

**EFFECT OF PLANT GROWTH REGULATORS AND
CHEMICALS ON FRUIT SETTING, YIELD AND
QUALITY OF MANGO (*Mangifera indica* L.) VAR.
KESAR.**

BY
GAIKAWAD GOKUL BHAUSAHEB
B.Sc. (Agriculture)



DEPARTMENT OF HORTICULTURE,
COLLEGE OF AGRICULTURE, BADNAPUR
VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH,
PARBHANI 431 402 (M.S.), INDIA

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**A thesis submitted to
Vasantarao Naik Marathwada Krishi Vidyapeeth, Parbhani in Partial
Fulfilment of the requirement for the degree of**

**MASTER OF SCIENCE
IN
HORTICULTURE
(FRUIT SCIENCE)**



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2021

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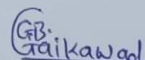
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I hereby declare that the thesis entitled, "EFFECT OF PLANT GROWTH REGULATORS AND CHEMICALS ON FRUIT SETTING, YIELD AND QUALITY OF MANGO (*Mangifera indica* L.) VAR. KESAR." submitted by me is based on the actual work carried out under the guidance and supervision of **Dr. M. B. Patil**. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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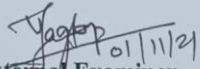
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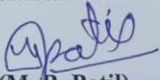
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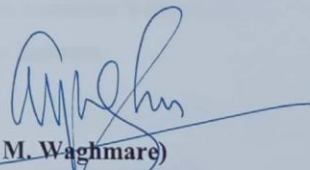
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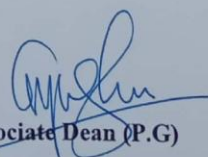
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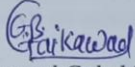
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ABBREVIATIONS

%	-	Percent
/	-	Per
⁰ C	-	Degree celsius
C.D.	-	Critical difference
cm	-	Centimeters
cv.	-	Cultivar
var.	-	Variety
<i>et.al.</i>	-	Et alia, and others
Fig.	-	figures
g	-	gram
ha	-	hactare
IBA	-	Indole 3 butyric acid
NAA	-	Napthalene acetic acid
<i>i.e.</i>	-	that is
mg	-	miligrams
mm	-	milimeters
MT/ha	-	Metric tonnes per hectare
No.	-	numbers
NS	-	Non Significant
pp	-	Page number
ppm	-	Parts per million
Pub.	-	Publication
RBD	-	Randomized Block Design
S.E. \pm	-	Standard error of mean
T	-	Treatment
<i>viz.</i>	-	Like, namely
t	-	tonnes
MT	-	Millions tonnes
hr	-	hours
GA ₃	-	Gibberellic acid
CPPU	-	N-(2-Chloro-4-pyridyl)-N-phenylurea
ZnSO ₄	-	Zinc sulphate
FeSO ₄	-	Ferrous sulphate
KNO ₃	-	Potassium nitrate
2.4.d	-	2.4.dichlorophenoxy acetic acid
mg/l	-	milligrams/liters
BA	-	Benzyl adenine
Conc.	-	concentration
PBZ	-	paclobutrazol
K ₂ SO ₄	-	Potassium sulphate
vol.	-	Volume
Wt.	-	Weight

CaCl ₂	-	Calcium Carbonate
m	-	Meters
RDF	-	Recommended dose of Fertilizer
CuSO ₄	-	Copper sulphate
cc	-	Cubic centimeters
mM/l	-	Milimolar per liters
Mn	-	Manganese
TSS	-	Total Soluble Solids
MgSO ₄	-	Magnesium sulphate
H ₃ BO ₃	-	Boric acid
FYM	-	Farm Yard Mannures
BA	-	Boric acid
Mt/ha	-	Metric tonnes/ha
K ₂ SO ₄	-	Potassium sulphate
N	-	normality
HCl	-	hydrochloric acid
HPO ₃	-	Metaphosphoric acid
PLW	-	Physiological loss weight
ABA	-	Abscisic acid

THESIS ABSTRACT

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1. Title of the thesis : EFFECT OF PLANT GROWTH REGULATORS AND CHEMICALS ON FRUIT SETTING, YIELD AND QUALITY OF MANGO (*Mangifera indica* L.) VAR. KESAR.
 2. Full name of the candidate : Gaikawad Gokul Bhausahab
 3. Full name of research guide : M. B. Patil
 4. department : Horticulture (Fruit Science)
 5. College / University : College of Agriculture, Badnapur
 6. Degree to be awarded : Master of Science Horticulture in (Fruit Science)
-

ABSTRACT

The present investigation entitled “Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar.” was carried out at Fruit Research Station, Aurangabad, Tahasil- Aurangabad, District- Aurangabad during 2020-21. The objective was to study the effect of plant growth regulators and chemicals on fruiting, yield and quality of mango (*Mangifera indica* L.) var. Kesar. An experiment was laid out in Randomized block design (RBD) with nine treatments and three replications. The observations include length of panicle (cm), breadth of panicle (cm), number of flowers per panicle, number of hermaphrodite flowers per panicle, number of male flower per panicle, sex ratio (male to hermaphrodite flowers), days taken from flowering to fruit setting, number of days taken from fruit set to harvest, fruit retention at harvesting stage (%), length of fruit (cm), breadth of fruit (cm), number of fruits per plant at harvest, fruit set (%), fruit drop (%), fruit weight (g), ripe fruit weight (g), yield per plant (kg), yield (t/ha), total soluble solids (%), titratable acidity (%), total sugar (%), reducing sugar (%), non reducing sugar (%), tss:acid ratio, b:c ratio, ascorbic acid content (mg/100 gram), physiological loss of fruit weight (PWL %) were recorded.

Among the treatments, T₄ Triacantanol (750 mg/l) were recorded maximum fruit retention at harvesting stage (1.00 %), length of fruit (11.58 cm), breadth of fruit (7.09 cm), weight of fruit (270 g), ripe fruit weight (252.67 g), volume of fruit (164.93 cc), number of fruit per plant at harvest (87.67), fruit set at pea stage (14.17 %) and marble stage (7.52 %), yield (23.67 kg/plant), yield per ha (11.83 t/ha). Maximum ascorbic acid content was observed under treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (46.38 mg/100 gram pulp). Minimum physiological loss of fruit weight during ripening (PWL) *i.e.* (6.41 %), titratable acidity (0.25 %) reported under treatment T₄ Triacantanol (750 mg/l). Minimum fruit drop (86.66 %), number of days taken from fruit set to harvest (99 days) clearly indicated in treatment T₄ Triacantanol (750 mg/l).

From above finding it can be concluded that, to enhance fruit retention, minimum fruit drop and higher yields can be obtained by foliar application of triacantanol @ 750 mg/l. However, to improve the quality of 'Kesar' mango GA₃ @ 35 ppm would be effective.

Keywords: Plant growth regulators, Triacantanol, Fruit setting, Fruit retention, Hermaphrodites flowers.

CHAPTER- I
INTRODUCTION

CHAPTER- I

INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family *Anacardiaceae*. It is one of the most important fruits in India and is considered the national fruit. It is originated from Indo-Burma region. (Mukherjee, 1958). In the Indian sub-continent, it has been cultivated for four thousand years. Mango is most popular among the tropical fruits of the world and has been rightly described as 'King of Fruits' owing to its delicious taste, captivating flavor and attractive aroma. Mango fruits are rich sources of Vitamin A and good sources of Vitamin C. They contain a good amount of minerals particularly potassium.

Ripe mango fruit is considered invigorating, refreshing and fattening. It is mainly used for both consumptions as ripe fruits and processing into various products like jam, jelly, squashes, syrups, nectars, baby food, mango leather, toffee etc. Unripe fruits are also used for making chutney and pickles. Mango seed oil or mango butter is extracted from mango kernels (6-12%), resembling cocoa butter. The ash of burnt leaves is a household remedy for burns and scalds. The wood is used for furniture, floor and ceiling boards, window frames, tea chests, packing boxes and splints, brush backs, plywood, shoe heels and agricultural implements. According to Hindu mythology, mango is accepted as a holy tree and leaves, and twigs are used in religious functions.

It is grown in tropical and subtropical conditions and at elevations of 1400 meters above sea level. The optimum temperature range for growth is 18 to 35°C, and it can tolerate temperatures as high as 48°C. It can survive in areas having an average annual rainfall is ranging from 25 cm to 200 cm. Rainfall and frost during a flowering period are found to be harmful. Mango fruits are delicious, refreshing and also the chief source of vitamins, minerals and proteins. Mango can grow and crop on a wide variety of soils. It requires deep, well-drained soils with loamy texture.

India is the largest producer of mango globally with the production of 21822.3 thousand MT from an area of 2258.1 thousand ha having productivity of 9.7 MT/ha and Maharashtra state production of 791.36 thousand MT from an area of 166.76

thousand ha having productivity of 4.75 MT/ha, (Anonymous 2018). According to (2016-17) total area of mango under cultivation was 2212.24 thousand MT, and total mango production in India was 19506.20 thousand MT. Total export of mango from India in 2017-18 was quantity about 49.18 thousand MT and it gives about 38234.02 lakh rupees.

Mango fruit has a delicious taste, excellent flavor and attractive fragrance, and it is also rich in vitamin A. Mango fruit is utilized at all stages of its development, *i.e.*, in its immature and mature stage. The raw fruits are used for making chutney, pickles and juices. Besides being used for dessert, the ripe fruits are also utilized for preparing several products like squashes, syrups, nectars, jams, and jellies. The mango kernel also contains 8-10 % good quality fat used for soap and a substitute for cola in confectionery. Fresh mango and mango pulp are the important products of Agri - exports from India. India's main export destinations for mango are UAE, Kuwait and Middle East countries, with a limited quantity being shipped to the European market. Although India is the largest mango producer, accounting for about 60 percent of world production, Kesar is the leading mango variety in the Maharashtra region. India's share in the world mango market is about 15 percent. Mango accounts for 40 percent of the total fruit exports from the country. There is good scope for increasing the area and productivity of mango in the country, due to this reason, horticulturists have started cultivation of mango on a large scale, and in recent years the demand for mango grafts has increased manifold.

The seed kernel of mango contains moisture (5.9 %), ash (2.43 %), crude protein (5.20 %), carbohydrate (76.14 %) and crude fiber (0.49 %). The mineral composition potassium (116.9 ppm), sodium (23.1 ppm), calcium (0.26 ppm) and magnesium (0.56 ppm). The phytochemical studies show the presence of alkaloids, steroids, tannins, phenol, resins, glycoside, and volatile oil but saponins and phlorotannins are absent. The presence of some of these metabolites confirms the plant's usefulness in the treatment of various diseases.

Mango, being a cross-pollinated and highly heterozygous nature, In many parts of the country, old mango orchards have been primarily established by seedling progenies, often of poor quality. Hence, the extensive use of the vegetative propagation method would be the greatest single step, which could be taken up to

improve mango production. In order to get genetically uniform and true to type plant, it should be propagated vegetatively. Flowering is the foremost event that sets the stage for mango production each year. With favorable growth conditions, the timing and intensity of flowering greatly determine when and how much fruit is produced during a current season. Flowering in mango is preceded by the differentiation of the flower bud in the shoots. The period of differentiation is reported to be October-December in Maharashtra condition, depending upon the climatic conditions. It takes about a fortnight for the tiny bud to develop and open into a flower. Apart from the inherent character of the variety, the time of flowering in a different region is mainly governed by the local climatic conditions. Under mild climatic conditions of southern and western India, mango starts flowering from December onward, whereas under the extreme climatic condition of North India, the flowering is comparatively more precise and late.

The sex form of mango is andromonoecious, plant-bearing male and hermaphrodite flower separately on the same terminal panicles. There are two types of flower in occurs on the same tree, but usually on different panicles, hermaphrodite with abortive ovary (functional male), hermaphrodite female with non-dehiscent anthers (functional female) and male flowers. Floral biology of mango trees are generally polygamous bearing male and hermaphrodite flowers on the same inflorescence, *i.e.*, andromonoecious, and the mango inflorescence is basically terminal. The number of flowers in a panicle may vary from 1000 to 6000 depending on the variety (Mukherjee S.K., 1953). The mango flowers are small (5-10 mm) in diameter, have a 10 part perianth consisting of four or five sepals and petals that are ovate. Pistils-ovary abortion occurs early in staminate flower development, and in perfect flowers, the ovary is superior. The ovule is anatropous and pendulous. Individual flowers are borne collectively on panicles that consist of a central axis that further divides from primary, secondary and tertiary branches. Panicles are develop from dormant apical buds or lateral buds during the floral induction. Mango flowers usually open during the night and early morning hours and the flowering duration is usually short, *i.e.*, 2 to 3 weeks. Floral anthesis generally occurs at night in polyembryonic cultivars and night or early morning in monoembryonic types. Stigmas are receptive from 18 hr before anthesis to at least 72 hr after anthesis with optimum receptivity within 3 hr from anthesis. Flowering may start as early as

November or usually during December in the Rayalaseema region of Andhra Pradesh and the south Konkan region on the West Coast of India. It is believed that flower bud differentiation depends upon the 'on' and 'off' year phases of the tree rather than on the initial cessation of growth of shoots.

In mango, heavy fruit drop is an important factor contributing to low fruit yield, and sometimes only 0.1% of fruits reached up to maturity. The maintenance of fruit quality is critical while employing any new technology for increasing production and shelf life. Thus fruit set in mango is a crucial event that significantly influences the ultimate fruit yield.

Considering the above facts, the present investigation is proposed to study the **“Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar”** with the following objective.

- To study the effect of plant growth regulators and chemicals on fruiting, yield and quality of mango (*Mangifera indica* L.) var. Kesar

It is hoped that the finding of these investigations will provide information and will be of great help to the research workers, mango orchardists and exporters for increasing fruit retention, yield and quality of mango fruits.

CHAPTER- II
REVIEW OF LITERATURE

CHAPTER- II

REVIEW OF LITERATURE

The present investigation was carried out to study the, “**Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar**” with the development and adoption of improved horticultural practices, use of plant growth regulators and chemicals becomes essential for sustainable production. Though the researchers have revealed the different horticultural technique for increasing crop production in large number of fruit crops, the use of plant growth regulators and chemicals remained little or untouched which may be due to long span phenological and physiological systems of the perennial trees having complex phenomenon of flowering.

