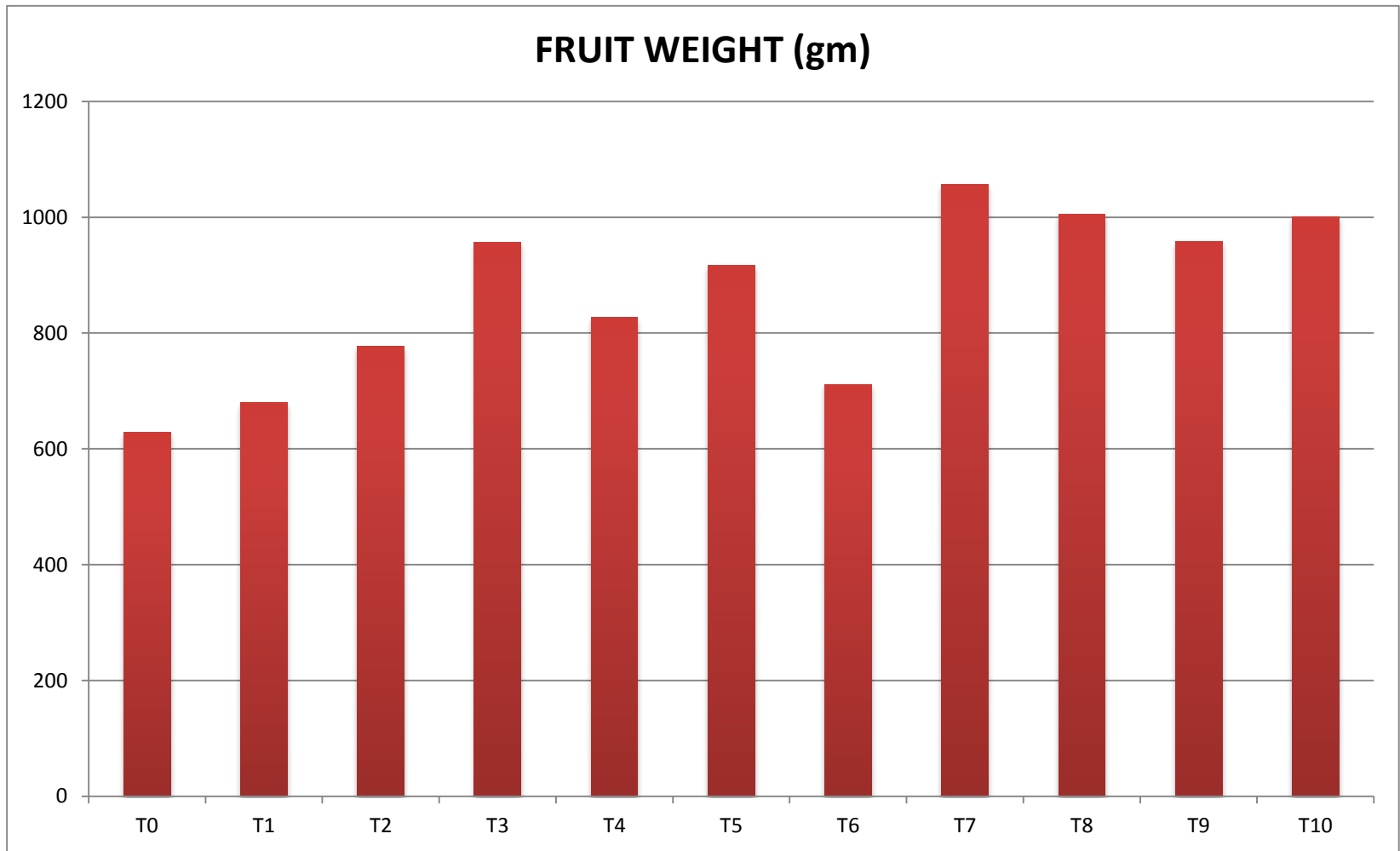
#### 4.2.4 Fruit weight (gm)

Table 4.8 and Fig.4.8 make it evident that there were significant differences in the average fruit weights across all of the study's treatments, which ranged from (628.66) gm to (1056.66 gm). The largest fruit weight was reported in T<sub>7</sub> (1056.66 gm), followed by T<sub>8</sub> (1005.66 gm), T<sub>10</sub> (1001.33 gm), and T<sub>9</sub> (958.33 gm), all of which were on par with one another. The smallest fruit weight was noted in T<sub>0</sub> (625.66 gm).

**Table 4.8 Effect of different organic manures on Fruit weight (gm) of papaya**

TREATMENTS	FRUIT WEIGHT (gm)
T <sub>0</sub> : 80% RDF + control	628.667
T <sub>1</sub> : 80% RDF + FYM (10 kg)	680.333
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	776.667
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	956.667
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	827.667
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	916.333
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	711.667
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	1,056.667
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	1,005.667
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	958.333
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	1,001.333
SE ( $\pm$ m)	33.226
CD at 5%	98.708

Significant difference in fruit weight between manure plants and plants under conventional dose of fertilizer might be due to continuous supply of nutrients to the plants. The results are in accordance with the outcomes of Pranesh *et al.* (2016), Prajapati *et al.* (2016).



**Fig. 4.8** Effect of different organic manures on Fruit weight (gm) of papaya

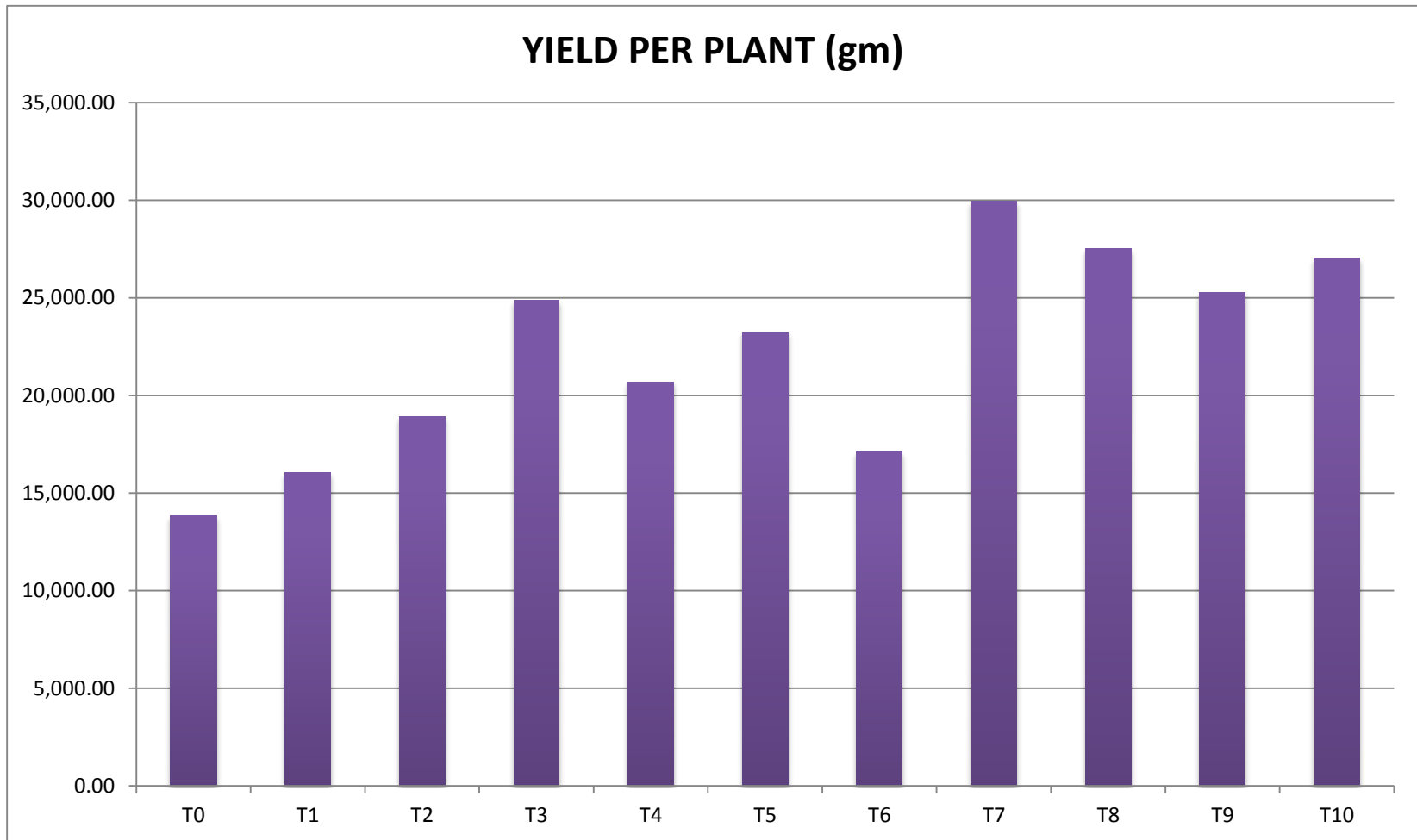
#### 4.2.5 Fruit yield per plant

The observations recorded on the effect of manures on fruit yield per plant is presented in Table 4.9 and Fig. 4.9.