A brief review of the effects of NAA, Urea, KNO₃ and Triacantanol on mango fruit retention and quality has been attempted. In recent years, the use of plant growth regulators has become common practice for increasing fruit set and controlling fruit drop in order to achieve higher yield (Prasad and Pathak, 1972; Singh and Ram, 1983). Climate change, particularly during flowering and fruit set, has been linked to erratic flowering and poor fruit set in mango. Modulation of flowering and fruit set via spraying of various hormones and chemicals is the best option for mitigating or reducing the impact of climate change on mango. Effect of chemicals on fruit retention and quality of mango varieties have been studied in past in different parts of the country and is reviewed under suitable heads.

2.1 Effect of plant growth regulators and chemicals on flowering, fruit set and fruit drop

Konhar and Arun (1988) studied that, the effect of growth regulators on flowering, fruit set and fruit retention in cashew (*Anacardium occidentale* L.). The higher percentage of fruit retention (25.8%) was obtained with the foliar application of Nutron (triacantanol) @ 500 mg l⁻¹.

Patel (1991) studied that, the combined effect of NAA (10, 20, 30 and 40 ppm) and urea (2 %) on mango cv. Kesar at marble stage. The fruit growth was enhanced by all treatments; however, the increase was significant under NAA 10 ppm + urea 2 per cent and NAA 20 ppm + urea 2 per cent.

Mandal and Kumar (1999) observed, the effect of photosynthesis improving chemicals on photosynthetic surface, fruit size and biochemical changes in guava. They found the maximum fruit length (6.92 cm) and diameter (6.76 cm) in mixatlol at 6 ml.

Jutamanee *et al.* (2002) concluded that, the foliar application of 0.2 % boric acid + 0.6 % calcium nitrate when inflorescences reached around 5 cm length resulted in maximum fruit set per tree in mango cv. Namdokmai.

Anila and Radha (2003) studied that, the mango floral morphological features, *i.e.* the percentage of bisexual flowers Alphanso had the maximum (44.39 % bisexual flowers) and Muvandan had the minimum, there was difference in length, width, colour, and density of inflorescences among the varieties. The number of initial fruits per inflorescence ranged from (5.39 to 8.45).

Prasad *et al.* (2006) noticed that, the 20 ppm NAA spraying recorded earliest panicle emergence and lowest sex ratio and the highest percentage of blossoming shoots in mango cv. Amrapalli.

Shinde *et al.* (2006) studied that, foliar spray of nutrients urea (2%) + NAA (20 ppm) + micronutrient mixture (50 ppm) was maximum effective for increasing fruit set per panicle (8.44) in mango.

Maqbool *et al.* (2007) studied the causes and potential remedies of fruit drop in mango, they reported that foliar application of NAA or 2,4-d at 20 mg/l reduced fruit drop, and also stated that an exogenous application of synthetic cytokinins CPPU (10 mg/l) 14 days after full bloom gave effective control over fruit drop.

Kalambe *et al.* (2008) studied that, the flowering behavior and correlation studies of mango cultivars in Chhattisgarh plain condition.

Bhamare *et al.* (2014) applied GA₃ (10, 15, 25 mg/l), NAA (20, 30, 40 mg/l), 2,4-D (20, 30, 40 mg/l) and water spray as control to study the fruit drop in mango cv. Mallika. Two spraying were done, one each at full bloom stage and pea stage. Among all the treatments, for securing minimum fruit drop the treatment NAA 20 mg/l performed best.

Shiozaki *et al.* (2014) studied the effect of benzyl adenine (BA) and CPPU (5 mg/l) in combination with gibberellic acid (100 mg/l.) on berry setting and production in grapes cv. Delaware was investigated (*Vitis labrusca* L.). They came to the conclusion that CPPU greatly increased berry set. GA₃ plus CPPU treatment resulted in a higher rate of berry setting than GA₃ alone.

Zaeneldeen *et al.* (2014) observed the maximum fruit set was recorded in the treatment urea 2% + GA₃ 50 ppm (4.82 & 4.62%) followed by urea 2% + GA₃ 25 ppm (4.81 & 4.61%) and urea 1% + GA₃ 50 ppm (4.68 & 4.48%). Whereas, minimum fruit set was noticed from the control (3.58 & 3.38%) plant in 2012 & 2013 seasons respectively, in mango.

Rajput *et al.* (2015) concluded that, the highest percentage of fruit set (76.33%) was observed with 0.2% boron + NAA 150 ppm, which was comparable to 0.2% boron + NAA 100 ppm in guava.

Amro *et al.* (2016) studied the effect of foliar sprays with urea at 2, 2.5, and 3 % concentrations, GA₃ at 50, 75, and 100 ppm concentrations, and application dates of October 25th and November 15th on blooming, fruiting, and fruit quality revealed that urea treatment outperformed GA₃ in delaying blooming date, particularly the 3 % urea treatment. In addition, application date effects revealed that foliar sprays of the tested urea and GA₃ related blooming date effect boosted the studied delaying blooming. As a result, it is preferable to spray Fagri Kalan mango trees with 3% urea on November 15th to improve fruiting and fruit quality.

Bhojar and Ramdevputra (2016) studied the foliar application of micronutrients such as zinc, iron, and boron in single or multiple combinations on guava (*Psidium*

guajava L.) cv. the Sardar combination (0.5 % Zinc sulphate + 0.5 % Ferrus sulphate + 0.3 % Borax) had a significant impact on fruit per shoot (3.6), overall yield (57.1 kg/tree), and sensory characteristics such as aroma (7.7), taste (8.1), flavour (8.2), texture (7.5) and overall acceptability (7.9). The use of 0.3 % Borax had a significant impact on the number of flowers per shoot (5.3). A foliar application of (0.5 % Ferrus sulphate + 0.3 % Borax) resulted in the lowest fruit drop per shoot, while a foliar application of (0.5 % Zinc sulphate + 0.3 % Borax) resulted in the highest fruit drop per shoot finally, the conclusion.

Dheeraj *et al.* (2016) studied the zinc sulphate at 0.1 %, paclobutrazol (PBZ) at 3ml/m⁻¹ canopy diameter, naphthalene acetic acid (NAA) at 80 ppm, gibberilic acid (GA₃) at 20 ppm, 1-2-chloro-4-pyridyl-3-phenyl urea (CPPU) at 10 ppm, potassium sulphate (K₂SO₄) at Paclobutrazol alone provided the most fruits, panicles, and yield (23.7% more than the control), followed by Naphthalene acetic acid (20.96 % increases in mango yield over control).

Merwad *et al.* (2016) reported that, the sprayed materials NAA @ 25 ppm + Zn (chelate) @ 0.2% + Ca (chelate) @ 0.4%+ B (boron) @ 200 ppm had a positive effect on fruit set (11.00 %) and (10.76 %) at pea stage in mango.

Momin *et al.* (2016) observed that, the maximum fruit setting at pea (14.30 % per panicle) and marble (56.34 % per panicle) sized stage of fruits per panicle in treatment triacontanol @ 750 mg/l in mango.

Patel *et al.* (2016) observed that, the foliar application of 1.0% KNO₃ in mid-October followed by 1.0% thiourea in mid-November was found best for increasing the number of fruit set at pea (14.56%), marble (3.15%) and maturity stage (0.87%) in cv. Kesar mango.

Abd El-Rhman *et al.* (2017) observed the effect of foliar sprays mango by NAA at 10 ppm, NAA at 20 ppm, NAA at 40 ppm concentrations was very effective in fruit set (21.08 %), (21.59 %), (21.98 %) respectively.

Somwanshi *et al.* (2017) observed that, the application urea (1%) + GA₃ (70 ppm)

recorded maximum fruit set (67.67 %) in sweet orange.

Sharma *et al.* (2018) studied the effect of Triacontanol in different fruit crop, *i.e.* enhance growth, chlorophyll content, photosynthesis, transpiration, stomatal conductance and uptake of nutrients in different fruit crop.

Saheda *et al.* (2019) studied that, the flowering characters in mango germplasm *i.e.* length of inflorescences, the width of inflorescences, total number of flowers per inflorescences, number of male flowers per inflorescences, % perfect flower, % fruit set per panicle ranging from (13.17 cm) to (43.17 cm), (10.03 cm) to (32.23 cm), (887.33) to (4242.00), (840.00) to (3655.33), (3.53 %) to (37.33) and (3.35 %) to (35.07), respectively. The mango cv. Bangalora was top of the list in case of length of the inflorescence (43.17 cm), width of the inflorescences (32.23 cm), total number of flower per inflorescences (4242.00), number of male flower per inflorescences (3655.33), the maximum % of perfect flower (37.33 %) and % of fruit set per panicle (35.07 %) was noted in mango cv. Neelum

2.2 Effect of plant growth regulators and chemicals on fruit retention and yield

Hairdry *et al.* (1997) applied foliar spray of NAA at different concentration (10, 20, 30 and 40 mg/l) in mango cv. Langra in tropical climatic conditions. They found maximum fruit weight and yield with application of NAA 20 mg/l at Pakistan.

Sud and Thakur (1999) carried out an investigation on effect of triacontanol on the fruit size and quality of peach cv. July Elberta. triacontanol was sprayed (2.5, 5.0, 7.5 and 10 mg l⁻¹) at two active stages of fruit development *i.e.* pea and after pit hardening stage. Fruit size in terms of length, diameter, weight and volume was recorded maximum with 5 mg l⁻¹ triacontanol applied at pea stage.

Sharma *et al.* (2008) studied the effect of TRIA (tricontanol) @ 2.5, 5.0, 7.5, and 10 mg l⁻¹ trees were sprayed thrice. *viz.*, 7 days before full bloom, 15 days after full bloom and one month after second application and they observed that TRIA @ 7.5 mg l⁻¹ increased the fruit weight, length, and diameter.

Vijendla *et al.* (2008) applied different PGR's in 5 years old mango cv. Amrapalli and concluded that an exogenous application of NAA at 50 ppm and 2, 4-D at 10 ppm at pea and marble stage of fruit growth was beneficial in improving the fruit retention % (9.85), number of fruit (88/plant) and yield (16.24 kg/plant).

Bhowmick and Banik (2011) stated that, the spraying with NAA at 40 ppm in mango, the maximum fruit retention percentage (7.25%) and the maximum number of fruits at harvest (790.17/tree) were reported.

Neem and Khan (2011) studied that, the tricontanol is a natural plant growth regulator found in epicuticular waxes. It is used to enhance the fruit production. Quite numbers of research have reported that tricontanol can be used for improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrient in various crops. It also increases the amino acid and reducing sugar in some plant.

Kumar *et al.* (2012) conducted an experiment to observed the influence of plant growth regulator on growth, yield and quality of strawberry. Foliar application of tricontanol @ (1.25, 2.5 and 5 mg l⁻¹) increased the number of fruit (23.31), fruit yield (376.69 g/plant) and fruit yield per hectare (27.90 tonnes) under tricontanol 5 mg l⁻¹ treated plant.

Mandal *et al.* (2012) in mango cv. Amrapalli studied that, the response of urea and plant growth regulators GA₃ (100 ppm), NAA (40 ppm), ethephon (200 ppm), SA (100 and 200 ppm) and triadimefon (1000 and 2000 ppm) on bearing and quality. They found an increase in yield from 6.60 kg/tree (control) to 8.83 kg/tree (NAA 40 ppm).

Sudha *et al.* (2012) observed that, the maximum number of fruit set (17.0%) was obtained with foliar spray of KNO₃ at 2% concentration in mango.

Varu *et al.* (2012) reported that, the days required for fruit set to harvest (99 days) fruit development periods in mango.

Bansode *et al.* (2014) observed that, the application of 2% Urea at pea stage, 0.5% MPP each at marble and egg stage significantly increased fruit retention in mango.

Chaudhary (2014) observed maximum fruit retention (1.57 %) in kesar mango.

Khot *et al.* (2015) studied that, the effect of foliar application of Gibberellic acid (40 % WSG) and CPPU (1 % SP) on yield, quality, leaf photosynthesis, and biochemical changes in grape berries depends on the concentration, stage, and time of application. Foliar application of Gibberellic acid (GA₃) 40 % WSG and 90 % active ingredient while CPPU 1 % SP was given as a spray at pre-bloom, flowering, 3-4 mm berry size, and 6-7 mm berry size stages. In Thompson Seedless grapes, application of 40 ppm GA₃ (40 % WSG) alone or in combination with 2 ppm CPPU (1% SP) increased leaf photosynthesis, transpiration rate, and biochemical parameters such as protein content, starch, and total carbohydrate. With yield, there was a positive correlation with berry quality, leaf photosynthesis, and biochemical parameters. Spraying 40 ppm GA₃ (40 % WSG) alone or in combination with 2 ppm CPPU (1 % SP) was found to be effective for improving leaf photosynthesis, biochemical changes, quality, and yield parameters in Thompson Seedless grapes in this study.

Amarcholi *et al.* (2016) observed that, the plant treated with KNO₃ (1.0 %) found the significantly higher fruit retention in mango.

Ghosh (2016) concluded that, the two times application of NAA @ 50 ppm during pea stage at 21 days interval was beneficial for improving the fruit retention (14.25 %) of mango cv. Amrapalli under red and laterite zone of West Bengal.

Momin *et al.* (2016) observed that, the maximum fruit retention (2.33 %) at harvest stage of fruits in treatment triacontanol @ 750 mg/l in mango.

Patel *et al.* (2016) studied that, the effect of foliar application of nutrients Thiourea 2%, KNO₃ 0.5 % and chemicals maximization in vegetative growth (0.70), flowering shoot (0.85) length of shoots (48.57 cm), fruit set pea stage (14.56 %), marble stage (3.15 %), maturity stage (0.87 %), numbers of fruits per tree (281.30) and yield (77.02 kg/tree) of mango cv. Kesar.

Pujari *et al.* (2016) experimented to evaluate the effect of CPPU (Forchlorfenuron) on fruit retention and postharvest quality of Alphonso mango under in Konkan region in

three locations. CPPU was sprayed at a dose of 1, 2, 3, 4 ppm at the peanut and marble stage and water as control. They reported that 3 and 4 ppm CPPU significantly improved fruit retention and indicating the highest number of fruit per panicle.

Abd El-Rhman *et al.* (2017) observed that, the effect of foliar sprays mango by NAA at 10 ppm, NAA at 20 ppm, NAA at 40 ppm concentrations was very effective in fruit retention (5.29 %), (5.64 %), (5.60 %) respectively in mango.

Kulkarni *et al.* (2017) had undertaken study on different PGR's on mango during fruit developmental stages *viz.* at mustard, pea and marble stage. The maximum number of fruit per panicle at the pea stage (14.54) marble stage (4.39) and fruit harvested per panicle (1.52) was in the treatment T₁₀. The treatment T₁₅ (CPPU 20 ppm at marble + pea stage) increases fruit length (10.56 cm), diameter (6.43 cm) and average fruit weight (328.73 g) indicating superiority of treatment for increasing yield. The treatment T₈ (CPPU 10 ppm: pea stage) produce the maximum number of fruit per tree (362.33). Among the different PGR's and stages of application CPPU 10 ppm, at mustard+ pea stage recorded maximum yield (107.00 kg/tree) and (10.7 t/ha).

Singh *et al.* (2017) observed that, the application of NAA 40 ppm at pea stage and 20 ppm NAA marble stage gave maximum fruit retention amongst is concentrations tried in mango.

Chandramukhi Sahu *et al.* (2019) reported that, the three-level of NAA *i.e.* 15, 25, and 35 ppm, three-level of GA₃ *i.e.*, 15, 25 and 35 ppm and three levels of 2,4-D *i.e.* 15, 25, 35 ppm were sprayed at the pea and marble stage of fruit development. Foliar application of 35 ppm GA₃ at the pea and marble stage of fruit development increases the fruit retention percentage (15.23 %) and reduce fruit drop percentage (84.77 %).

Dhurve *et al.* (2018) studied that, the treatment consisted of two foliar applications of Zinc sulphate and Boric acid with their combinations *viz.* T₁ (control), T₂ (B+Zn @ 0+0.2%), T₃ (B+Zn @ 0+0.4%), T₄ (B+Zn @ 0+0.6%), T₅ (B+Zn @ 0.2+0%), T₆ (B+Zn @ 0.2% each), T₇ (B+Zn @ 0.2+0.4%), T₈ (B+Zn @ 0.2+0.6%), T₉ (B+Zn @ 0.4+0%), T₁₀ (B+Zn @ 0.4+0.2%), T₁₁ (B+Zn @ 0.4% each), T₁₂ (B+Zn @ 0.4+0.6%),

T₁₃ (B+Zn @ 0.6+0%), T₁₄ (B+Zn @ 0.6+0.2%), T₁₅ (B+Zn @ 0.6+0.4%) and T₁₆ (B+Zn @ 0.6% each). the findings revealed that foliar spray of T₁₁ (B+Zn @ 0.4% each) was found to be the best as compared to control treatment. among the treatment the foliar application of B+Zn @ 0.4% each was effective in enhancing growth parameter *viz.* plant height (m), light transmission ratio (%), energy interception ($\text{Cal cm}^{-2} \text{ min}^{-2}$), chlorophyll content index, reproductive parameter *viz.* first date of flower initiation, days taken for 50% flowering, number of flower /shoot, number of fruit /shoot and yield of hast bahar in pomegranate.

Pawar Ravina and Singh (2018) studied that, the application of RDF + foliar spray of ZnSO_4 @ 0.4 % + CuSO_4 @ 0.2 + Boric acid @ 0.2 % (2 sprays at just before flowering and marble stage) was found to be most effective for increasing number of fruits per panicle at pea and marble stage (9.67 and 4.58, respectively), yield/plant (271.51 kg), yield/ha. (27151 kg), percent increase in yield (56.40 %), TSS (18.51 %), total sugar (12.88 %), ascorbic acid content (43.62 mg 100 g pulp) with reduced acidity (0.149 %).

2.3 Effect of plant growth regulators and chemicals on physical characters of fruit

Jindal and Dwivedi (1986) studied the effect of triacontanol on fruit quality of Santa Rosa plum. Triacontanol was applied @ 16 mg l^{-1} 10 days before the expected date of fruit maturation. Fruit weight and volume were maximum after treatment with 4 and 8 mg l^{-1} triacontanol.

Mehata *et al.* (1990) planned experiment on effect of tricontanol and paclobutrazol on quality of apricot cv. New Castel, triacontanol was sprayed at (5, 10 or 20 mg/l). Tricontanol @ 20 mg/l significantly increased fruit length (3.17 cm), diameter (3.17 cm) and weight (24.06 g).

Patil *et al.* (2005) under investigation in mango cv. Parbhani Bhushan orchard at Maharashtra, India during 2002-03. Ten years old mango trees, spaced at 10 m x 10 m, were sprayed with chemicals KNO_3 (at 2.0, 4.0 and 6 .0%) and urea (at 1.0, 1.5 and 2.0 %), and growth regulators NAA (at 40, 60 and 80 ppm) and Iriaconlanol (at 300, 500 and

700 ppm) at flowering stage and when the fruits were of pea and marble sizes. Triaccontanol at 700 ppm recorded the highest values for fruit length (10.91 cm), breadth (8.91 cm), volume (336.58 cc) and weight (330.41), followed by triaccontanol at 500 ppm and NAA at 40 ppm.

Shinde *et al.* (2008) observed that, the sprayed at flowering, pea and marble stage of fruit development stage Triaccontanol 700 ppm showed significantly maximum volume (336.58 cm³), weight (330.41g) and mesocarp (69.92 %) as compared to the rest of the treatments under study in mango.

Chowdhary (2009) studied the effect of triaccontanol 0.05 per cent on haldipada green and red fruit yield and chemical as well as physical characters of fruit.

Usha Kumari and Prahlad Deb (2018) studied that, the treatments comprising two levels of each zinc sulphate heptahydrate (*viz.* @ 0.5% and @ 1.0 %), borax (*viz.* @ 0.5% and @ 1.0 % as source of boron). two sprays were done at the flowering stage and one month later of the first spray. the results revealed that the effect of zinc and boron were found significant on fruit physical characters and fruit quality characters as well. the treatment combination of zinc sulphate @ 0.5% and borax @ 0.5% resulted from maximum fruit length (16.81cm), fruit weight (664.36 g), fruit volume (631.03 ml).from the result of the present experiment it can be concluded that post-flowering sprays of zinc and boron have a significant role to improve the yield and quality of pineapple. more precise application of zinc sulphate @ 0.5% and borax @ 0.5% is best for improving the yield and quality of pineapple cv. Mauritius.

Halepotara *et al.* (2019) studied the harvesting of mango at different day after fruit setting for study heat unit for different mango developmental stage maturation and its quality parameters.

Parauha Shuchi and S. K. Pandey (2019) studied the spraying of a combination of nutrients *viz.*, KNO₃ (2 %), urea (2 %), ZnSO₄ (0.8) and ZnSO₄ (0.4 %) and growth regulators *viz.*, NAA (50 & 25 ppm) and GA₃ (30 & 20 ppm) was compared with control (no spray). The experimental result indicates that the foliar spray of GA₃ (30 ppm +

KNO₃ 2 %) showed better performance in a higher number of fruits at the initial stage (63.81), more fruit retention percentage at the harvest stage (1.94 %), fruit yield (14.70 kg/tree), fruit weight (182.29 g), fruit length (9.91cm), fruit width (6.90 cm), fruit volume (172.01 ml) and peel weight (31.36 g).

Tsomu and Patel (2019) studied the experiment comprises of 15 treatments with different PGR's and micronutrients *i.e.* NAA (T₁ 20 mg/l, T₂ 40 mg/l), GA₃ (T₄ 25 mg/l, T₅ 50 mg/l) and zinc sulphate (T₅ 0.5 %) and Borax (T₆ 0.2 %) and combined treatment *i.e.* NAA 20 mg/l + ZnSO₄ 0.5 %, (T₇), NAA 20 mg/l + Borax 0.2 % (T₈), NAA 40 mg/l + ZnSO₄ 0.5 % (T₉), NAA 40 mg/l + Borax 0.2% (T₁₀), GA₃ 25 mg/l + ZnSO₄ 0.5 % (T₁₁), GA₃ 25 mg/l + Borax 0.2 % (T₁₂), GA₃ 50 mg/l + ZnSO₄ 0.5 % (T₁₃), GA₃ 50 mg /L + Borax 0.2 % (T₁₄) along with water spray or control were applied as foliar spray at full bloom, pea and marble stage of fruit growth. Combined effect of NAA 20 mg/l + Borax 0.2 % significantly increases the number of fruit per plant (213.33) and fruit yield (79.97 kg/tree) where as NAA 20 mg/l + ZnSO₄ 0.5 % recorded as highest fruit length (12.92 cm), fruit diameter (7.05 cm), fruit volume (342.83 cc), fruit weight (352.16 g), pulp weight (268.80 g), pulp:peel (5.96) and pulp stone ratio (7.31).

Nainwad *et al.* (2019) investigated that, the different treatments GA₃ 100 ppm recorded maximum length of fruit (8.94 cm), diameter of fruit (8.06 cm), and volume of fruit (253.74 ml), number of fruit per plant (78.83), average weight of fruit (298.52 g), yield per plant (23.05 kg), yield per ha (17.06 MT/ha), weight of arils per fruit (232.86 g), weight of 100 arils (50.57 g) while treatment control recorded minimum value for all above parameters. Treatment spermedine 15.0 mM/l exhibited significantly maximum rind thickness (3.30 mm) and rind weight (66.08 g) over rest of the treatments while minimum rind thickness (2.41 mm) and rind weight (48.53 g) was observed in treatment control and treatment 6BA respectively.

2.4 Effect of plant growth regulators and chemicals on quality of fruit

Mehata *et al.* (1990) noted that, the tricontanol applied at (5, 10, 15 mg/l) significantly increased the total sugar content and reduced acidity as compared to the control.

Sharma *et al.* (1990) reported that, the reduction in flower drop with application of tricontanol may be due to the reason that it may have increased carbohydrates level and C:N ratio.

Beniwal *et al.* (1992) observed effect of foliar application of urea and potassium sulphate on physico-chemical attributes of grapes.

Singh *et al.* (1996) conducted an field experiment on litchi with foliar application of Mixatanol (tricontanol), Miraculan (tricontanol) and Vipul (tricontanol) or cytozyme. Spraying these growth regulator s at fruit set significantly increased fruit sugar content , acidity, sugar: acid ratio and ascorbic acid content .

Hairdry *et al.* (1997) found maximum total soluble solid (16.65 %), with NAA 5 mg/l. However, the highest reducing sugar (4.48 %) and lowest acidity (0.29 %) in mango was NAA 20 mg/l at Pakistan.

Sud and Thakur (1999) revealed that, the fruit quality of peach in terms of total soluble, total sugar and vitamin C content was noticed maximum with 7.5 mg l⁻¹ concentration of tricontanol.

Kahlon and Uppal (2005) revealed that, the sugar content increase gradually with the advancement of the storage period up to the 7th day and then after it decreased on 10th day of storage and it was reported that total reducing sugar content, non- reducing sugar content and total sugar content of mango fruits was observed maximum in borax @ 1.0%. Suggested that conversion of starches and polysaccharides into simple sugar with the advancement of storage was responsible for the increase of reducing sugar, and onward decline was due to the utilization of sugar in evapo-transpiration and other biochemical activities.

Ghosh *et al.* (2009) reported that, the fruit quality about TSS, total sugar and ascorbic acid content was increased in treatment NAA 10 ppm compared to control in aonla.

Bhowmick *et al.* (2011) recorded maximum TSS, total sugar and non-reducing sugar when ZnSO₄ @ 1.5 % applied at marble stage while maximum reducing sugar was recorded in application of borax 0.25 % in mango cv. Himsagar.

Fathi *et al.* (2011) found that, the foliar spraying Sitofex (CPPU) at 5 and 10 ppm on full bloom stage increased fruit SSC (soluble solids content) from 12.33 to 19.00% in 5 ppm, 12.33 to 23.33 % in 10 ppm, and decreased acidity from 0.93 to 0.74 in 5 ppm, 0.93 to 0.70 in 10 ppm over control in persimmon (cv. Costata).

Nehete *et al.* (2011) conducted experiment on foliar spraying mango cv. Kesar with (ZnSO₄ 1% + borax 0.5 %) at the onset of flowering and pea stage significantly improved fruit quality, including TSS, total sugar, reducing sugar, and non-reducing sugar, as well as reduced acidity.

Bhatt *et al.* (2012) observed that, the foliar application of 0.5 % Borax at the marble stage resulted in substantially higher TSS, reducing sugar, non-reducing sugar, and ascorbic acid levels in mango cv. Dashehari.

Bhowmick *et al.* (2012) found that, the spraying 1.0 % ZnSO₄ at the pea and marble stages of mango cv. Amrapali resulted in substantially higher TSS, total sugar, non-reducing sugar, and ascorbic acid levels.

Sudha *et al.* (2012) revealed that, the foliar application of nitrogenous chemicals in mango orchards prior to flowering improves flowering, fruit set (17.0 %), yield (43.8 kg/tree), and biochemical parameters in mango cv. Alphonso.

Gcharge *et al.* (2014) revealed that, the treatment T₁ (KNO₃ 1% at pea, marble, and egg stages) had the highest TSS (20.97 °Brix) and total sugars (15.71 %) than the control. The power, on the other hand, had the highest titratable acidity (0.46 %) in mango.

Makwana *et al.* (2014) revealed that, the reduction in the rate of respiration and

evapo-transpiration as well delaying in ripening, due to restricted ethylene accumulation in the treated fruits.

Chovatiya *et al.* (2015) studied that, the biochemical evaluation *i.e.* total sugar (117.78 mg/g), TSS (21.75 %), acidity (0.21 %), ascorbic acid content (46.39 mg/100 g pulp), reducing sugar (26.85 mg/g) of kesar mango fruits at different location of Saurashtra region.

Krishnamoorthy *et al.* (2015) studied the effect of foliar nutrition of IIHR mango special on leaf nutrient status of mango and observed that the manganese content (298mg/g), iron content (452mg/g), zinc content (56mg/g) and boron content (84 mg/g) in the leaves at harvest were maximum with application of IIHR mango special @ 5 g/l along with soil application 1.0 : 1.0 : 1.5 kg/tree NPK + 50 kg FYM .

Osama *et al.* (2015) studied that, NAA at 50 ppm treatment applied at full bloom and two months later (the second date) induced the highest positive effect on the studied fruiting and fruit quality traits of Keitt mango trees.