Data showed that T<sub>7</sub> (29,936.670), followed by T<sub>8</sub> (27,528.330), T<sub>10</sub> (27,032.000), and T<sub>9</sub> (25,262.670), had the significantly highest overall fruit output per plant. They were statistically equal to one another, although T<sub>0</sub> had the lowest yield (13,821.670). Drip irrigation increased field capacity for moisture, improved root systems in terms of quantity and spread, and promoted lush plant growth. These factors, along with the use of organic manures, led to better fruit growth and development, which eventually increased production.

**Table 4.9 Effect of different organic manures on yield per plant (gm) of papaya**

TREATMENTS	YIELD PER PLANT (gm)
T <sub>0</sub> : 80% RDF + control	13,821.670
T <sub>1</sub> : 80% RDF + FYM (10 kg)	16,023.330
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	18,923.330
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	24,883.670
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	20,701.000
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	23,258.000
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	17,095.000
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	29,936.670
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	27,528.330
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	25,262.670
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	27,032.000
SE ( $\pm$ m)	1,184.916
CD at 5%	3,520.114



**Fig. 4.9** Effect of different organic manures on yield per plant (gm) of papaya

#### 4.2.6 Fruit yield per hectare (q/ha)

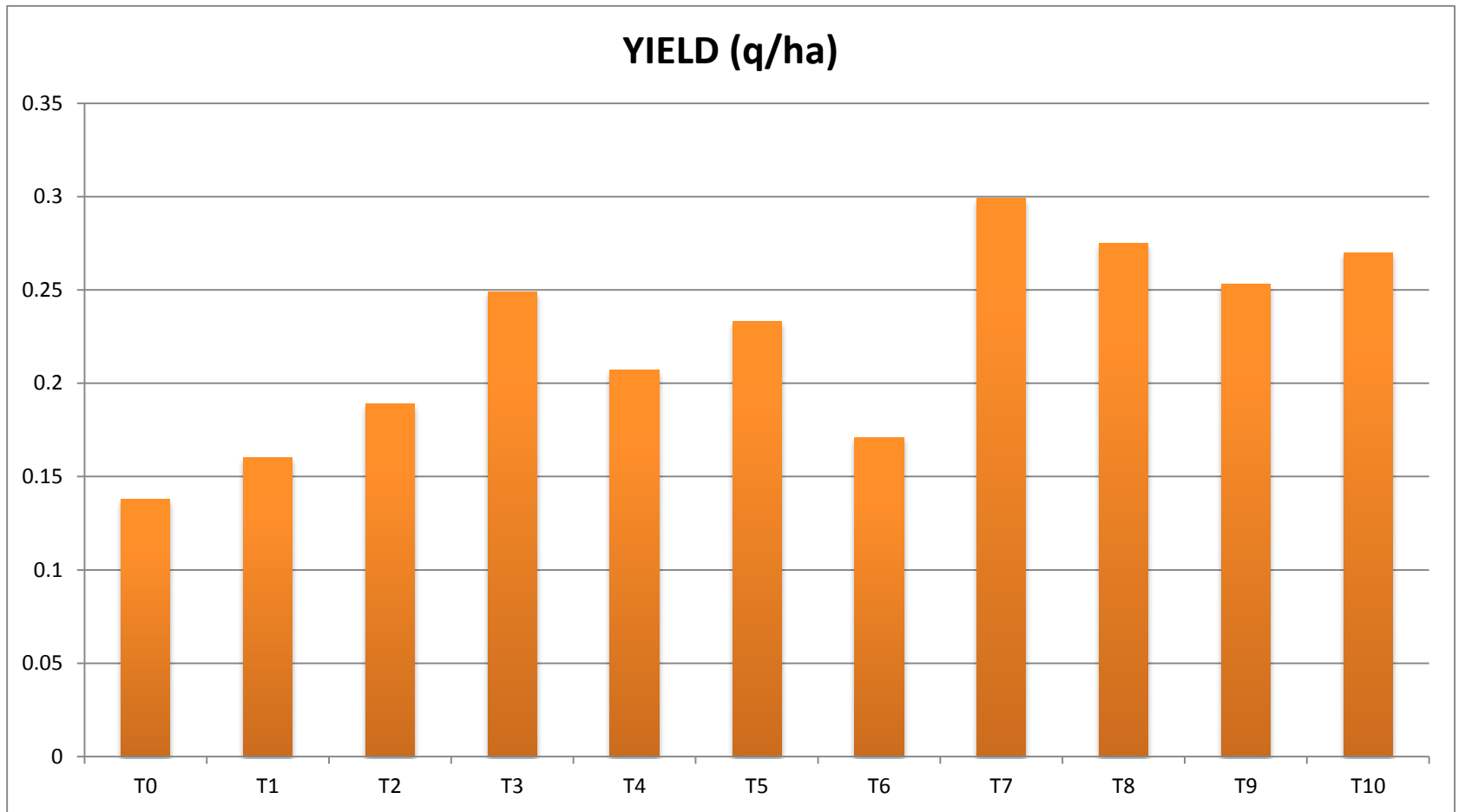
Data with respect to fruit yield influenced by different organic manures are shown in Table 4.10 and Fig. 4.10.

It is apparent from the data that the total fruit yield ranged from (0.138 q) to (0.299 q). Significantly maximum fruit yielded per hectare was found in T<sub>7</sub> (0.299 q) followed by T<sub>8</sub> (0.275 q), T<sub>10</sub> (0.270 q) and T<sub>9</sub> (0.253 q), respectively. Whereas T<sub>7</sub> and T<sub>8</sub> are statistically at par to with each other. Minimum yield was observed in T<sub>0</sub> (0.138 q).

The increase in yield was largely a consequence of higher fruit number and fruit weight. Apart from this, drip irrigation restricts the fluctuation in soil water potential within a narrow range and maintained favorable water regime leading to higher yield. Organic manures augmented the yield and productivity. Similar results were reported by Bhardwaj and Bajpai (2015), Pranesh *et al.* (2016).

**Table 4.10 Effect of different organic manures on yield (q/ha)**

TREATMENTS	YIELD (q/ha)
T <sub>0</sub> : 80% RDF + control	0.138
T <sub>1</sub> : 80% RDF + FYM (10 kg)	0.160
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	0.189
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	0.249
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	0.207
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	0.233
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	0.171
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	0.299
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) + Leaf mold (5 kg)	0.275
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	0.253
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	0.270
SE ( $\pm$ m)	0.012
CD at 5%	0.035



**Fig. 4.10 Effect of different organic manures on yield (q/ha)**

### 4.3 Quality parameters

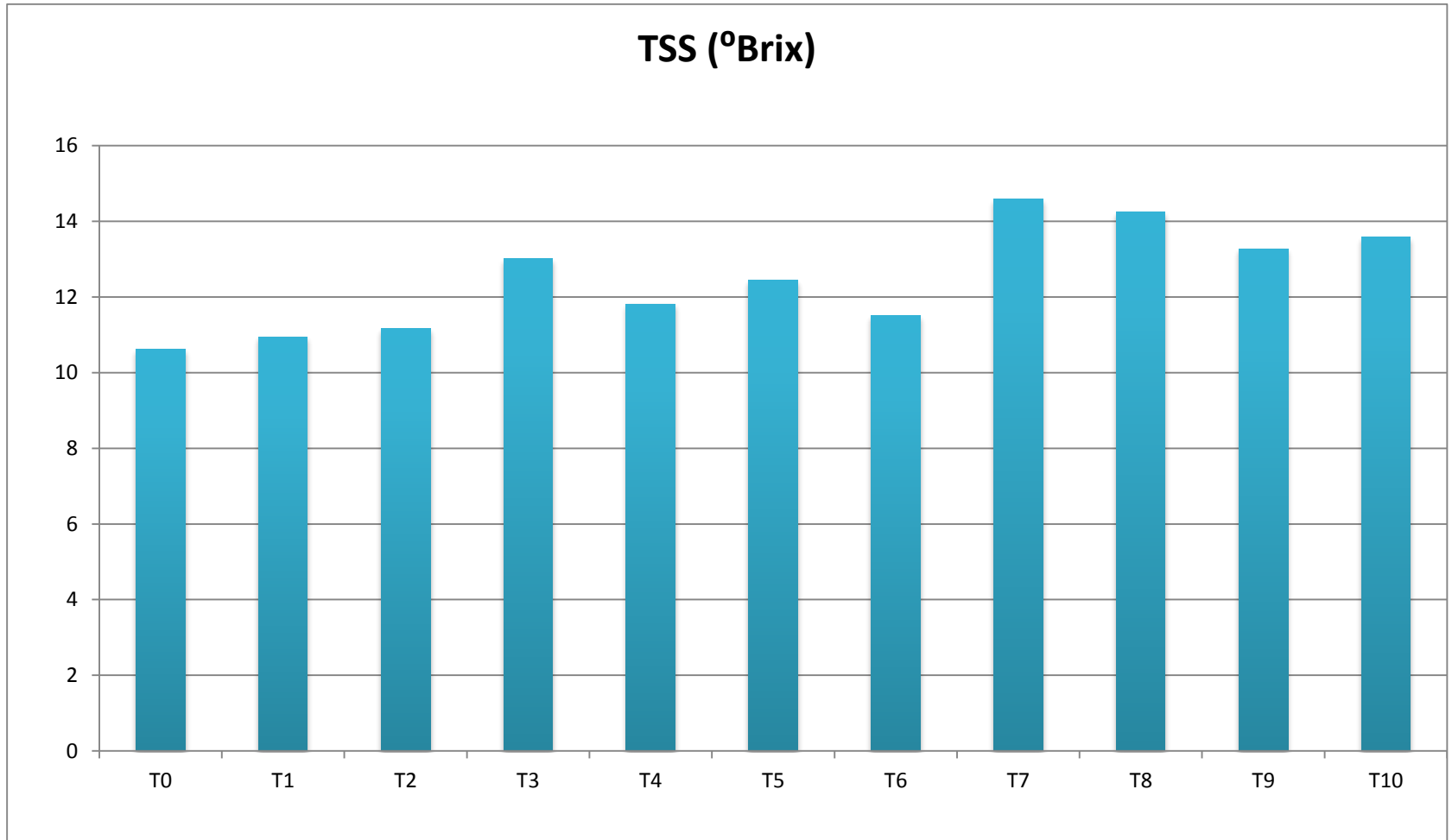
#### 4.3.1 Total soluble solids (<sup>o</sup> Brix)