Bhalekar *et al.* (2016) evaluate that, the eight-year-old nine exotic mango cultivars *viz.* Kent, Osteen, Hy 13/3, Lily, Keitt, Palmer, Hy 13/1, Maya, Tommy Atkins along with cv. Kesar as a local check. The cv. Maya recorded the highest fruits/plant (93.50). The cv. Kent recorded significantly superior fruit weight (328.4 g) and fruit yield (25.22 kg/plant or 5.04 Mt/ ha). It was followed by cv. Maya with fruit production (17.6 kg/ plant or 3.52 Mt/ ha). The cv. Kesar recorded 52.7 fruits/plant with 208.1 g average fruit weight and yield of 11.0 kg/plant or 2.20Mt/ha. However, from Organoleptic evaluation for quality parameters *viz.* pulp colour, flavour, fibre content, taste, juiciness *etc.* it was observed that cv. Maya recorded the highest overall score (65.9 %) which was followed by cv. Kesar (64.1%). As for as Indian and foreign mango market concern, it is concluded that cv. Maya would be a future choice for cv. Kesar. eight-year old nine exotic mango cultivars *viz.* Kent, Osteen, Hy 13/3, Lily, Keitt, Palmer, Hy 13/1, Maya, Tommy Atkins along with cv. Kesar as a local check. The cv. Maya recorded the highest fruits/plant (93.50). The cv. Kent recorded significantly superior fruit weight (328.4 g) and fruit yield (25.22 kg/plant or 5.04 Mt/ ha). It was followed by cv. Maya

with fruit production (17.6 kg/ plant or 3.52 Mt/ ha). The cv. Kesar recorded 52.7 fruits/plant with 208.1 g average fruit weight and yield of 11.0 kg/plant or 2.20 Mt/ha. However, from Organoleptic evaluation for quality parameters *viz.* pulp colour, flavor, fiber content, taste, juiciness *etc.* it was observed that cv. Maya recorded the highest overall score (65.9 %) which was followed by cv. Kesar (64.1%). As for as Indian and foreign mango market concern, it is concluded that cv. Maya would be a future choice for cv. Kesar.

Ghosh S. N. (2016) concluded that applying NAA @ 50 ppm twice during the pea stage at 21-day intervals was beneficial for improving the TSS (18.65 %), acidity (0.13 %), TSS:Acid ratio (149.05) of mango cv. Amrapali grown in West Bengal's red and laterite zones.

Suman *et al.* (2017) investigated the function of plant growth regulators in fruit production. Auxin and gibberellins, for example, are commonly used to reduce fruit drop and improve fruit quality.

Mahida *et al.* (2018) reported that foliar spraying ZnSO₄ (0.25 and 0.50 %) and ZnSO₄ (0.25 and 0.50%) on mango orchards during the flowering, pea, and egg stages of the fruit was successful. The findings show that a foliar spray of 0.25 % ZnSO₄ and 0.50 % ZnSO₄ in combination outperformed the other treatments under review in terms of fruit set, retention percentage, and yield attributes. The fruits with the highest TSS and ascorbic acid content were also obtained from trees treated with 0.25 % ZnSO₄ and 0.50 % ZnSO₄.

Gautam *et al.* (2018) revealed that spraying Daminozide (50 ppm and 100 ppm), NAA (25 ppm and 50 ppm), and GA₃ (25 ppm 50 ppm) on mango resulted in the highest TSS (24.44 °Brix), while control fruits had the lowest TSS (18.22 °Brix). In the current analysis, 50 ppm NAA resulted in a 29.86% increase in TSS over power. Titratable acidity was found to be highest at 50 ppm GA₃ (0.17 and 0.18 %), whereas control fruits had the lowest titratable acidity (0.09 and 0.10 %).

Fatman *et al.* (2019) observed that using Boric acid at 0.2 % in mango cv.

Chaunsa resulted in improved results compared to control treatments, including improvements in fruit set panicle (35.7 % and 50.0 %), fruit preservation (125 % and 40 %), shelf life (73.3 % and 36.6 %), total soluble solid (35.1 % and 40.6 %), and total soluble solid (35.1 % and 40.6 %).

Haider *et al.* (2019) investigated the source of B as boric acid (BA) applied twice as a foliar mist, *i.e.*, 0, 0.1, 0.2, and 0.3 %. The findings showed that, as compared to the monitor, a substantial increase in fruit weight at ripening and harvesting stages (36.9%), fruit length (21.9%), fruit width (10.1%), flower (22.1%), and fruit terminals (40.0%) confirmed the efficacy of T₄ (BA 0.3%). A substantial increase in average yield (78.6 %) confirmed the efficacy of boric acid (0.3 %). To summaries, boric acid is an essential and effective source of B for improving mango cv. Chaunsa, SB Similarly, BA (0.3%) is a better option than 0.2 and 0.1 % BA.

Nainwad *et al.* (2019) investigated the different treatments GA₃ 100 ppm recorded maximum total soluble solids (15.77 %), reducing sugar (13.78%), total sugar (15.20 %), ascorbic acid (16.86 mg/100 g), juice content (52.50 %), and minimum pH of juice (1.91 %), and titrable acidity (0.26 %), whereas treatment control recorded minimum value for total soluble solids (13.28 %), reducing sugar (11.83 %), total sugar (12.85 %), ascorbic acid (14.69 mg/100 g), juice content (40.33 %) and maximum titrable acidity (0.35 %), pH of juice (2.30). Significantly maximum shelf life of pomegranate fruits was observed in treatment spermadine 15.0 mM/l. (26.43 days) over rest of the treatments under study treatment control recorded minimum shelf life of pomegranate fruits (19.25 days).

Thupten Tsomu (2019) Studied that, the effect of plant growth regulators and micronutrients on Mallika mango and its physico-chemical parameters as well as shelf life of fruits

Kumari *et al.* (2020) investigated the role of calcium, potassium, boron and zinc on the yield and quality of mango cv. Langra. the treatments includes CaCl₂ 4%, CaCl₂ 6%, CaCl₂ 8%, K₂SO₄ 1.0%, K₂SO₄ 1.5%, K₂SO₄ 2.0%, Borax 1.0%, Borax 1.5%), Borax 2.0%, ZnSO₄ 0.2%, ZnSO₄ 0.4%, ZnSO₄ 0.8%) and T₁₃ control. Spraying was done 30 days before the anticipated day of harvesting. The result revealed that among all

the treatments borax 2 % was most effective in increasing fruit weight (353.07 g), pulp weight (290.60 g), and pulp percentage (82.30 %). Whereas CaCl₂ 4.0% had given the highest yield/plant (63.79 kg) with better fruit quality attributes. On the other hand number of fruits per plant and fruit quality parameters such as TSS (21.08 %), TSS: acid ratio (84.39:1), sugars (12.04 %), total carotenoids (1.64 mg/100 g), ascorbic acid content (75.26 mg/100 g), total phenolics (6.34 mg/GAE/g) was highest in borax 1%. Thus, the present study concluded that borax 1% and CaCl₂ 4% was most efficient in enhancing yield and yield attributes as well as in retaining the quality of mango fruits.

2.5 Effect of plant growth regulators and chemicals on shelf life of fruit

Bhatt *et al.* (2012) observed that, the foliar application of 0.5 % Borax and 0.5 % ZnSO₄ at the marble level improved the shelf life of mango cv. Dashehari.

Singh *et al.* (2012) investigated that, the impact of pre-harvest chemical treatment and mulching on mango cv. Dashehari quality and marketability. They revealed that spraying 1.0 % borax 30 days before the expected harvest date, combined with black polythene mulching, greatly improved the shelf life of mango fruit.

CHAPTER – III
MATERIALS AND METHODS

CHAPTER – III

MATERIALS AND METHODS

The present investigation entitled, Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar was carried out during the year 2020-2021. The details of the material used and the methodology followed for recording various observations are described in this chapter.

3.1 Material

3.1.1 Location

The present experiment was conducted on the Fruit Research Station, Himayatbag, Aurangabad during 2020-2021.

3.1.2 Agro-climatic conditions

Geographically Aurangabad district is situated at 513 m above mean sea level at 19^o 52'34.19" N latitude and 75^o20'35.93" E longitudes with an altitude of 513 meters. The average rainfall of the station is about 623.5 mm, received mostly from June to September. The mean minimum and maximum temperature during the last five years were 15.25 and 43.85^o and the mean relative humidity ranges from 30 to 90 percent and rainfall in recent years (2020-21) is 777 mm.

The meteorological data during investigation for the year 2020-2021 was recorded in respect of maximum and minimum temperature, rainfall and humidity at Fruit Research Station, Himayatbag, Aurangabad. The period of experimentation is furnished in Appendix I.

3.1.3 Soil

The area of the Himayatbag is dominated by black soil formed from basalt rock originated through volcanic eruption belongs to order vertisols. The soil is dominant in montmorillonite, followed by a moderate amount of kaolinite and traces of ellite.

The soil has been classified in to deep black to medium black and shallow black soil based on soil depth and texture. The soil is characterized by black colour dominated by montmorillonite clay with a high coefficient of expansion when wet and shrinkage in summer, leading to deep cracking. The soil is alkaline in reaction saturation.

3.1.4 Experiment site

The field experiment entitled, “Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar” was conducted at Fruit Research Station, Himayatbag Aurangabad, during the year 2020-2021.

The soil used for the experiment was uniform, with a gentle slope. The soil was medium black with uniform in texture, colour and had good drainage. Drip irrigation was made for an easy supply of water. Paths were kept at convenient places for easy harvesting and other operations. The field was attached with the approach for transportation.

3.1.7 Experimental details

1. Title	: Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (<i>Mangifera indica</i> L.) var. Kesar
2. Experimental design	: Randomized Block Design (RBD)
3. Year of Study	: 2020-2021
4. Number of treatments	: 09
5. Number of Replication	: 03
6. Number of plant per treatments	: 03
7. Total number of plant under Observation	: 81
8. Planting Dimention	: 5.0 m × 4.0 m
9. Experimental location	: Fruit Research Station, Aurangabad

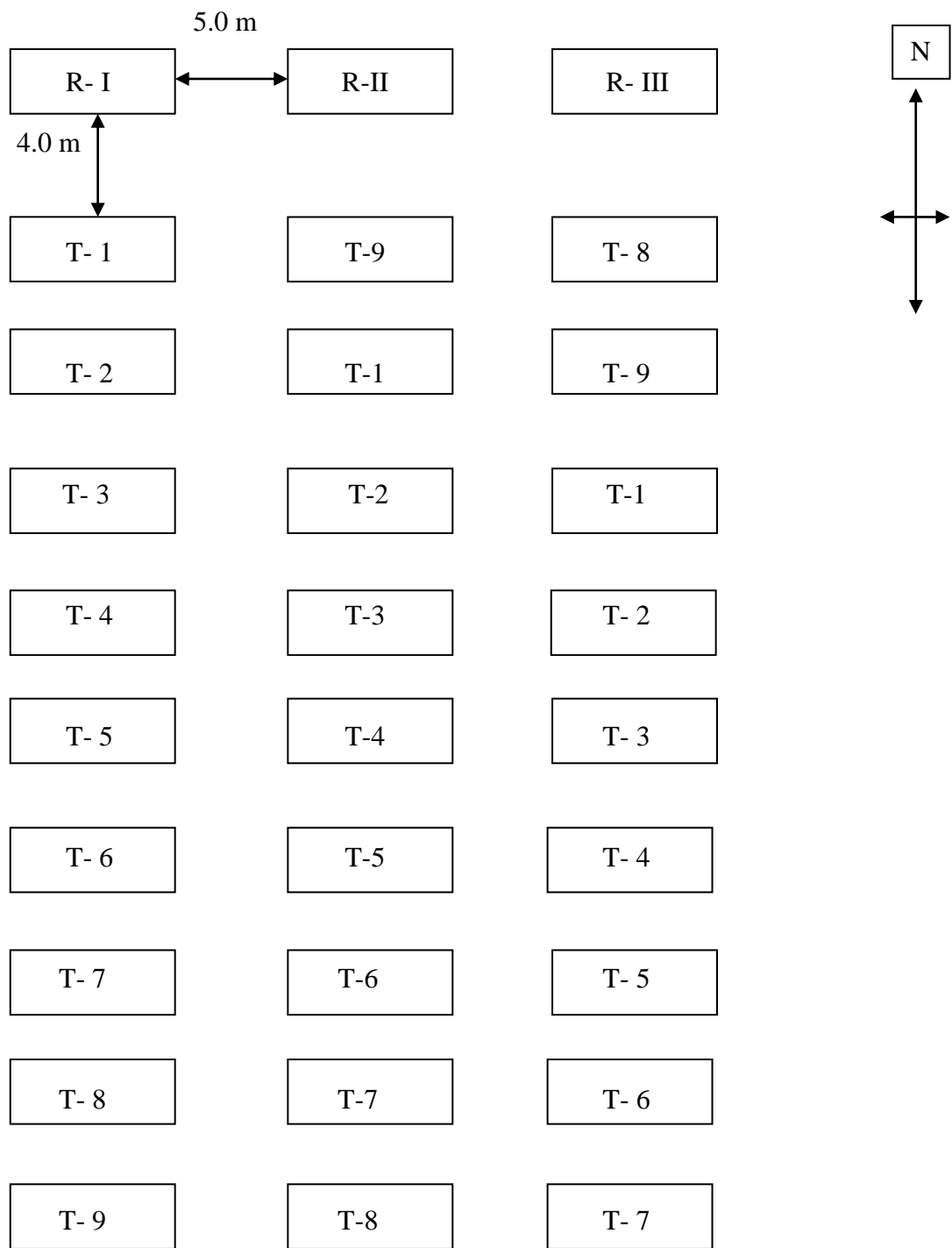


Fig. 3.1 Plan of Layout



Plate 1: General view of experimental site

3.1.8 Treatments details

Treatment No.	Chemical name	Chemical conc.	Application (Foliar Spray)
T ₁	GA ₃	35 ppm	Pea and Marble stage
T ₂	CPPU	5 ppm	Pea and Marble stage
T ₃	CPPU	10 ppm	Pea and Marble stage
T ₄	Triaccontanol	750 mg/L	Pea and Marble stage
T ₅	NAA	50 ppm	Pea and Marble stage
T ₆	NAA + ZnSO ₄	25 ppm + 0.5 %	Pea and Marble stage
T ₇	NAA + FeSO ₄	25 ppm + 0.5 %	Pea and Marble stage
T ₈	NAA+ Borax	25 ppm + 0.2 %	Pea and Marble stage
T ₉	Control	No Treatment	-

3.1.5 Selection of trees

Eighty-one trees with uniform growth were chosen. Three replications are used for nine treatments, making it simple to determine the mean of all observations.