The observations on TSS in the fruits are shown visually in Fig.4.11 and in Table 4.11 Under varied treatments, various manures and combinations had a noticeable impact on the TSS of papaya fruit. TSS was significantly greater with treatment T<sub>7</sub> (14.58), which was statistically comparable to treatments T<sub>8</sub> (14.24), T<sub>10</sub> (13.58), and T<sub>9</sub> (11.49). Treatments T<sub>8</sub>, T<sub>10</sub> and T<sub>9</sub> were likewise discovered to be statistically equivalent to one another. T<sub>0</sub> yielded the lowest result of TSS (10.62) i.e. control.

The data presented clearly proved that the treatment T<sub>7</sub> (80% RDF + vermicompost (5 kg) + leaf mold (5 kg)) gave the highest TSS. This may be because key nutrients are involved in the synthesis of carbohydrates, the breakdown and transport of starch, the accumulation of sugars, the synthesis of protein, and the neutralisation of organic acids that are crucial for physiology. These findings are consistent with Mango and Strawberry research by Mohit and Rajesh Kumar (2014) and Strawberry research by Singh *et al.* (2010).

**Table 4.11 Effect of different organic manures on TSS (<sup>o</sup> Brix)**

TREATMENTS	TSS ( <sup>o</sup> Brix)
T <sub>0</sub> : 80% RDF + control	10.623
T <sub>1</sub> : 80% RDF + FYM (10 kg)	10.947
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	11.163
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	13.010
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	11.813
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	12.453
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	11.510
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	14.580
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	14.247
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	13.277
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	13.583
SE ( $\pm$ m)	0.217
CD at 5%	0.645



**Table 4.11 Effect of different organic manures on TSS (° Brix)**

### 4.3.2 Reducing sugar (%)

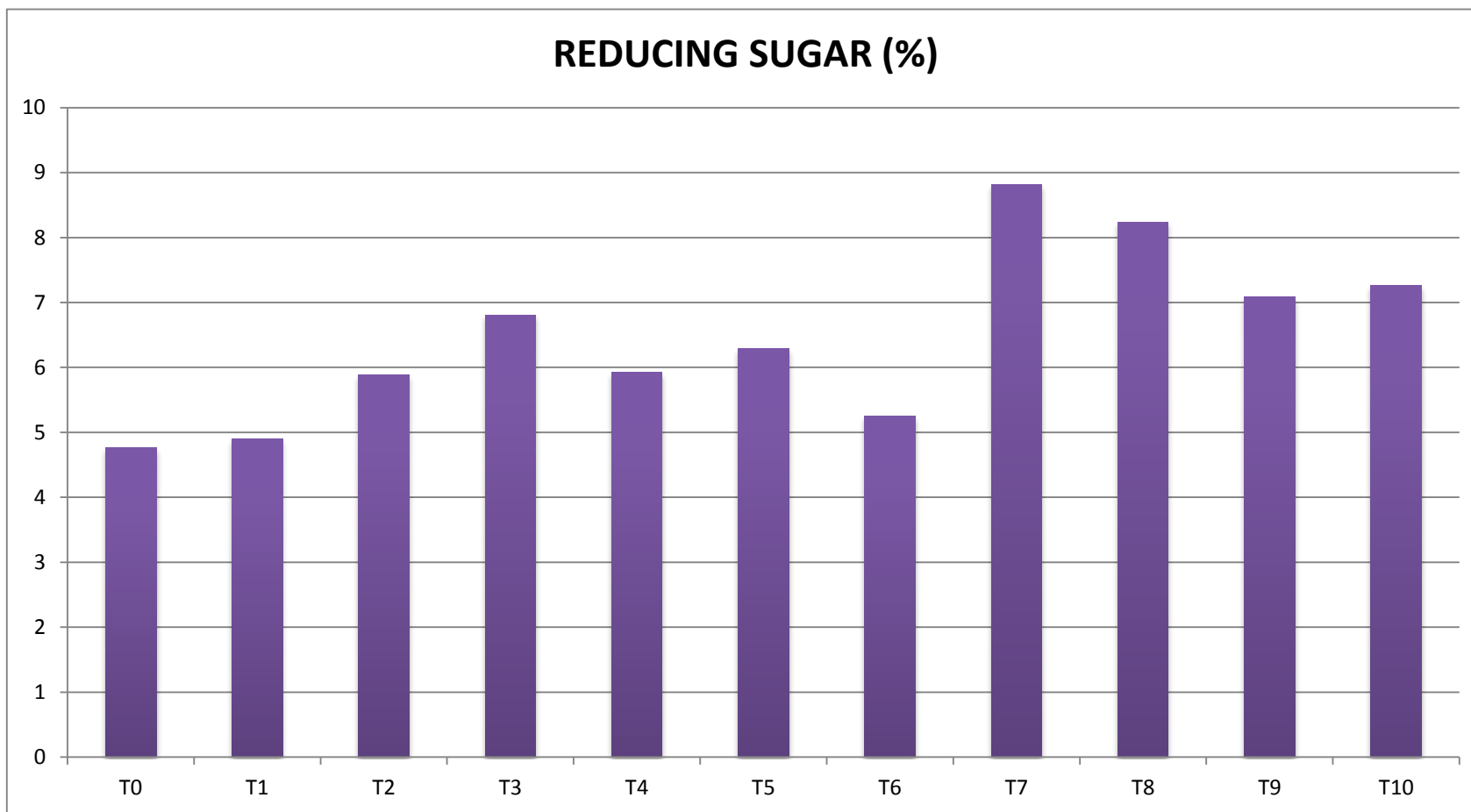
Data taken on the effect of different organic manures is presented in Table 4.12 and graphically depicted in Fig. 4.12.

According to the data, T<sub>7</sub> (80 percent RDF + 5 kg vermicompost + 5 kg leaf mold) had the highest reducing sugar percentage at 8.82%, followed by T<sub>8</sub> (8.24%), T<sub>10</sub> (7.26%), and T<sub>9</sub> (7.08%). Statistics compared treatment T<sub>7</sub> and T<sub>8</sub> similarly. T<sub>0</sub> had the lowest proportion of reducing sugar which was 4.76%.

The increased degree of organic manure treatments may have improved quality metrics due to better nutrient availability throughout the plant growth phase. Additionally, Mohit and Rajesh Kumar (2014) and Singh *et al.* (2010) studies on strawberries both showed similar results.