3.1.6 Plan of layout

The experiment was designed in the Randomized Block Design (RBD) method, with nine treatments replicated three times.

3.2.1 Treatment application

Foliar spraying of plant growth regulators and chemicals at fruit size goes to pea stage and marble stage, total two foliar sprayings with the help of Knapsack spraying pump.

- Foliar spraying fruit stages
 1. Pea size stage of fruit
 2. Marble size stage of fruit

3.3 Observations

3.3.1 Flowering parameters observations

3.3.1.1 Length of panicle (cm)

The panicle length was measured with a measuring scale from the base to the tip of the fully developed panicle (inflorescence) and expressed in cm.

3.3.1.2 Breadth of panicle (cm)

The breadth of the panicle was measured and expressed in cm. The panicle breadths of four randomly selected shoots (North, South, East, and West) were measured, and the mean was determined.

3.3.1.3 Number of flowers per panicle

The number of flowers per panicle at the time of flowering, three panicles were selected at all directions of the tree at randomly and labeled for each panicle. The number of flowers formed on each labeled panicle was recorded at the time flowering after the first spray, and from this flowers per panicle was calculated.

3.3.1.4 Number of hermaphrodite flowers per panicles

The total number of the hermaphrodite flowers was counted from the total number of flowers per panicles.

➤ Number of male flowers per panicle

The total number of the male flowers was counted from the total number of flowers per panicles.

➤ Sex ratio (male to hermaphrodite flowers)

Sex ratio counted by following formula

$$\text{Number of male flowers} \div \text{Number of hermaphrodite flowers}$$

3.3.1.5 Day taken from flowering to fruit setting

The number of days taken from panicle initiation to the fruit set stage of the tagged shoots was recorded and computed as days taken for fruit set from panicle initiation. It was recorded by visiting the experimental orchard every day after panicle emergence when 50 per cent flowers on a panicle were opened.

3.3.1.6 No. of days taken from fruit set to harvest

The number of days taken from maximum fruit set at pea stage to fully developed matured fruit at the time of harvesting, by manually calculated date wise.

3.3.1.7 Fruit retention at harvesting stage (%)

Fruit retention per panicle was worked out from the retained fruit of mango per panicle at the fruit maturity stage, and their average value is worked out in percent by the following formula :

$$\text{Fruit retention \%} = \frac{\text{Number of fruits retained at harvest /panicle}}{\text{Total number of fruit set/panicle}} \times 100$$

3.3.2 Fruit and yield attributes

3.3.2.1 Weight of fruit (g)

The weight of five fruit was noted on the electronic balance from each treatment. Average for each treatment in gram was computed.

3.3.2.2 Length of fruit (cm)

Fruits from each treatment were harvested at maturity, and their length was measured in centimeters with the help of a vernier caliper. The average length was worked out under each treatment.

3.3.2.3 Breadth of fruit (cm)

Fruits from each treatment were harvested at maturity, and their breadth was measured in cm with the help of a vernier caliper. The average width was worked out under each treatment.

3.3.2.4 Volume of fruit (cc)

The volume of fruit was recorded in ml by the water displacement method.

3.3.2.5 Number of fruits per plant at harvest

The number of fruits was counted treatment-wise at harvest. The result was expressed as the number of fruits per tree.

3.3.2.6 Fruit set (%)

Fruit set per panicle at pea stage:- Three panicles per treatment from each direction were randomly tagged for counting the fruit set at pea stage and average values were worked out for recording fruit set per panicle.

Fruit set at marble stage /panicle :- Fruit set at marble stage was counted and recorded on the same selected three panicles in all directions, and the following formula calculated fruit set per panicle.

$$\text{Fruit set at marble stage (\%)} = \frac{\text{No. of fruits / panicle at marble stage}}{\text{Total no. of fruit set/panicle}} \times 100$$

3.3.2.7 Fruit drop (%)

The number of fruit drops was recorded per panicle at the harvesting stage. The percent fruit drop was worked out from the number of fruits retained per panicle.

$$\text{Fruit drop \%} = \frac{\text{Fruit set} - \text{Fruit retention}}{\text{Fruit set}} \times 100$$

3.3.2.8 Yield per plant (kg/plant)

The fruits calculated yield per tree was ripened at room temperature, and the weight of the fruits was recorded using a weighing balance, and it was expressed in

grams. The value of ripened fruit is multiplied by the number of fruits per tree and averaged and expressed in kilogram. using the following formula:

$$\text{Yield / tree (kg)} = \text{Average wt. of fruit} \times \text{Number of fruits per plant at maturity}$$

3.3.2.9 Yield (t/ha)

For recording yield, total produce per ha was calculated as fruit yield per tree, per ha in tones.

➤ **B:C ratio**

Benefit cost ratio calculated by following formula

$$\text{Gross income} \div \text{cost of cultivation}$$

3.3.3 Quality parameters observation

Mango fruits were picked in two pickings based on the production of size and maturity indices, and fruits were randomly sampled from the first picking (peak harvest) and used for qualitative estimations. Fruits were able to ripen by being wrapped in newspaper and rice straw. The consistency parameters were investigated after ripening.

3.3.3.1 Total soluble solids (%)

Total soluble solids were measured using a hand refractometer and corrected at 20°C using a temperature correction table. (A.O.A.C., 1975).

3.3.3.2 Titratable acidity (%)

The titratable acidity of the fruit juice was determined. For this, 10 ml of juice was titrated against 0.1 N NaOH using phenolphthalein as an indicator. The percent acidity of the juice was expressed as citric acid in gram in 100 g of fruit juice by using the following formula.

$$\text{Acidity (\%)} = \frac{\text{Titre} \times \text{Normality} \times \text{volume} \times \text{Equivalent} \times 100}{\text{Volume of sample taken} \times \text{weight or volume of} \times 1000 \text{ for estimation sample taken}}$$

3.3.3.3 Total sugar (%)

For estimating the total sugars, 50 ml of filtrate was hydrolyzed with 5 ml of concentrated hydrochloric acid at room temperature for 24 hours. After neutralization with 6 N NaOH using phenolphthalein indicator, the volume was made up to 100 ml

with distilled water. The aliquot was used to estimate total sugars following the method outlined by Lane and Eynon (1987) and expressed as a percent.

$$\text{Total sugar (\%)} = \frac{1.25}{\text{Burette reading}} \times 100$$

3.3.3.4 Reducing sugar (%)

Reducing sugar is determined by Lane and Eynon method (1987) in a known weight of composite sample using lead acetate for precipitation (clarifying) of the extraneous material, and potassium oxalate is to remove excess lead (deleading). Reducing sugar of the lead-free aliquots is estimated by titrating against boiling standardized Fehling's solution (mixture) using methylene blue as an indicator. Total invert sugar was estimated using the same method in a solution of hydrolysed sucrose (after acid hydrolysis) with concentrated HCl followed by neutralizing excess acid with NaOH.

$$\text{Reducing sugar (\%)} = \frac{\text{Mg of invert sugar} \times \text{dilution} \times 100}{\text{Titre} \times \text{Volume of sample taken} \times 100}$$

3.3.3.5 Non-reducing sugar (%)

Non-reducing sugars were computed by using the following formula.

$$\text{Non-reducing sugar (\%)} = \text{Total sugar (\%)} - \text{Reducing sugar (\%)}$$

3.3.3.6 TSS:Acid ratio

The TSS and acidity ratio of fruit was calculated by dividing the TSS by the acidity.

$$\text{TSS:Acid ratio} = \text{TSS/Acidity}$$

3.3.3.7 Ascorbic acid (mg/100 g)

Ascorbic acid was estimated by the Indophenol method (Ranganna, 1986). Ten ml of fresh juice sample was blended with 3 % meta-phosphoric acid (HPO₃), and the volume was made to 100 ml with HPO₃ solution. An aliquot of 10 ml was taken and titrated against standard dye solution (2, 6 dichlorophenol indophenol dye) until the light pink colour persisted for at least 15 seconds. Standardization of dye (dye factor) was done by titrating it against standard ascorbic acid diluted in 3 % HPO₃ solution. The ascorbic acid was calculated using the following formula and expressed as mg ascorbic acid per 100 gm fresh weight.

$$\text{Ascorbic acid (mg/100gm)} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up}}{\text{Weight of sample} \times \text{Aliquot taken}} \times 100$$

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

3.3.3.8 Physiological loss of fruit weight (%)

Three fruits from each replication were earmarked for studying physiological loss in weight. The loss in weight was calculated by noting down the difference between matured and ripened fruit weight. It was calculated as follows and expressed in percent.

$$\text{PWL \%} = \frac{\text{Matured weight(g)} - \text{Ripened weight (g)}}{\text{Matured weight (g)}} \times 100$$

3.4 Statistical analysis

The obtained findings will be statistically evaluated and correctly interpreted by the framework defined in Panse and Sukhatme (1985).



Plate 4: Visits of research guide and member of student advisory committee member to experimental field.

CHAPTER- IV
RESULTS AND DISCUSSION

CHAPTER- IV

RESULTS AND DISCUSSION

The present investigation entitled, “**Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L.) var. Kesar**” was laid out in a well-established mango orchard six year old at Fruit Research Station, Aurangabad (M.S.) during the year 2020-2021 with the objectives to study the effect of plant growth regulators and chemicals on fruiting, yield and quality of mango (*Mangifera indica* L.) var. Kesar

The present study was undertaken with nine treatments *i.e.* foliar application on kesar variety of mango at pea stage and marble stage of fruit development. The result of investigation obtained is presented in this chapter under appropriate heads. The data for fruit setting, yield and quality parameters were subjected to statistical analysis by using Randomized Block Design (RBD). The results obtained on these aspects are presented here under different headings with tables, figures and photographs at appropriate heads.

4.1 Flowering parameters observation

4.1.1 Length of panicle (cm) before spraying of plant growth regulators and chemicals

Length of panicles are presented in Table 4.1 and graphically depicted in Fig. 4.1 which indicated that the results were non-significant in respect of length of panicle.

Table 4.1 Length of panicle (cm) of mango var. Kesar before spraying of plant growth regulators and chemicals

Treatment No.	Treatments	Length of panicle (cm)
T ₁	GA ₃ 35 ppm	28.00
T ₂	CPPU 5 ppm	28.44
T ₃	CPPU 10 ppm	29.44
T ₄	Triacantanol 750 mg/l	28.44
T ₅	NAA 50 ppm	28.56
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	27.11
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	28.89
T ₈	NAA 25 ppm+ Borax 0.2 %	28.89
T ₉	Control (No treatment)	28.44
S.E.(m±)		0.69
C.D. at 5 %		NS

4.1.2 Breadth of panicle (cm) before spraying of plant growth regulators and chemicals

The results obtained on breadth of panicle are presented in Table 4.2 and graphically depicted in Fig. 4.2 revealed non-significant difference in respect of breadth of panicle.

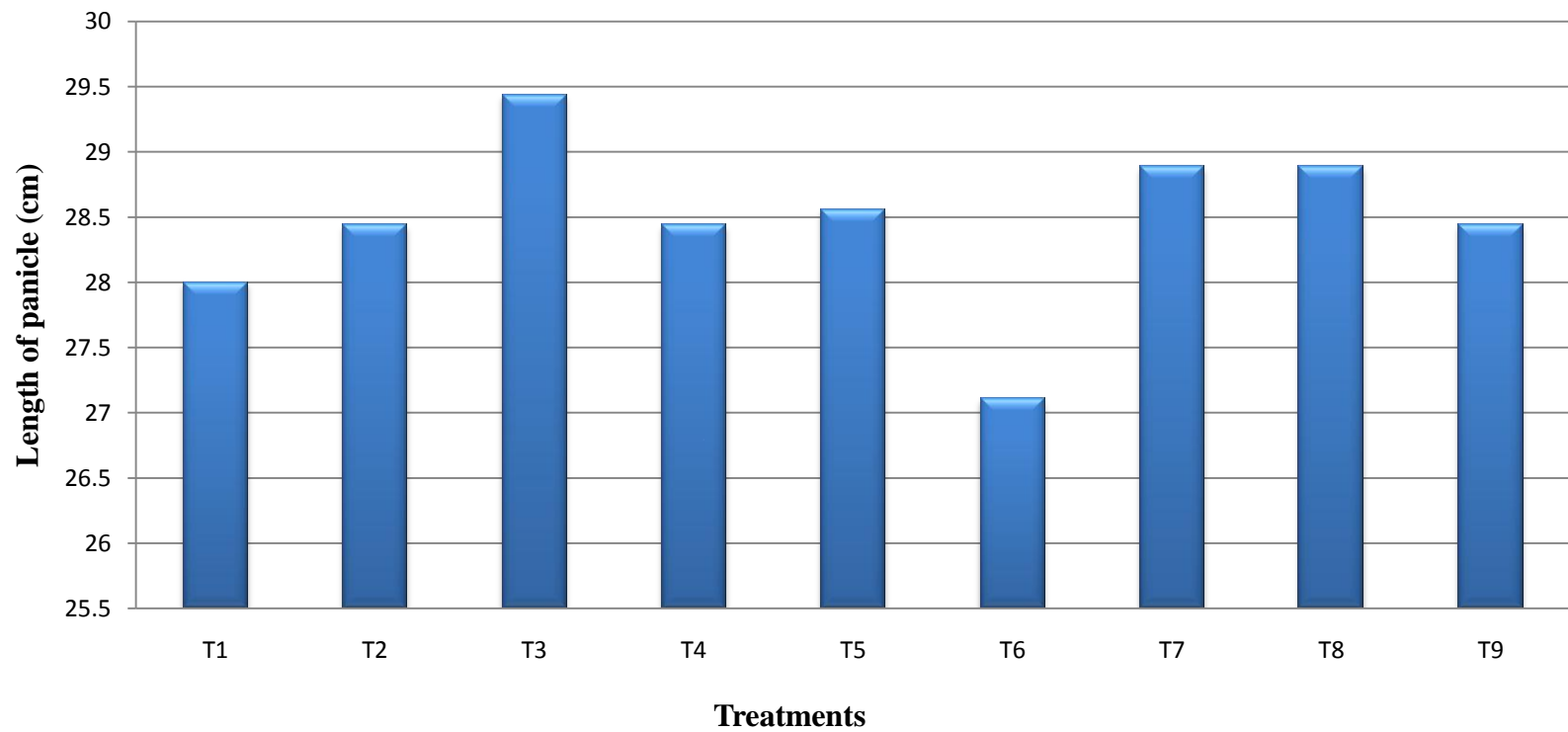


Fig. 4.1: Length of panicle (cm) of mango var. Kesar before spraying of plant growth regulators and chemicals