**Table 4.12 Effect of different organic manures on reducing sugar (%)**

TREATMENTS	REDUCING SUGARS (%)
T <sub>0</sub> : 80% RDF + control	4.763
T <sub>1</sub> : 80% RDF + FYM (10 kg)	4.900
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	5.890
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	6.810
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	5.923
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	6.293
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	5.247
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	8.820
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	8.240
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	7.087
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	7.260
SE ( $\pm$ m)	0.201
CD at 5%	0.598



**Table 4.12 Effect of different organic manures on reducing sugar (%)**

### 4.3.3 Non – Reducing sugars (%)

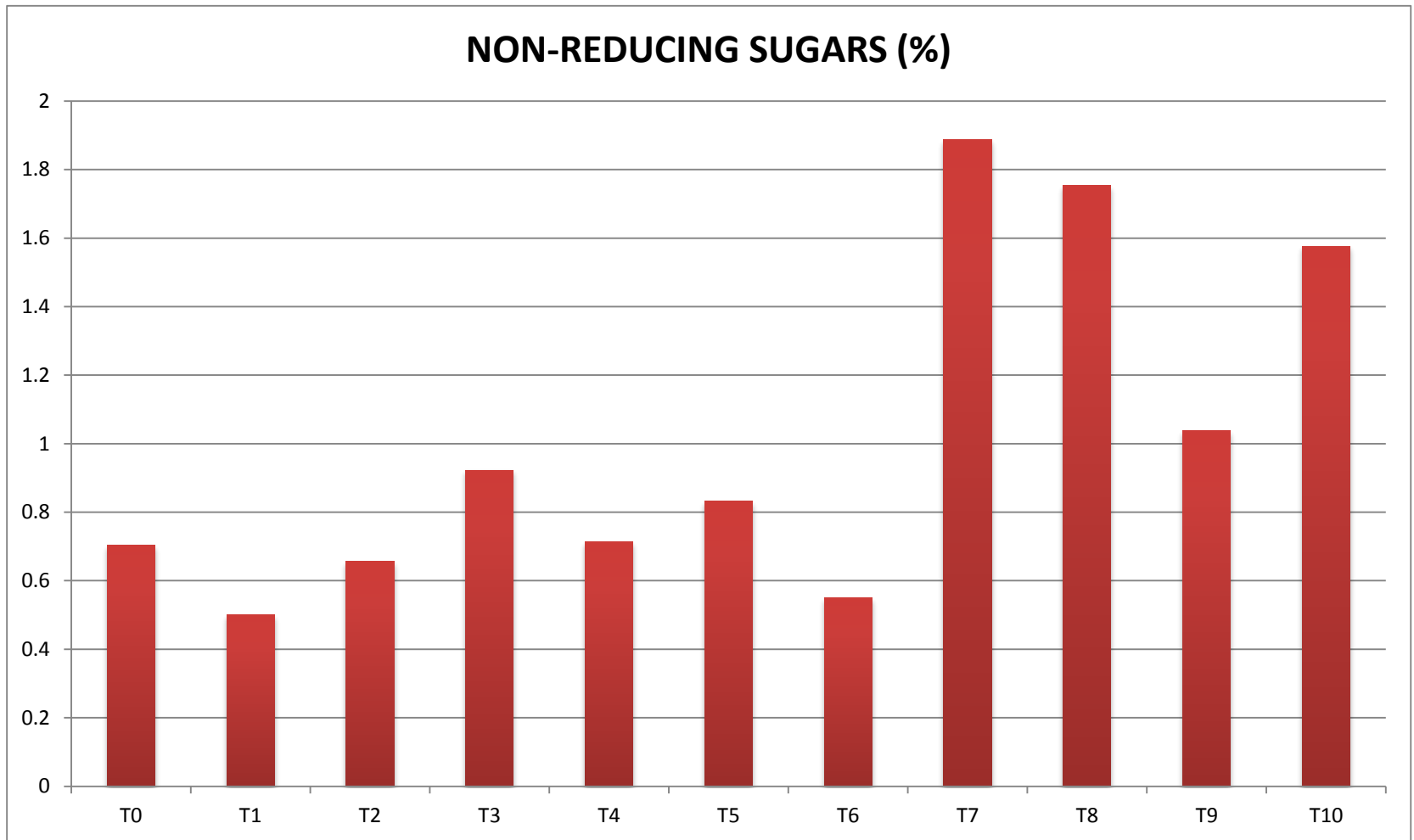
In Table 4.13 data on non-reducing sugar values with various organic manures are shown as percentages. And shown visually in Fig. 4.13

The effect of different organic manures gave the maximum non reducing sugar percentage was observed in T<sub>7</sub> (80 percent RDF + 5 kg vermicompost + 5 kg leaf mold) which was 1.88 and minimum was observed in control T<sub>0</sub> which was 0.70. T<sub>7</sub> gave the maximum percentage followed by T<sub>8</sub> (1.75), T<sub>10</sub> (1.57) and T<sub>9</sub> (1.03). However, T<sub>7</sub> and T<sub>8</sub> were statistically at par to eachother.

The increased degree of organic manure treatments may have improved quality metrics due to better nutrient availability throughout the plant growth phase. Additionally, Mohit and Rajesh Kumar (2014) and Singh *et al.* (2010) studies's on strawberries both showed similar results.

**Table 4.13 Effect of different organic manures on non-reducing sugar (%)**

TREATMENTS	NON-REDUCING SUGARS (%)
T <sub>0</sub> : 80% RDF + control	0.703
T <sub>1</sub> : 80% RDF + FYM (10 kg)	0.500
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	0.657
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	0.923
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	0.713
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	0.833
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	0.550
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	1.887
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	1.753
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	1.037
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	1.577
SE (±m)	0.083
CD at 5%	0.246



**Fig. 4.13 Effect of different organic manures on non-reducing sugar (%)**

#### 4.3.4 Total sugars (%)

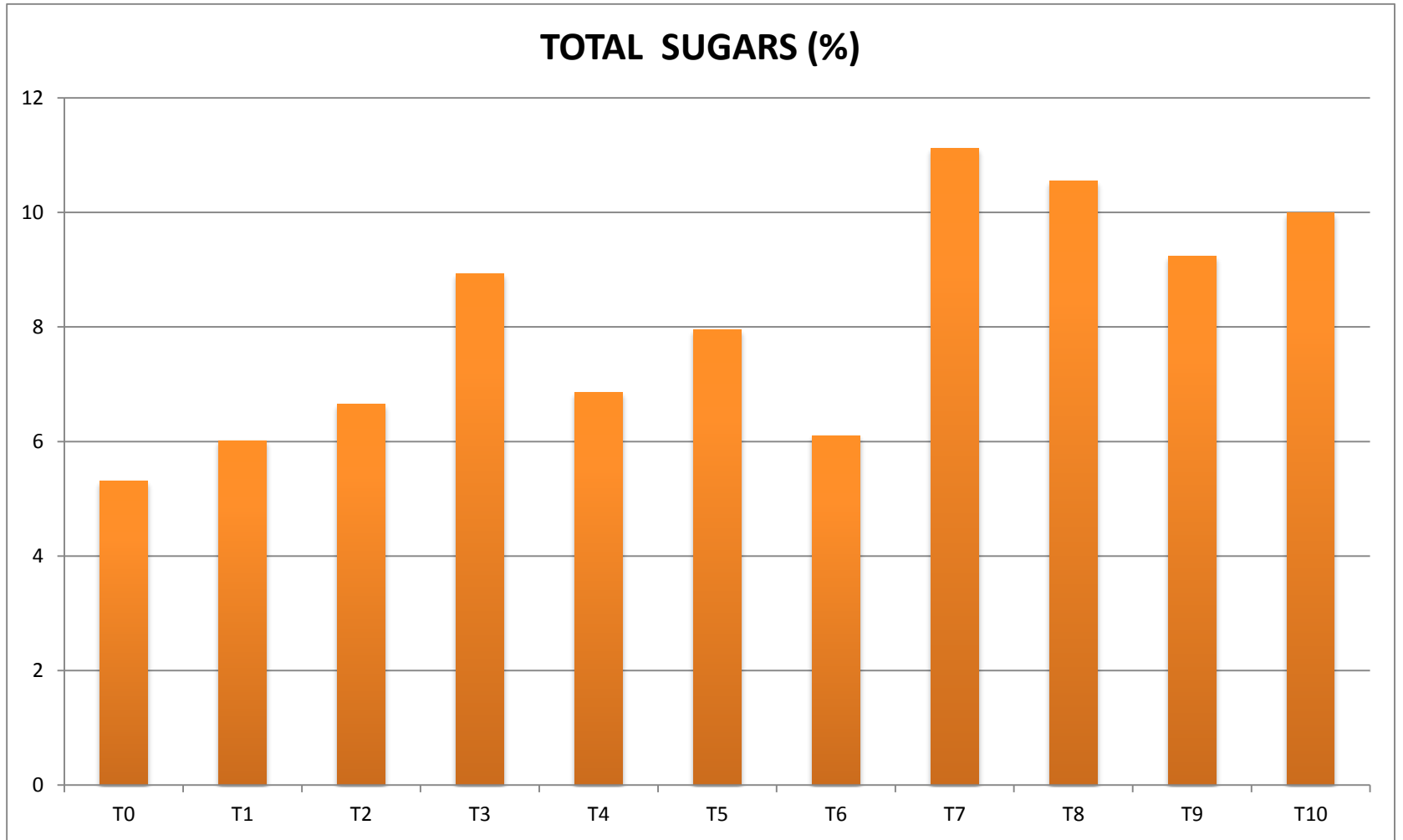
In Fig.4.14 a graphic representation of the data from Table 4 percentage of total sugars is shown. The results in terms of total sugars percentage differed across various organic manures.

It is clear from the data that total sugar ranged from 5.31 to 11.12%. Consequently, maximum total sugar was found in T<sub>7</sub> (11.12) followed by T<sub>8</sub> (10.54), T<sub>10</sub> (9.99) and T<sub>9</sub> (9.23), whereas minimum total sugar was observed in control or T<sub>0</sub> (5.31).

The quality improvement is due to K involvement in Carbohydrate synthesis, breakdown and translocation of starch, synthesis of protein and neutralization of physiologically important organic acids. Similar findings were also reported by Singh *et al.* (2010), Pranesh *et al.* (2016).

**Table 4.14 Effect of different organic manures on total sugar (%)**

TREATMENTS	TOTAL SUGARS (%)
T <sub>0</sub> : 80% RDF + control	5.313
T <sub>1</sub> : 80% RDF + FYM (10 kg)	6.017
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	6.650
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	8.927
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	6.860
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	7.947
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	6.107
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	11.120
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	10.547
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	9.233
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	9.993
SE ( $\pm$ m)	0.315
CD at 5%	0.935



**Fig. 4.14** Effect of different organic manures on total sugar (%)

#### 4.3.4 Acidity (%)

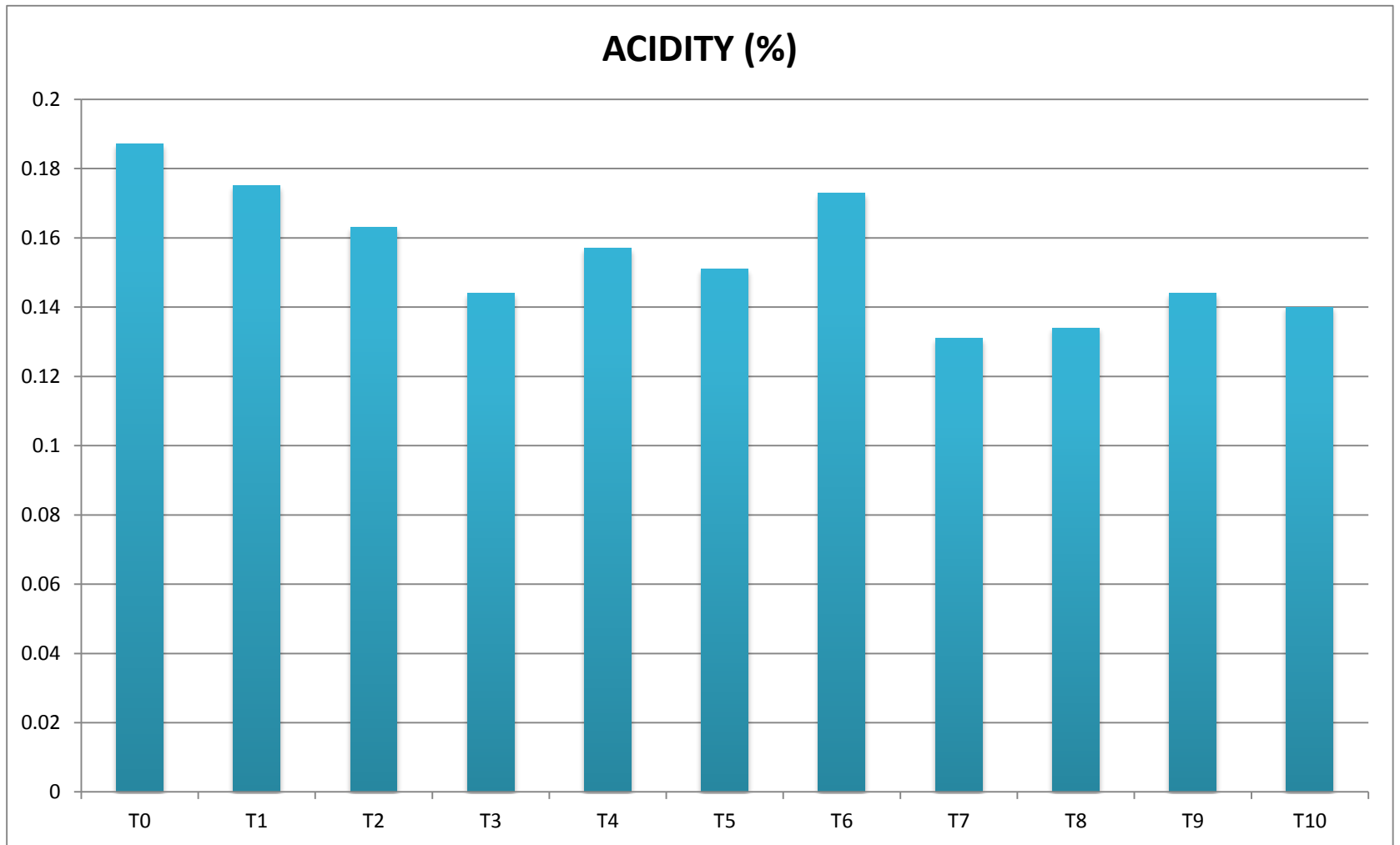
Different organic manure gave varied effect on acidity percentage, for which observed data is shown in Table 4.15 and graphically depicted in Fig. 4.15

From the data it is observed that lowest percent of acidity is noted in T<sub>7</sub> (0.13) which was significantly at par with T<sub>8</sub> (0.13), T<sub>10</sub> (0.14) and T<sub>9</sub> (0.14). The treatments T<sub>7</sub> and T<sub>8</sub> gave statistically similar results. Highest percentage of acidity observed in control i.e. T<sub>0</sub> (0.18).

The use of organic manure in conjunction with the appropriate fertiliser dosage showed a regulatory effect on the translocation and absorption of different metabolites, with carbohydrates playing a key role in determining the quality of fruits. Fruits' carbohydrate reserves in the stem and root are extensively depleted during ripening and hydrolyzed into sugars, improving the quality of the fruit. The outcomes are consistent with Kanwar *et al.* (2020), Pranesh *et al.* (2016) and other researchers.

**Table 4.15 Effect of different organic manures on acidity (%)**

TREATMENTS	ACIDITY (%)
T <sub>0</sub> : 80% RDF + control	0.187
T <sub>1</sub> : 80% RDF + FYM (10 kg)	0.175
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	0.163
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	0.144
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	0.157
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	0.151
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	0.173
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	0.131
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	0.134
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	0.144
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	0.140
SE ( $\pm$ m)	0.004
CD at 5%	0.011



**Fig. 4.15 Effect of different organic manures on acidity (%)**

### 4.3.5 Ascorbic acid (%)

Percentile values of ascorbic acid observed due to various organic manures is shown in Table 4.16 and graphically depicted in Fig. 4.16.

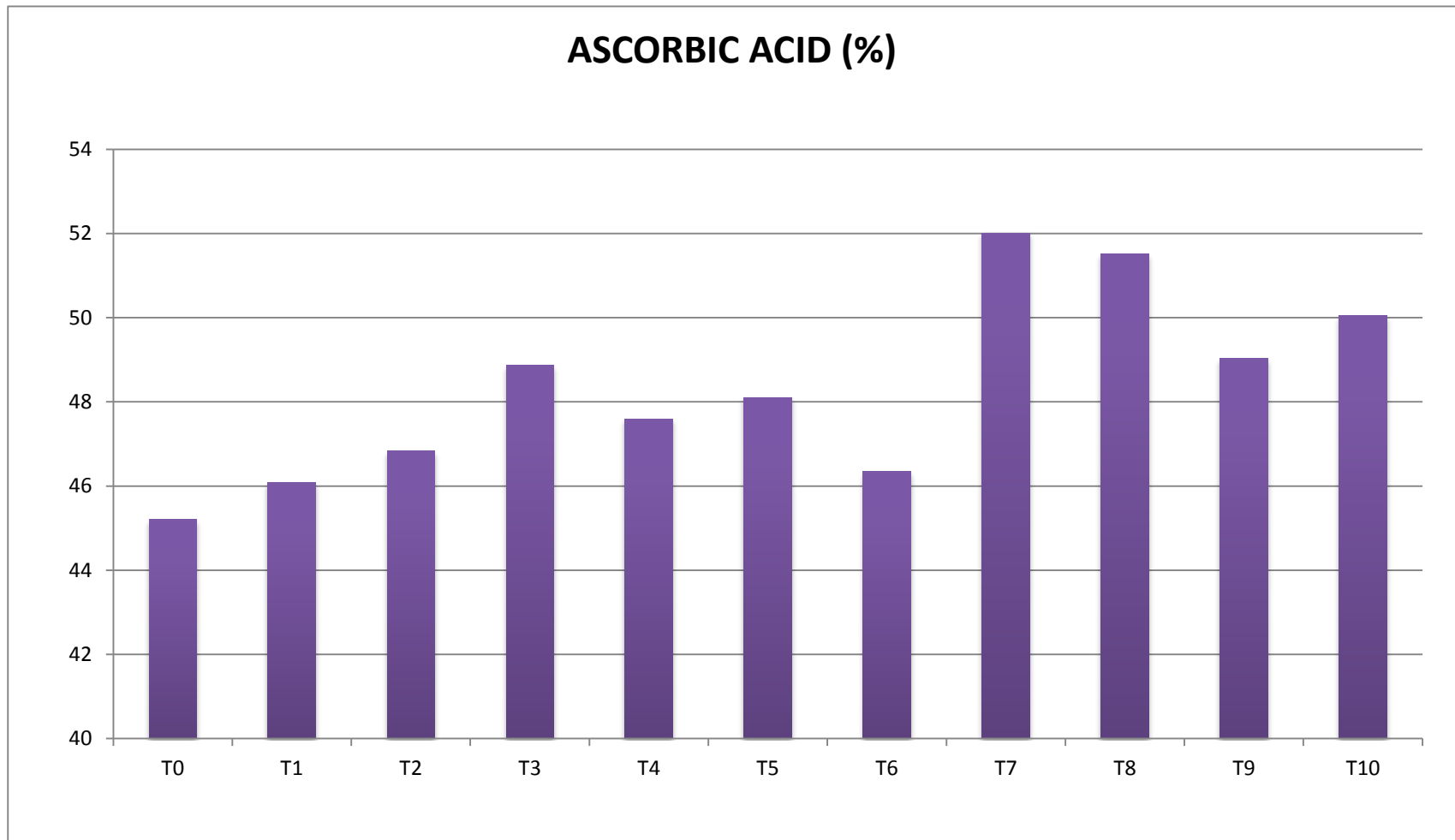
The findings showed that there were notable differences between the treatments when it came to ascorbic acid content.