Table 4.2 Breadth of panicle (cm) of mango var. Kesar before spraying of plant growth regulators and chemicals

Treatment No.	Treatments	Breadth of panicle (cm)
T ₁	GA ₃ 35 ppm	26.33
T ₂	CPPU 5 ppm	27.56
T ₃	CPPU 10 ppm	25.78
T ₄	Triaccontanol 750 mg/l	26.22
T ₅	NAA 50 ppm	26.33
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	26.11
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	26.00
T ₈	NAA 25 ppm+ Borax 0.2 %	26.56
T ₉	Control (No treatment)	26.33
S.E.(m±)		0.51
C.D. at 5 %		NS

4.1.3 Number of flowers per panicle before spraying of plant growth regulators and chemicals

The data collected on number of flowers per panicle were presented in Table 4.3 and graphically depicted in Fig. 4.3. The results were found non-significant with regards to number of flower per panicle before spraying

Table 4.3 Number of flowers per panicle of mango var. Kesar before spraying of plant growth regulators and chemicals

Treatment No.	Treatments	Number of flowers per panicle
T ₁	GA ₃ 35 ppm	3,037.11
T ₂	CPPU 5 ppm	3,138.89
T ₃	CPPU 10 ppm	3,188.22
T ₄	Triacantanol 750 mg/l	3,207.33
T ₅	NAA 50 ppm	2,968.67
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	3,120.00
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	3,153.89
T ₈	NAA 25 ppm+ Borax 0.2 %	3,060.67
T ₉	Control (No treatment)	3,043.33
S.E.(m±)		55.92
C.D. at 5 %		NS

4.1.4 Number of male flowers, hermaphrodite flower per panicle, Sex ratio

The results obtained on number of male flowers, hermaphrodite flower per panicle and sex ratio are presented in Table 4.4 and graphically depicted in Fig. 4.4, 4.4 (a), 4.4 (b), The results indicated non-significant in hermaphrodite flowers.

The maximum number of male flowers per panicle was observed in treatment T₄ *i.e.* (3054.57), minimum number of male flowers observed in control treatment *i.e.* (2880.45).

The maximum sex ratio observed in treatment T₄ *i.e.* (20.00) and minimum sex ratio observed in control treatment *i.e.* (17.68).

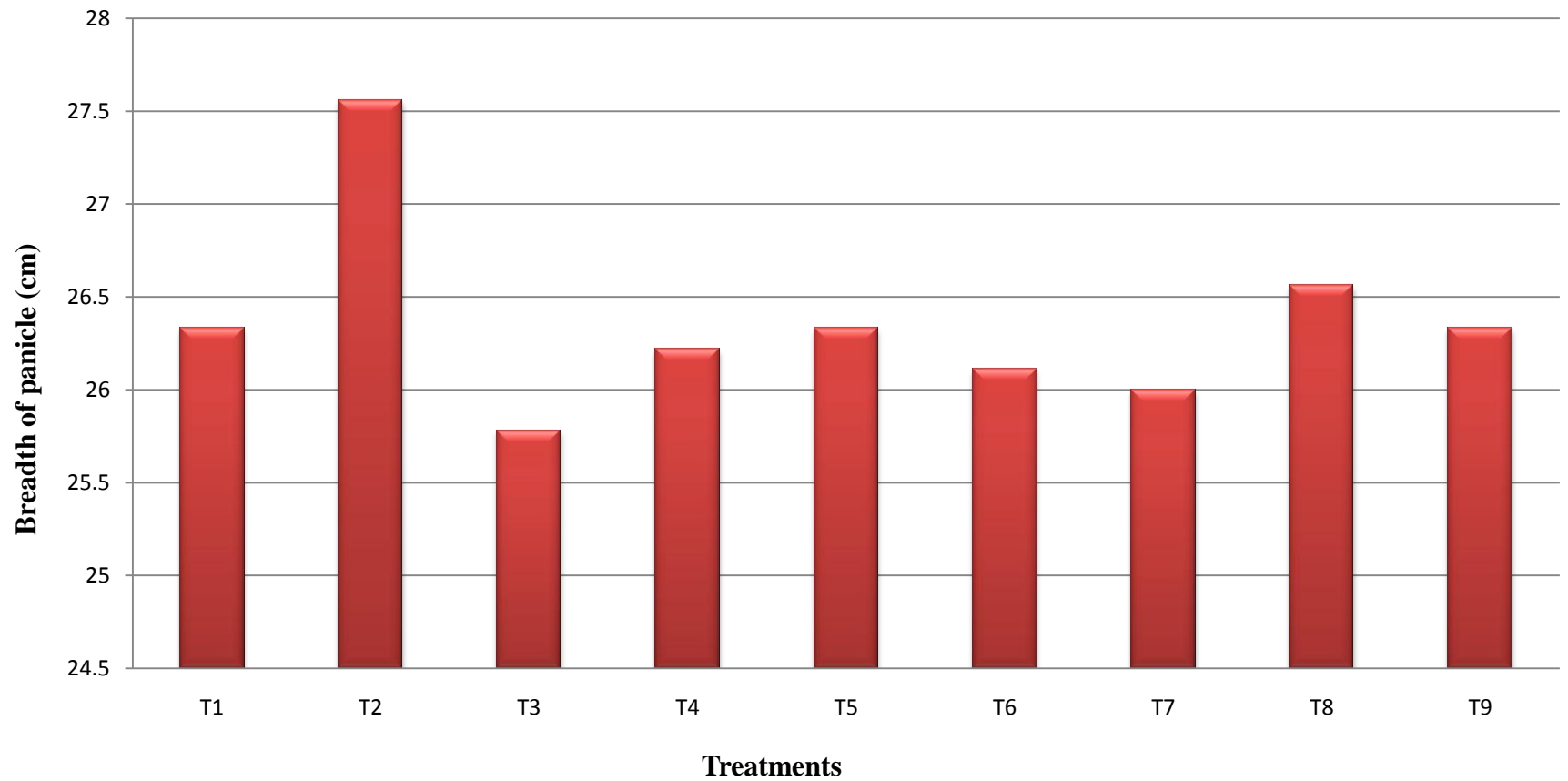


Fig. 4.2: Breadth of panicle (cm) of mango var. Kesar before spraying of plant growth regulators and chemicals

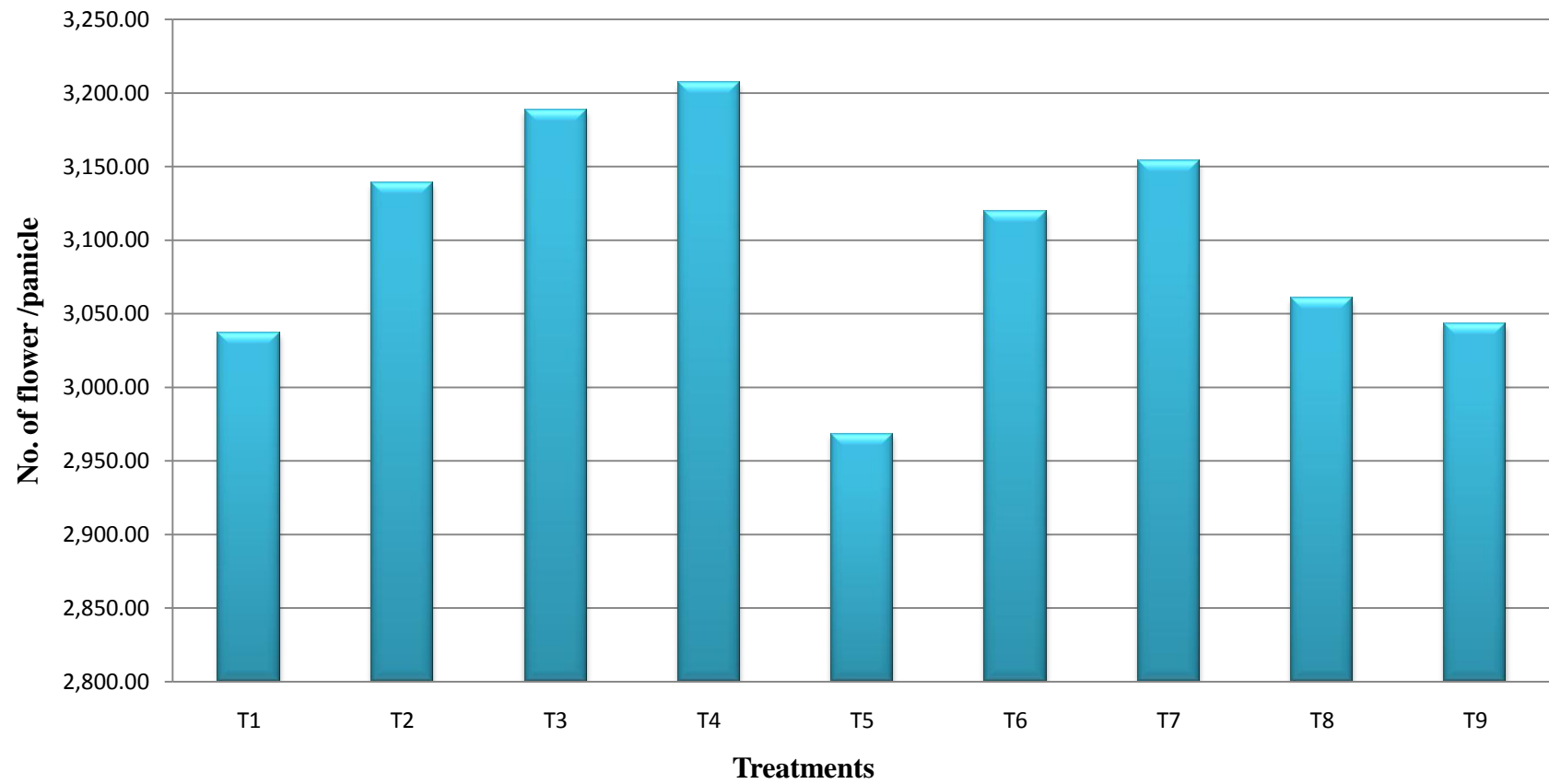


Fig. 4.3: Number of flowers per panicle of mango var. Kesar before spraying of plant growth regulators and chemicals

Table 4.4 Number of male flowers, hermaphrodite flowers per panicle, sex ratio

Treatment No.	Treatments	Number of male flowers per panicle	Number of hermaphrodite flowers per panicle	Sex ratio (male to hermaphrodite flowers)
T ₁	GA ₃ 35 ppm	2,883.10	154.00	18.72
T ₂	CPPU 5 ppm	2,982.07	156.89	19.00
T ₃	CPPU 10 ppm	3,033.02	155.22	19.54
T ₄	Triaccontanol 750 mg/l	3,054.67	152.67	20.00
T ₅	NAA 50 ppm	2,814.57	154.11	18.26
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	2,962.11	157.89	18.76
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	3,001.02	152.89	19.62
T ₈	NAA 25 ppm+ Borax 0.2 %	2,903.67	157.00	18.49
T ₉	Control (No treatment)	2,880.45	162.89	17.68
S.E.(m±)		1.08	2.51	0.25
C.D. at 5 %		3.27	NS	0.76

4.1.5 Days taken from flowering to fruit setting

The results of days taken from flowering to fruit setting are presented in Table 4.5 and graphically depicted in Fig. 4.5. The results indicated that there were non-significant differences.

Table 4.5 Days taken from flowering to fruit setting of mango var. Kesar

Treatment No.	Treatments	Number of days taken from flowering to fruit setting
T ₁	GA ₃ 35 ppm	19.00
T ₂	CPPU 5 ppm	19.33
T ₃	CPPU 10 ppm	19.67
T ₄	Triacantanol 750 mg/l	18.00
T ₅	NAA 50 ppm	16.00
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	17.67
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	16.33
T ₈	NAA 25 ppm+ Borax 0.2 %	18.00
T ₉	Control (No treatment)	20.33
S.E.(m±)		0.95
C.D. at 5 %		NS

4.1.6 Effect of plant growth regulators and chemicals on number of days taken from fruit set to harvest of mango var. Kesar

The number of days taken from fruit set to harvest as influenced by different treatments are presented in Table 4.6 and depicted in Fig. 4.6. The responses to application of various plant growth regulators and chemical treatments regarding number of days taken from fruit set to harvest were significant.

The data presented in Table 4.6 clearly indicated that, the minimum days required for fruit maturation (99 days) were recorded in the treatment T₄ (triacantanol 750 mg/l), which was statistically at par with the treatment T₅ (100.33 days). The next best treatments were T₁ (101.33 days) *i.e.* (GA₃ 35 ppm), T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (102.00 days), and T₃ (CPPU 10 ppm) *i.e.* (103.33 days) which were statistically at par with each other. Treatments T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.*

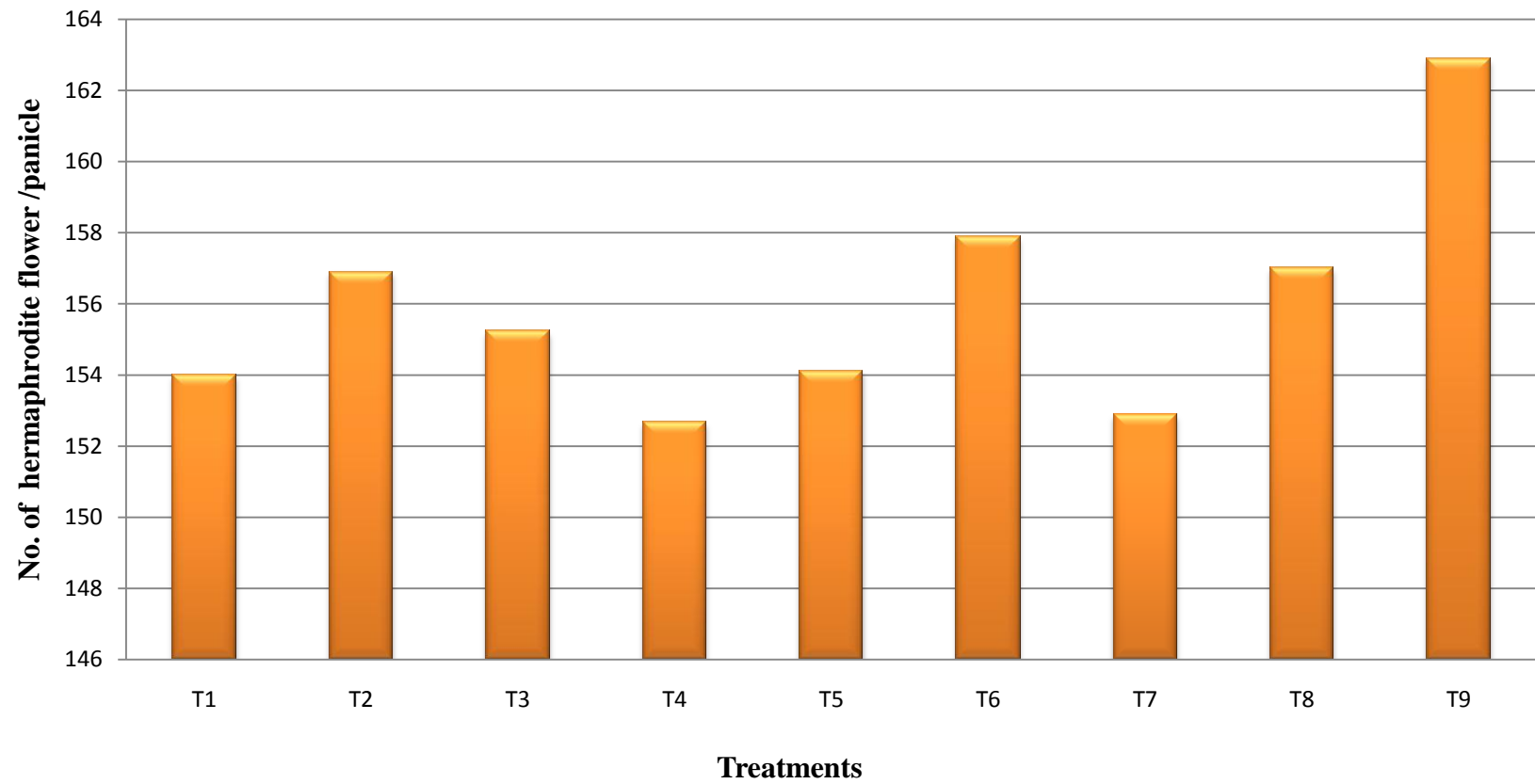
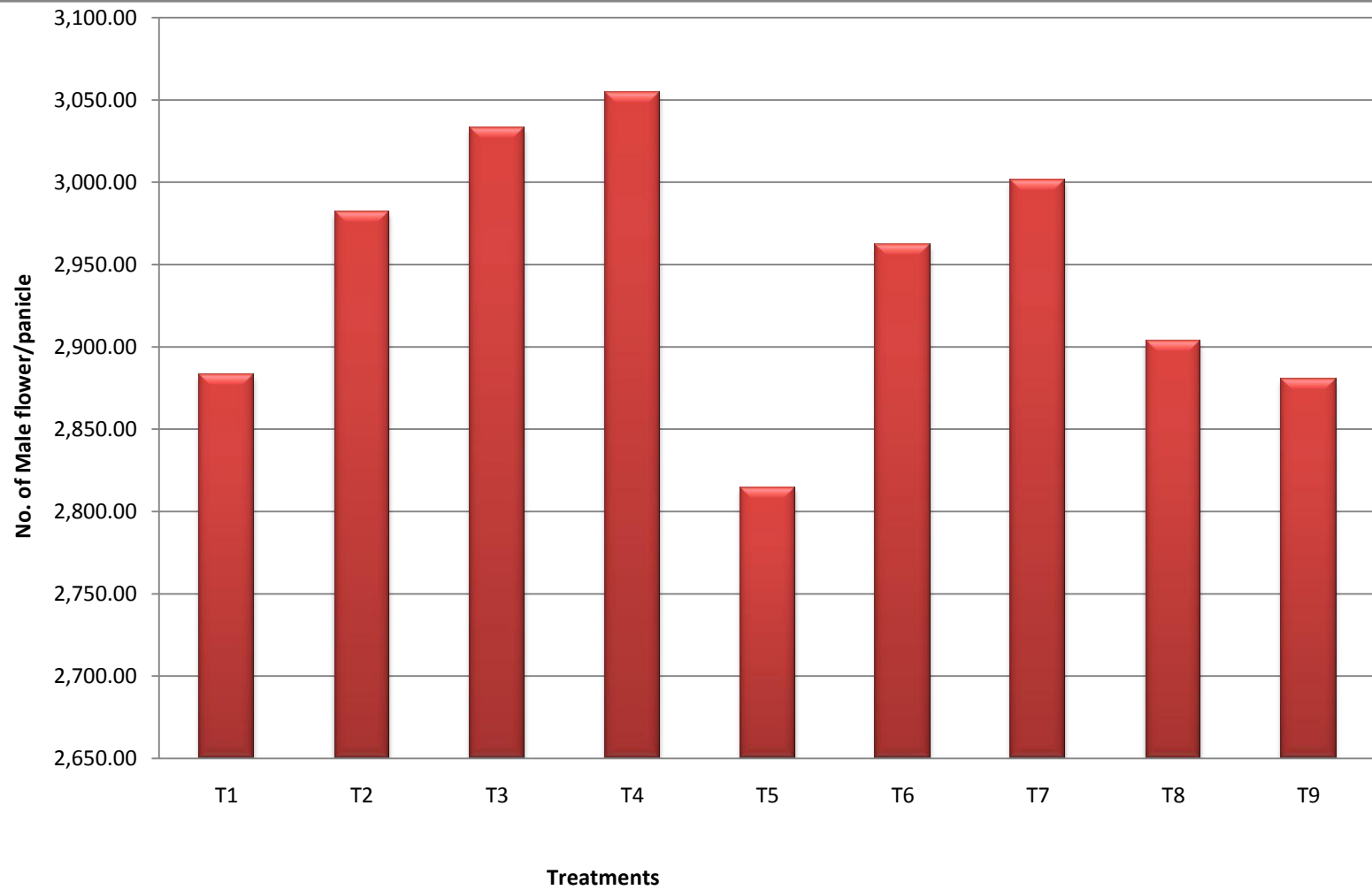
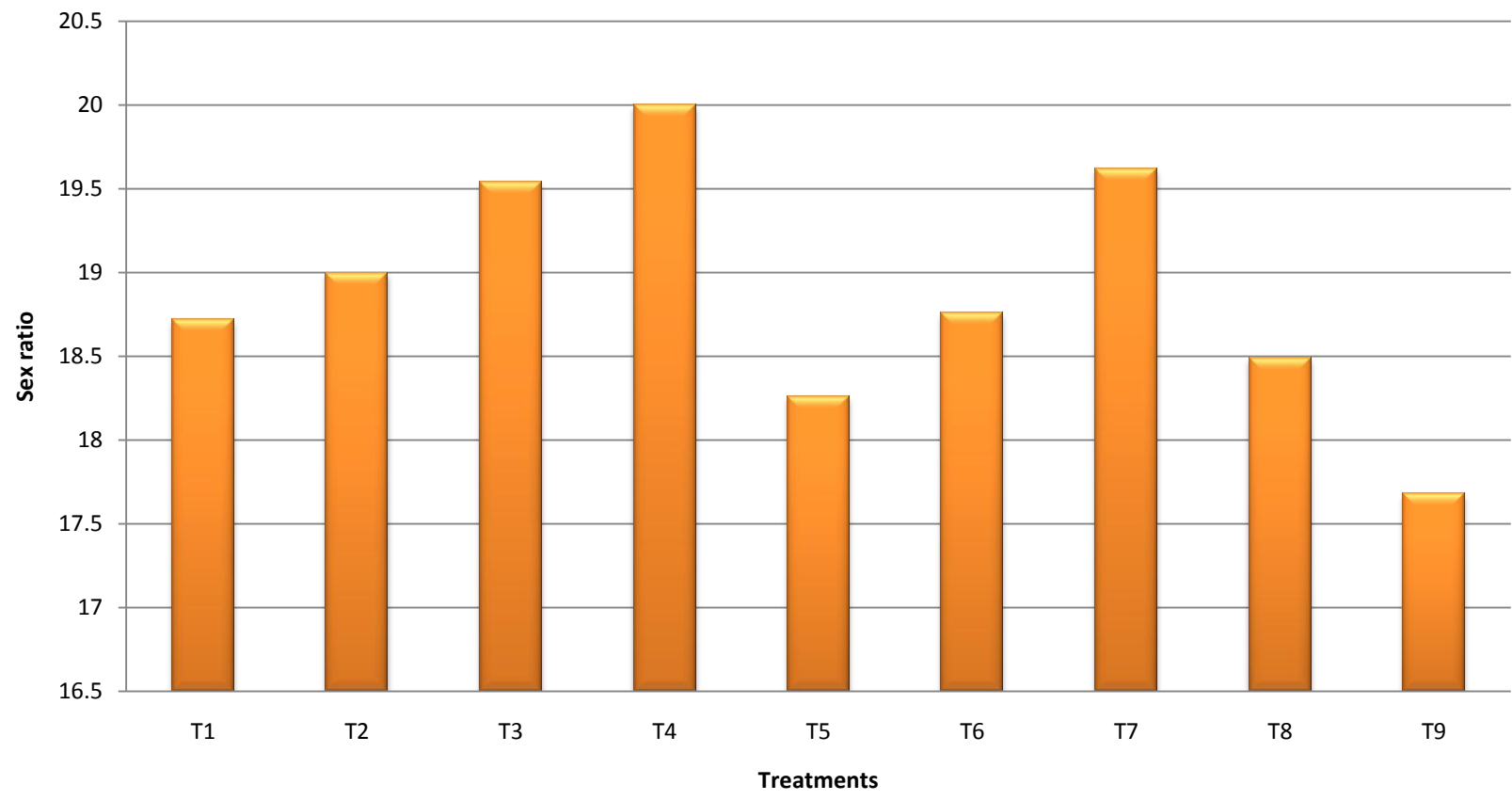


Fig. 4.4: Number of hermaphrodite flowers per panicle of mango var. Kesar before spraying of plant growth regulators and chemicals



4.4 a) Number of male flower per panicle



4.4 b) Sex ratio (Male to Hermaphrodite flowers)

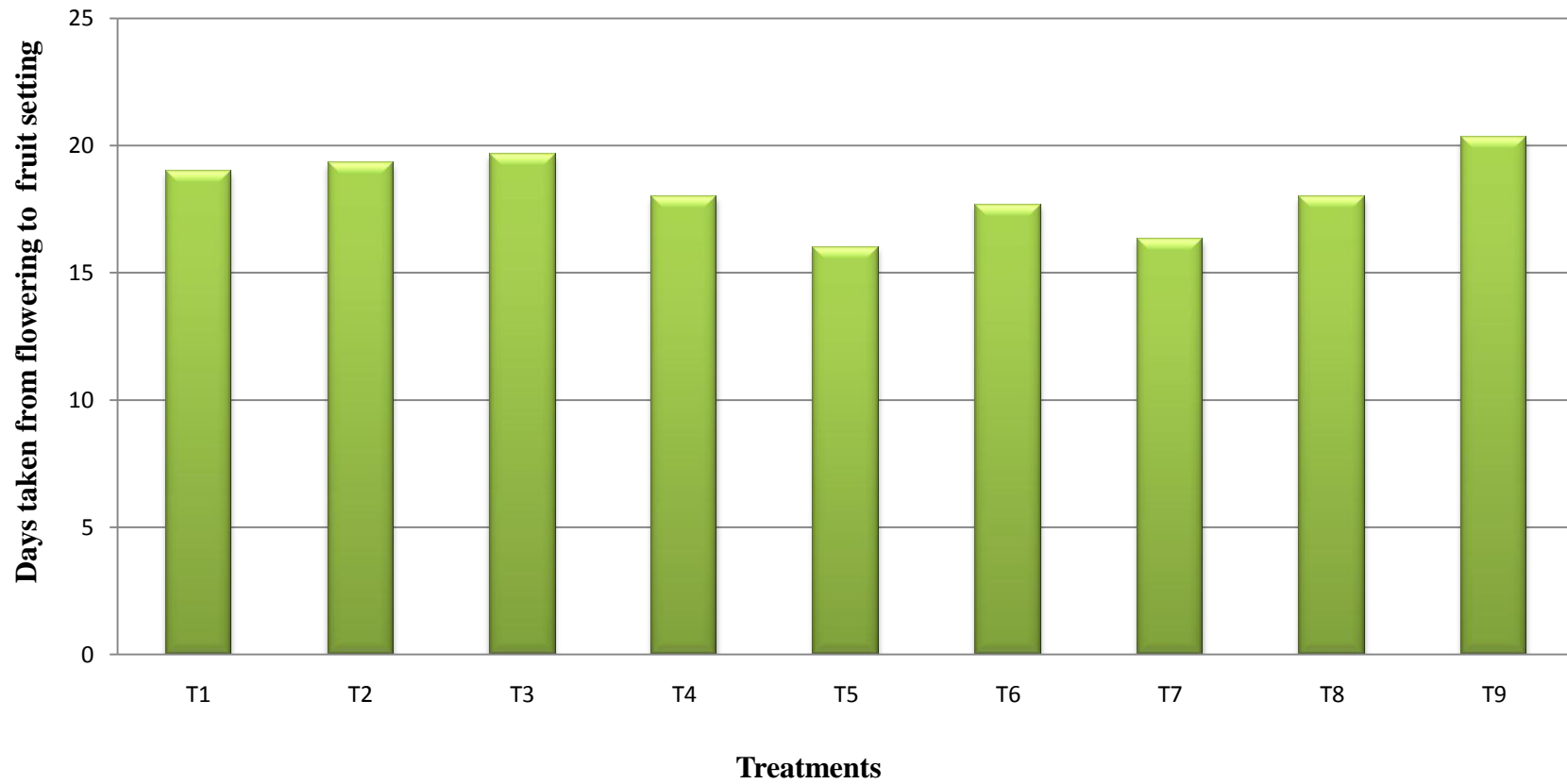


Fig. 4.5: Days taken from flowering to fruit setting of mango var. Kesar before spraying of plant growth regulators and chemicals

(105.67 days) and T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (107.67 days) were showed intermediate effect and were at par with each other. The maximum days required for fruit maturation from fruit set to harvesting (114 days) was recorded in the treatment T₉ *i.e.* control.