Highest percentage of ascorbic acid was found under the treatment T<sub>7</sub> (80 percent RDF + 5 kg vermicompost + 5 kg leaf mold) which was 52.01 and lowest value was observed in T<sub>0</sub> (45.20). T<sub>7</sub> was found to be the superior most among all other treatments.

It is due to ripening of fruits where fruits change its physical, physiological and biochemical changes that is conversion of starch into soluble sugars. Present findings are in accordance with Kanwar *et al.* (2020), Pranesh *et al.* (2016).

**Table 4.16 Effect of different organic manures on ascorbic acid (%)**

TREATMENTS	ASCORBIC ACID (%)
T <sub>0</sub> : 80% RDF + control	45.207
T <sub>1</sub> : 80% RDF + FYM (10 kg)	46.073
T <sub>2</sub> : 80% RDF + Vermicompost (10 kg)	46.847
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	48.873
T <sub>4</sub> : 80% RDF + Castor cake (10 kg)	47.597
T <sub>5</sub> : 80% RDF + Goat compost (10 kg)	48.107
T <sub>6</sub> : 80% RDF + FYM (5 kg) + Leaf mold (5 kg)	46.343
T <sub>7</sub> : 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	52.010
T <sub>8</sub> : 80% RDF + Neem cake (5 kg) Leaf mold (5 kg)	51.513
T <sub>9</sub> : 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg)	49.023
T <sub>10</sub> : 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg)	50.050
SE ( $\pm$ m)	0.281
CD at 5%	0.835



**Fig. 4.16** Effect of different organic manures on ascorbic acid (%)

#### 4.4 Benefit Cost Ratio (B:C)

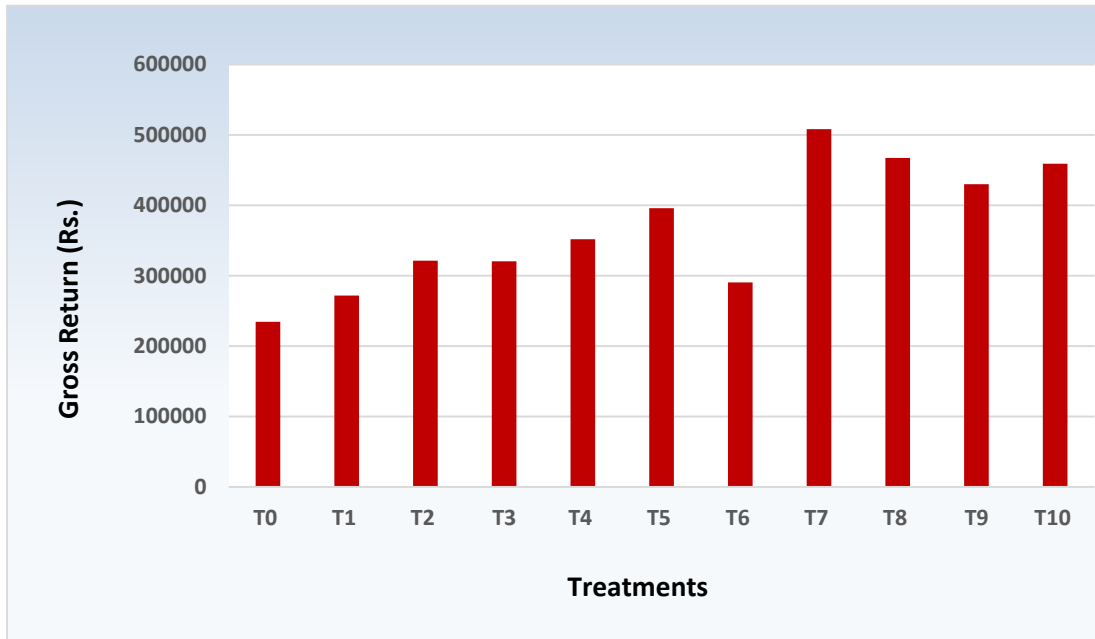
Effect of different levels of fertigation and mulching on total cost of cultivation, gross income, net return and benefit cost ratio of papaya crop are given in table .... and depicted through fig. 4.17

Total cost of cultivation, gross income and net return (Rs.170397) (Rs. 508300) and (Rs. 337303), respectively, was found in the treatment combination of 80%RDF + Vermicompost (5 kg) + Leaf mold (5 kg). the minimum total cost of cultivation, gross income and net return (Rs. 170327)

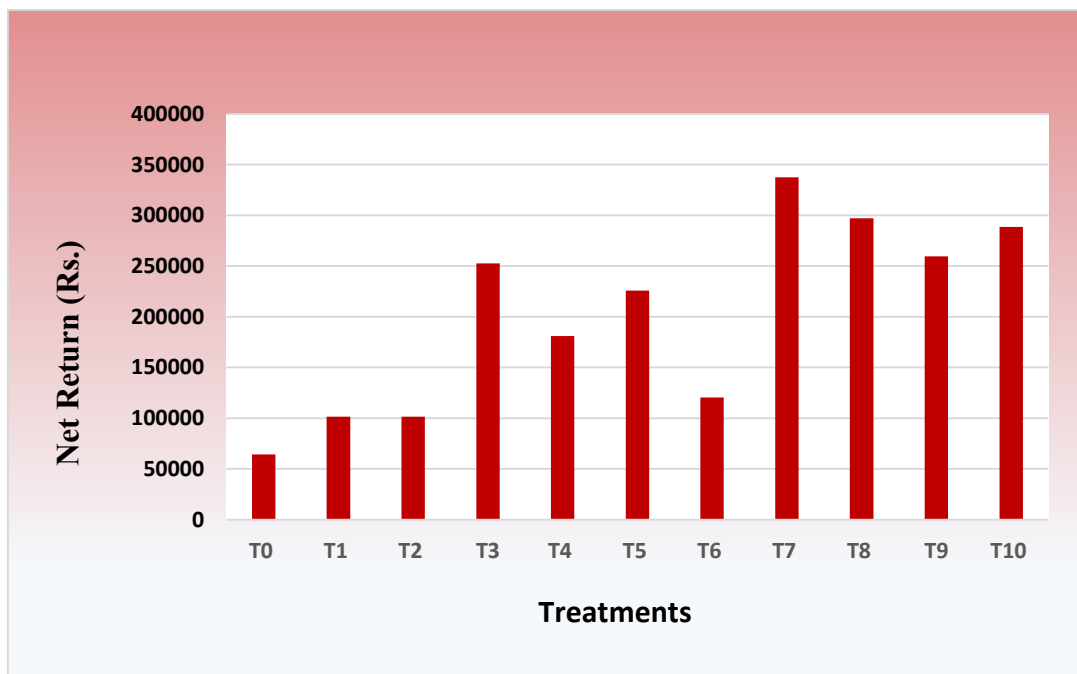
(Rs. 234600) and (Rs. 64273) was observed in the treatment control. Similar findings were reported by Pranesh et. Al. (2016).

Table Effect of different organic manures on total cost of cultivation, gross income, net return and benefit cost ratio of papaya crop.

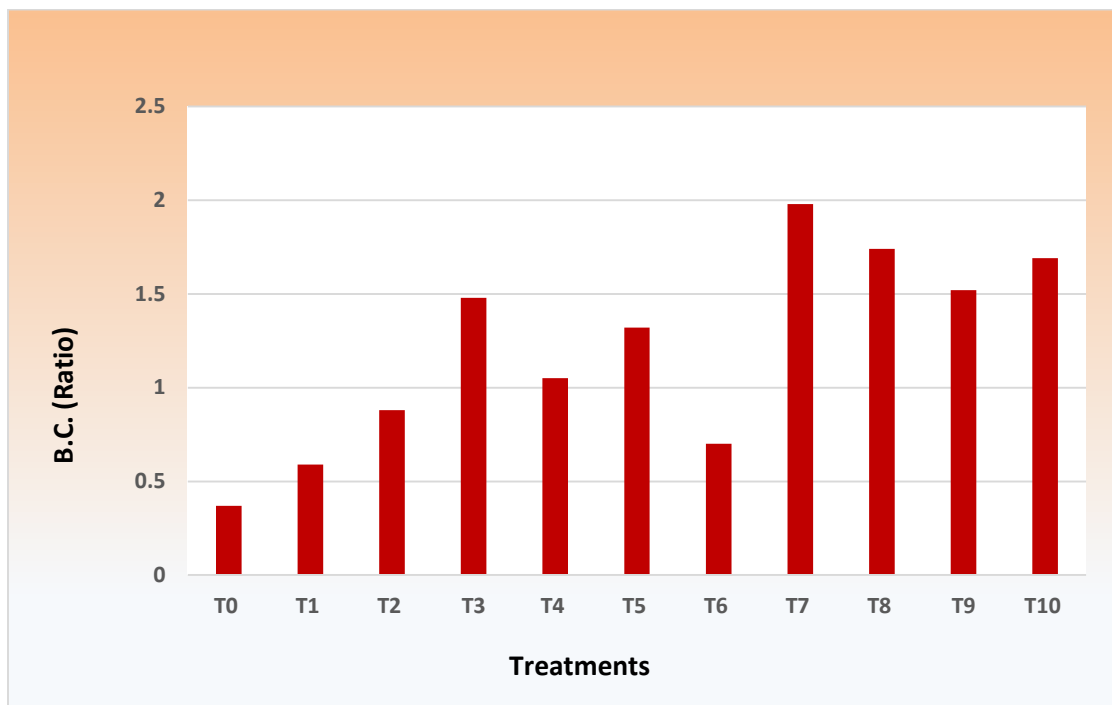
Treatment	Cultivation cost ha <sup>-1</sup>	Gross return (Rs. ha <sup>-1</sup> )	Net return (Rs. ha <sup>-1</sup> )	B : C ratio
T <sub>0</sub> : 80% RDF (Control)	170327	234600	64273	0.37
T <sub>1</sub> : 80%RDF + FYM (10 kg)	170427	272000	101573	0.59
T <sub>2</sub> : 80%RDF + Vermicompost (10 kg)	170447	321300	101573	0.88
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	170627	320300	252673	1.48
T <sub>4</sub> : 80%RDF + Castor cake (10 kg)	170827	351900	181073	1.05
T <sub>5</sub> : 80%RDF + Goat compost (10 kg)	170437	396100	225663	1.32
T <sub>6</sub> : 80%RDF + FYM (5 kg) + Leaf mold (5 kg)	170387	290700	120313	0.70
T <sub>7</sub> : 80%RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	170397	508300	337303	1.98
T <sub>8</sub> : 80%RDF + Neem cake (5 kg) + Leaf mold (5 kg)	170487	467500	297013	1.74
T <sub>9</sub> : 80%RDF + Castor cake (5 kg) + Leaf mold (5 kg)	170587	430100	259513	1.52
T <sub>10</sub> : 80%RDF + Goat compost (5 kg) + Leaf mold (5 kg)	170391	459000	288608	1.69



**Fig. 4.17** Effect of different organic manures on gross income of papaya crop



**Fig. 4.18** Effect of different organic manures on net return of papaya crop



**Fig. 4.19** Effect of different organic manures on benefit cost ratio of papaya crop



**Fig. 4.20 General View of experimental field**

## CHAPTER V

# SUMMARY AND CONCLUSIONS

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The present investigation entitled “**To study influence of different organic manures on growth, yield, and quality of papaya (*Carica papaya L.*) in Chhattisgarh plains.**” was carried out during the year 2021 – 22 at Horticulture instructional cum Research farm, Precision Farming Development Centre, Department of Fruit Science, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). the experiment was laid out in Randomized Block Design (RBD) with three replications and eleven treatments combination viz., T<sub>0</sub> : 80% RDF + control, T<sub>1</sub> : 80% RDF + FYM (10 kg), T<sub>2</sub> : 80% RDF + Vermicompost (10 kg), T<sub>3</sub> : 80% RDF + Neem cake (10 kg), T<sub>4</sub>: 80% RDF + Castor cake (10 kg), T<sub>5</sub>: 80% RDF + Goat compost (10 kg), T<sub>6</sub>: 80% RDF + FYM (5 kg) + Leaf mold (5 kg), T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg), T<sub>8</sub>: 80% RDF + Neem cake (5 kg) Leaf mold (5 kg), T<sub>9</sub>: 80% RDF + Castor cake (5 kg) + Leaf mold (5 kg), T<sub>10</sub>: 80% RDF + Goat compost (5 kg) + Leaf mold (5 kg). the experiment findings based on observations viz., plant height, number of leaves, petiole length, stem girth, number of fruits per plant, fruit length, fruit diameter, fruit weight, yield per plant, total yield, TSS, reducing sugars, non-reducing sugar, total sugar, acidity and ascorbic acid of papaya.

### **Experiment obtained during the study are summarized as follows :**

- Significantly maximum plant height (35.58 cm), (96.36 cm), (133.08 cm), (176.83 cm) was recorded at thirty, ninety, one fifty and two ten days after transplanting under (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). Whereas, the minimum plant height (21.03 cm), (71.37 cm), (111.33 cm), (141.35 cm) under the treatment (T<sub>0</sub> : 80% RDF + control).
- The number of leaves was found significantly maximum (5.00), (9.66), (18.33) and (29.66) was recorded at thirty, ninety, one fifty and two ten days

after transplanting under the treatment T<sub>7</sub>: (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). Whereas, the minimum number of leaves (3.00), (4.66), (12.66) and (23) under the treatment (T<sub>0</sub>: 80% RDF + control).

- The petiole length was found significantly maximum (46.96 cm), (65.88 cm), (71.57 cm) and (72.69 cm) was recorded at thirty, ninety, one fifty and two ten days after transplanting under the treatment T<sub>7</sub>: (80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). Whereas, the minimum number of leaves (35.66 cm), (50.30 cm), (53.11 cm) and (56.15 cm) under the treatment (T<sub>0</sub>: 80% RDF + control).
- The stem girth was found significantly maximum (15.01 cm), (25.37 cm), (33.41 cm) and (39.31 cm) under treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). While minimum stem girth (15.01 cm), (12.74 cm), (21.10 cm) and (24.93 cm) was recorded in treatment (T<sub>0</sub>: 80% RDF + control) at thirty, ninety, one fifty and two ten days after transplanting.
- The number of fruits per plant was found significantly maximum (28.33) was recorded under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)). Whereas, the minimum number of fruits (22) under the treatment (T<sub>0</sub>: 80% RDF + control).
- Significantly maximum fruit length (21.76 cm) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (15.73 cm) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) gave the maximum fruit diameter (12.89 cm) and minimum (9.71 cm) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The maximum fruit weight (1056.66 gm) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (628.66 gm) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg))

gave the maximum fruit yield per plant

- The maximum (0.299 q) total yield was observed under treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (0.138 q) under the treatment (T<sub>0</sub>: 80% RDF + control).
- Significantly maximum TSS (14.58) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (10.62) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The maximum reducing sugars (8.82%) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (4.76%) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- Significantly maximum non-reducing (1.88 %) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and minimum (0.70%) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) gave the maximum total sugars (11.12%) and minimum (5.31%) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- Significantly the minimum acidity (0.13%) was observed under the treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) and maximum (0.18%) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).
- The treatment (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mold (5 kg)) gave the maximum ascorbic acid (52.01%) and minimum (45.20%) was recorded under treatment (T<sub>0</sub>: 80% RDF + control).

## CONCLUSIONS

The current experiment could lead to the following conclusions. (T<sub>7</sub>: 80% RDF + 5 kg of vermicompost + 5 kg of leaf mould) performed better than other

treatments (T<sub>8</sub>: 80% RDF + Neem cake (5 kg) Leaf mould (5 kg)) that were then applied.

It was concluded that (T<sub>7</sub>: 80% RDF + Vermicompost (5 kg) + Leaf mould (5 kg)) improved the yield and early production. Additionally, it was shown that the treatment (T<sub>8</sub>: 80% RDF + Neem cake (5 kilogramme) + Leaf mould (5 kg)) produced fruits of a larger size that sold for a higher price.

Along with earlier fruiting, the treatment T7 also produced a greater number of fruits, which increased papaya yield, improved fruit quality, and benefit-to-cost ratio. Providing leaf mould along with the treatments has been discovered to be beneficial for papaya farming.

### **SUGGESTIONS FOR FUTURE RESEARCH WORK**

The following points are believed to be worthy of additional research given the experience gained during the course of the current investigations and the outcomes.

1. The findings of this experiment that lasted a year served as the foundation for the current study. To come to firm conclusions and recommendations, more research is necessary for at least two years in a row.
2. It is possible to do research on various organic manures in combination with traditional fertilisers and biofertilizers for papaya farming.
3. In comparison to other irrigation techniques, the drip method's partial wetting of the soil reduces the likelihood of infestation. As a result, there is a decreased need for labourers to apply pricy, toxic chemicals to the environment.

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## APPENDICES

### APPENDIX – A : weekly meteorological data during crop growth period (from July 15, 2021 to February 24, 2022)

Wk No.	Date	Max. Temp. (°C)	Min. Temp. (°C)	Rain-fall (mm)	Rainy days	Relative Humidity (%)		Vapour Pressure (mm of Hg)		Wind Velocity (Kmph)	Evapo-ration (mm)	Sun Shine (hours)
						I	II	I	II			
29	July 16-22	34.2	26.5	56.8	3	84	63	23.5	23.9	6.8	33.7	6.7
30	23-29	30.4	24.8	88.2	5	91	80	22.2	23.0	10.4	18.5	1.5
31	30-05	28.8	24.8	15.8	2	88	76	21.8	22.4	11.6	18.6	1.3
32	Aug 06-12	33.0	25.6	63.6	3	88	70	23.1	23.9	8.5	29.2	3.2
33	13-19	32.8	26.0	25.8	3	90	68	24.2	23.4	4.2	23.4	3.1
34	20-26	32.1	25.6	22.8	3	90	70	23.5	24.1	5.9	23.4	3.9
35	27-02	32.6	25.5	9.8	2	87	65	23.2	22.7	5.2	27.7	5.0
36	Sep 03-09	32.6	24.9	86.0	4	88	70	22.7	23.7	4.6	27.2	6.4
37	10-16	31.1	24.5	238.4	7	94	79	22.6	23.2	6.9	20.1	2.6
38	17-23	30.2	24.3	16.2	2	92	74	22.1	23.1	4.6	13.8	1.9
39	24-30	31.8	24.7	26.8	3	91	70	22.7	22.9	4.8	21.8	5.1
40	Oct 01-07	32.7	25.1	0.0	0	90	66	23.2	23.6	3.2	22.1	6.1
41	08-14	32.6	23.0	0.4	0	89	47	20.9	16.8	2.2	26.1	6.7
42	15-21	32.4	24.3	15.2	2	90	57	21.7	19.2	4.5	27.2	7.8
43	22-28	31.4	18.1	0.0	0	87	35	15.4	12.5	2.6	27.2	9.3
44	29-04	30.4	19.1	0.0	0	88	50	16.1	15.8	3.7	23.4	7.8
45	Nov 05-11	30.1	14.8	0.0	0	87	34	12.4	10.6	2.6	23.4	7.3
46	12-18	29.1	21.3	0.6	0	93	65	18.4	18.5	5.0	17.3	3.1
47	19-25	31.0	20.4	48.0	1	92	53	17.6	17.1	3.0	19.7	5.8

Wk No.	Date	Max. Temp. (°C)	Min. Temp. (°C)	Rain-fall (mm)	Rainy days	Relative Humidity (%)		Vapour Pressure (mm of Hg)		Wind Velocity (Kmph)	Evapo-ration (mm)	Sun Shine (hours)
						I	II	I	II			
						48	26-02	29.1	13.6			
49	Dec 03-09	28.7	17.3	0.0	0	85	49	13.8	14.0	3.8	19.7	6.2
50	10-16	27.8	13.4	0.0	0	88	39	11.2	10.2	2.6	18.2	5.2
51	17-23	25.7	8.4	0.0	0	88	33	8.0	8.0	2.1	17.1	5.5
52	24-31	26.4	13.8	82.4	2	91	57	11.5	12.8	2.7	14.0	1.9
01	Jan 01-07	26.32	12.44	0	0	93.28	45.4 2	10.0	20.5	2.3	1.91	6.87
02	08-14	24.28	16.60	2.14	0	94	70.5 7	11.5	9.8	2.4	1.67	2.84
03	15-21	25.34	12.20	0	0	91	45.4 2	9.6	7.8	2.2	2.12	6.07
04	22-28	28.97	12.07	0.42	0	86.71	39.0 0	10.6	11.6	2.4	2.91	6.74
05	Feb 29-04	27.81	10.74	0	0	88.42	28.4 2	8.6	6.1	2.3	3.41	8.85
06	05-11	28.47	11.35	1	0	86.57	31.4 2	8.0	6.4	2.6	3.44	7.47
07	12-18	27.64	12.34	0	0	83.85	31.5 7	11.4	12.3	2.5	3.12	7.3
08	19-25	31.88	14.21	0	0	82.14	29.7 1	11.3	9.8	2.6	4.02	6.32
09	25-04 March	33.08	17.88	0	0	83.28	35.8 5	10.3	11.0	2.4	4.02	6.15

**APPENDIX – B : COST OF CULTIVATION OF PAPAYA (*Carica papaya* L.)**

<b>S.No.</b>	<b>Particulars</b>	<b>Total cost (Rs. ha<sup>-1</sup>)</b>
<b>(A)</b>	<b>Fixed cost</b>	
	Land preparation	
	a) Tractor ploughing (Rs. 700 per hour )	<b>2800/-</b>
	b) Harrowing (Rs.700 per hour)	<b>2800/-</b>
	c) Rotavator (Rs. 500 per hour)	<b>1400/-</b>
	d) Cultivator (Rs. 500 per hour)	<b>1500/-</b>
	The pit of 60X60X60 cm size digging charges @Rs.2.5/pit	<b>9000</b>
	Filling of pits (30 labour ha <sup>-1</sup> ) @ Rs, 327	<b>9810/-</b>
	Cost of papaya seedling @ Rs.14/ seedling	<b>62,222/-</b>
	Planting of seedling (5 labour ha <sup>-1</sup> ) @ Rs. 327	<b>1635/-</b>
	After care of seedling (12 man days) @ Rs. 327	<b>3924/-</b>
	Transplanting (40 man days) @ Rs. 327	<b>13,080/-</b>
	Drip irrigation charges including electricity	<b>5500/-</b>
	Plant protection	
	a) Imidacloprid	<b>750/-</b>
	b) Saaf	<b>736/-</b>
	Harvesting (40 labour ha <sup>-1</sup> ) @ Rs.	<b>13,080/-</b>
	<b>Sub total</b>	<b>128237/-</b>
	Drip operation cost	<b>8000/-</b>
	Miscellaneous	<b>8000/-</b>
	<b>Grand total</b>	<b>144237/-</b>
<b>B)</b>	<b>Variable cost</b>	
	Cost of fertilizers	
	a) Urea @ 80%	<b>4264/-</b>
	b) DAP @ 80%	<b>14400/-</b>
	c) Potash @ 80%	<b>3248/-</b>
	d) SSP @ 80%	<b>16000/-</b>
	Cost of organic manures	
	a) FYM (Rs. 10/Kg)	<b>150/-</b>
	b) Vermicompost (Rs. 12/Kg)	<b>180/-</b>
	c) Neem cake (Rs. 30/Kg)	<b>450/-</b>
	d) Castor cake (Rs. 50/Kg)	<b>750/-</b>
	e) Goat compost (Rs. 11/Kg)	<b>165/-</b>
	f) Leaf mold (Rs. 2/Kg)	<b>30/-</b>

**APPENDIX – C : Cost and returns of papaya cultivation**

<b>Treatment</b>	<b>Cultivation cost ha<sup>-1</sup></b>	<b>Gross return (Rs. ha<sup>-1</sup>)</b>	<b>Net return (Rs. ha<sup>-1</sup>)</b>	<b>B : C ratio</b>
T <sub>0</sub> : 80% RDF (Control)	170327	234600	64273	0.37
T <sub>1</sub> : 80%RDF + FYM (10 kg)	170427	272000	101573	0.59
T <sub>2</sub> : 80%RDF + Vermicompost (10 kg)	170447	321300	101573	0.88
T <sub>3</sub> : 80% RDF + Neem cake (10 kg)	170627	42300	252673	1.48
T <sub>4</sub> : 80%RDF + Castor cake (10 kg)	170827	351900	181073	1.05
T <sub>5</sub> : 80%RDF + Goat compost (10 kg)	170437	396100	225663	1.32
T <sub>6</sub> : 80%RDF + FYM (5 kg) + Leaf mold (5 kg)	170387	290700	120313	0.70
T <sub>7</sub> : 80%RDF + Vermicompost (5 kg) + Leaf mold (5 kg)	170397	508300	337303	1.98
T <sub>8</sub> : 80%RDF + Neem cake (5 kg) + Leaf mold (5 kg)	170487	467500	297013	1.74
T <sub>9</sub> : 80%RDF + Castor cake (5 kg) + Leaf mold (5 kg)	170587	430100	259513	1.52
T <sub>10</sub> : 80%RDF + Goat compost (5 kg) + Leaf mold (5 kg)	170391	459000	288608	1.69

## RESUME

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Membership of professional societies (If any) : No

Awards/Recognitions (If any) : No

Publication (If any) : In numbers only : No

  
Signature