Among all treatments minimum days required to maturation of fruit from fruit setting to harvesting was observed in treatment T₄ (triacontanol 750 mg/l) *i.e.* (99 day). This might be due to triacontanol increases amino acid, sugars and carbohydrates in fruit hence maturation period takes minimum days compared to treatment T₉. Similar results were obtained by Varu *et al.* (2012).

Table 4.6 Effect of plant growth regulators and chemicals on number of days taken from fruit set to harvest of mango var. Kesar

Treatment No.	Treatments	Number of days taken from fruit set to harvest
T ₁	GA ₃ 35 ppm	101.33
T ₂	CPPU 5 ppm	109.00
T ₃	CPPU 10 ppm	103.33
T ₄	Triacontanol 750 mg/l	99.00
T ₅	NAA 50 ppm	100.33
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	105.67
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	107.67
T ₈	NAA 25 ppm+ Borax 0.2 %	102.00
T ₉	Control (No treatment)	114.00
S.E.(m±)		0.67
C.D. at 5 %		2.01

4.1.7 Effect of plant growth regulators and chemicals on fruit retention at harvesting stage (%) of mango var. Kesar

The data regarding fruit retention at harvesting stage was affected by various treatments is presented in Table 4.7 and depicted in Fig. 4.7 The response to the application of different plant growth regulators and chemical treatments regarding fruit retention per cent were significant.

The data presented in Table 4.7 indicated that all the treatments and their concentrations were effective in increasing the fruit retention at the harvesting stage. The treatment T₄ *i.e.* (triacontanol 750 mg/l) recorded maximum fruit retention (1.00 %), which was superior over control was statistically at par with the treatment T₅ (0.98 %). The next best treatments were T₁ (0.91 %) and T₈ (0.83 %) which were at par with each other. The treatment T₃ (0.76 %), T₆ (0.61 %), showed intermediate effect.

Maximum fruit retention per cent at harvesting stage was observed in treatment T₄ (triacontanol 750 mg/l) *i.e.* (1.00 %) this might be due to triacontanol increases chlorophyll content, photosynthesis rate, transpiration, stomatal conductance and uptake of nutrients in leaves, and minimum fruit retention per cent at harvesting stage was observed in treatment T₉ (control) *i.e.* (0.25 %). Similar result were also reported by Chaudhary (2014), Bhamare *et al.* (2014) in mango, Konhar and Arun (1988) in cashewnut.

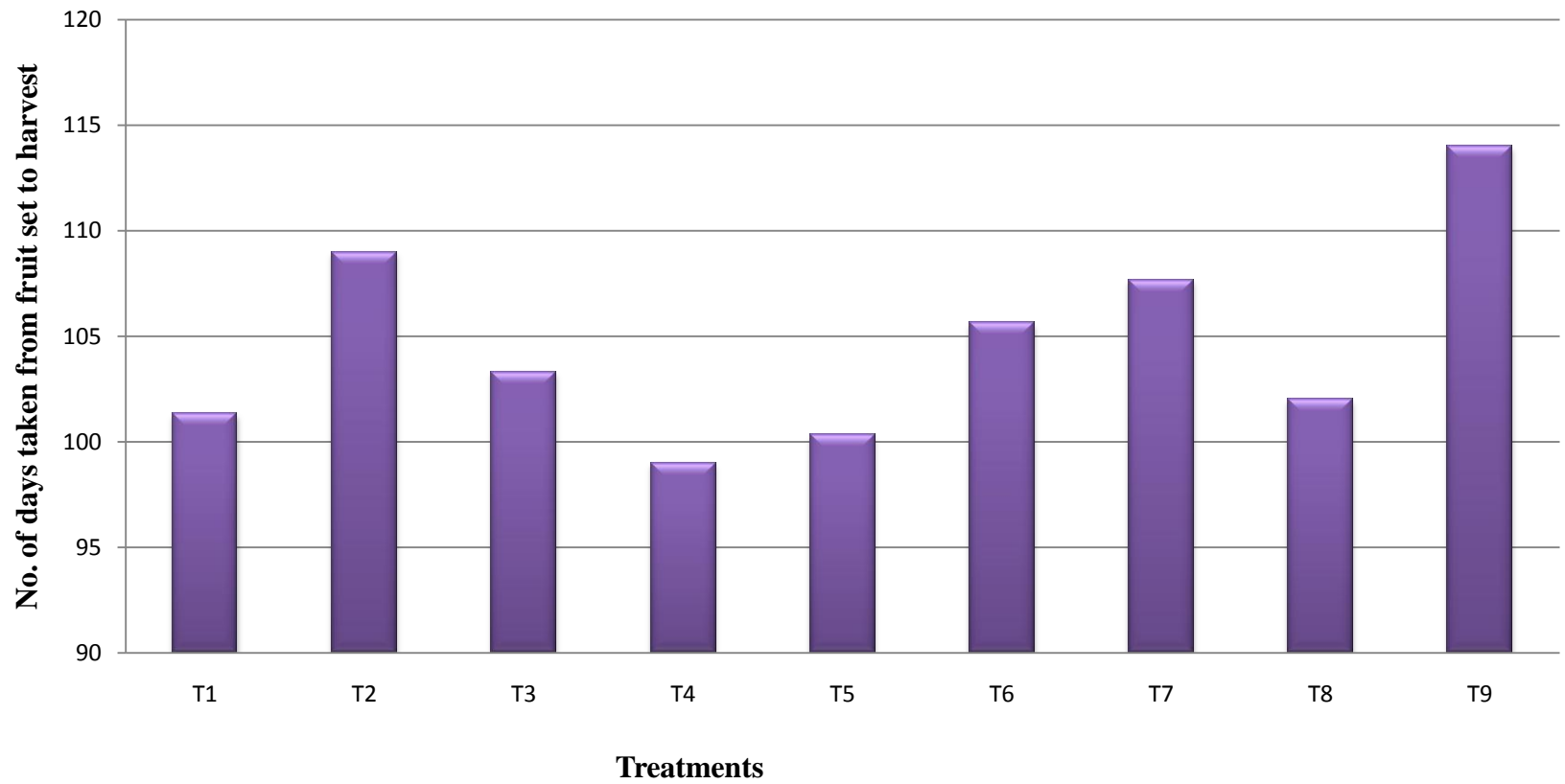


Fig. 4.6: Effect of plant growth regulators and chemicals on number of days taken from fruit set to harvest of mango var. Kesar



T₁ GA₃-35ppm



T₂ CPPU-5ppm



T₃ CPPU-10ppm



T₄ Triacontanol-750mg



T₅ NAA-50ppm



T₆ NAA+ZnSO₄ (25ppm+0.5%)



T₇ NAA+FeSO₄ (25ppm+0.5%)



T₈ NAA+Borax (25ppm+0.2%)



T₉ Control

Table 4.7 Effect of plant growth regulators and chemicals on fruit retention at harvesting stage (%) of mango var. Kesar

Treatment No.	Treatments	Fruit retention at harvesting stage (%)
T ₁	GA ₃ 35 ppm	0.91 (5.47)
T ₂	CPPU 5 ppm	0.44 (3.80)
T ₃	CPPU 10 ppm	0.76 (5.00)
T ₄	Triacantanol 750 mg/l	1.00 (5.73)
T ₅	NAA 50 ppm	0.98 (5.68)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	0.61 (4.47)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	0.51 (4.09)
T ₈	NAA 25 ppm+ Borax 0.2 %	0.83 (5.22)
T ₉	Control (No treatment)	0.25 (2.86)
S.E.(m±)		0.005
C.D. at 5 %		0.014

(* Figure in parenthesis denotes angular transformation of percent values)

4.2 Yield parameters observation

4.2.1 Effect of plant growth regulators and chemicals on length of fruit (cm) of mango var. Kesar

The data regarding length of fruit as affected by various treatments is presented in Table 4.8 and depicted in Fig. 4.8. The responses to the application of different plant growth regulators and chemical treatments regarding the length of fruit were significant.

The data clearly indicated that the maximum fruit length (11.58 cm) was recorded under the treatment T₄ *i.e.* (triacantanol 750 mg/l), which was superior over control. The next best treatment was T₁ (GA₃ 35 ppm) *i.e.* (10.46 cm) which was statistically at par with T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (10.29 cm). Treatment T₃ (CPPU 10 ppm) *i.e.* (10.11 cm) was at par with T₆ (NAA 25 ppm + ZnSO₄ 0.5 %)

i.e. (9.96 cm).The minimum length of fruit (8.97 cm) was noticed under treatment T₉ *i.e.* (control).

The promotive effect of triacontanol (750 mg/l) on length of fruit *i.e.* (11.58 cm) was maximum, this might be due to triacontanol enhance the physiological efficiency of cell division, elongation and thus exploits the genetic potential of plant to a large extent. Similar results were reported by Chowdhary *et al.* (2009), Patil *et al* (2005) in mango.

Table 4.8 Effect of plant growth regulators and chemicals on length of fruit (cm) of mango var. kesar

Treatment No.	Treatments	Length of Fruit (cm)
T ₁	GA ₃ 35 ppm	10.46
T ₂	CPPU 5 ppm	9.70
T ₃	CPPU 10 ppm	10.11
T ₄	Triacontanol 750 mg/l	11.58
T ₅	NAA 50 ppm	11.23
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	9.96
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	9.81
T ₈	NAA 25 ppm+ Borax 0.2 %	10.29
T ₉	Control (No treatment)	8.97
S.E.(m±)		0.08
C.D. at 5%		0.25

4.2.2 Effect of plant growth regulators and chemicals on breadth of fruit (cm) of mango var. Kesar.

The data regarding length of fruit as affected by various treatments is presented in Table 4.9 and depicted in Fig. 4.9. The responses to the application of

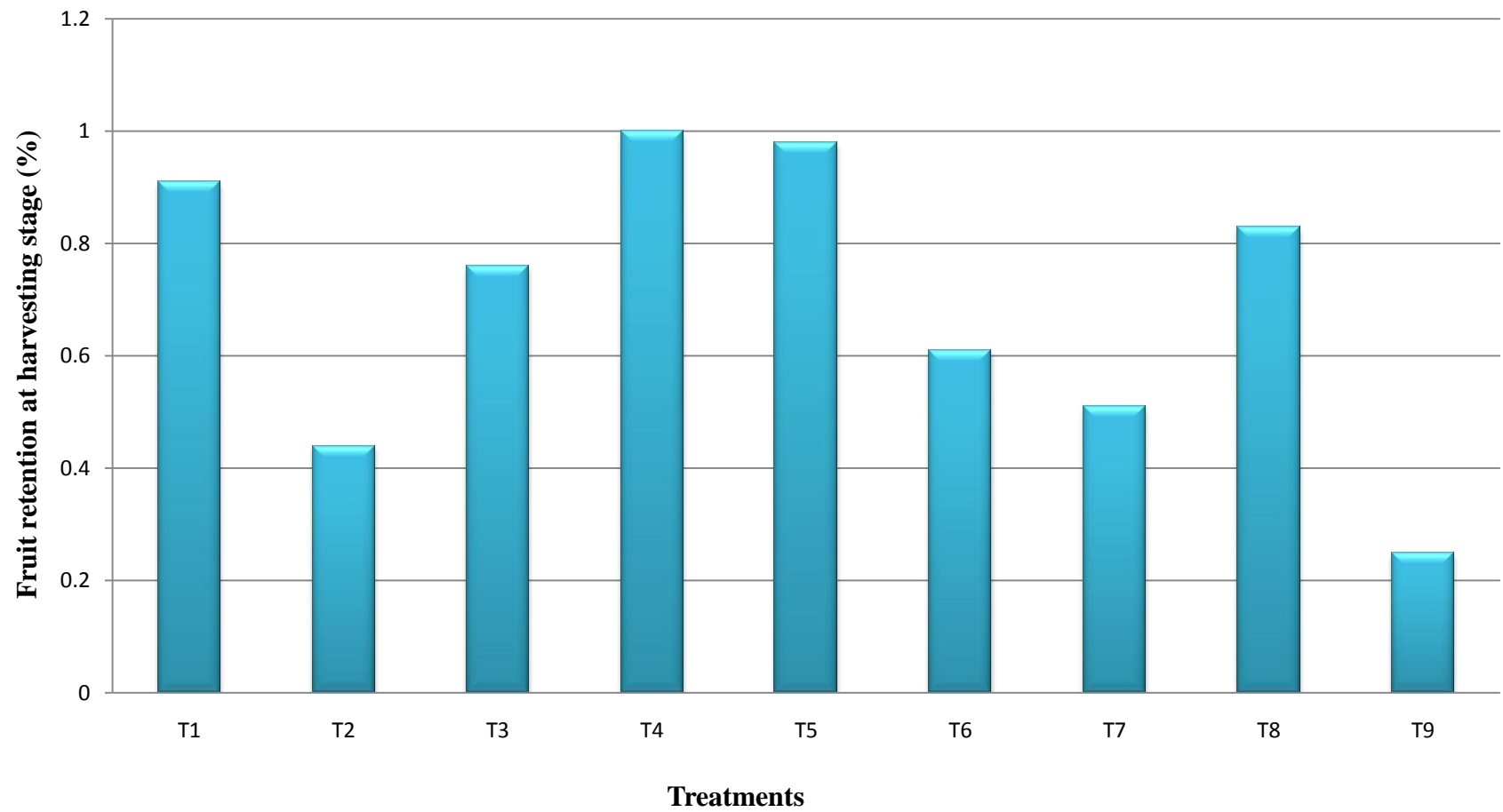


Fig. 4.7: Effect of plant growth regulators and chemicals on fruit retention at harvesting stage (%) of mango var. Kesar

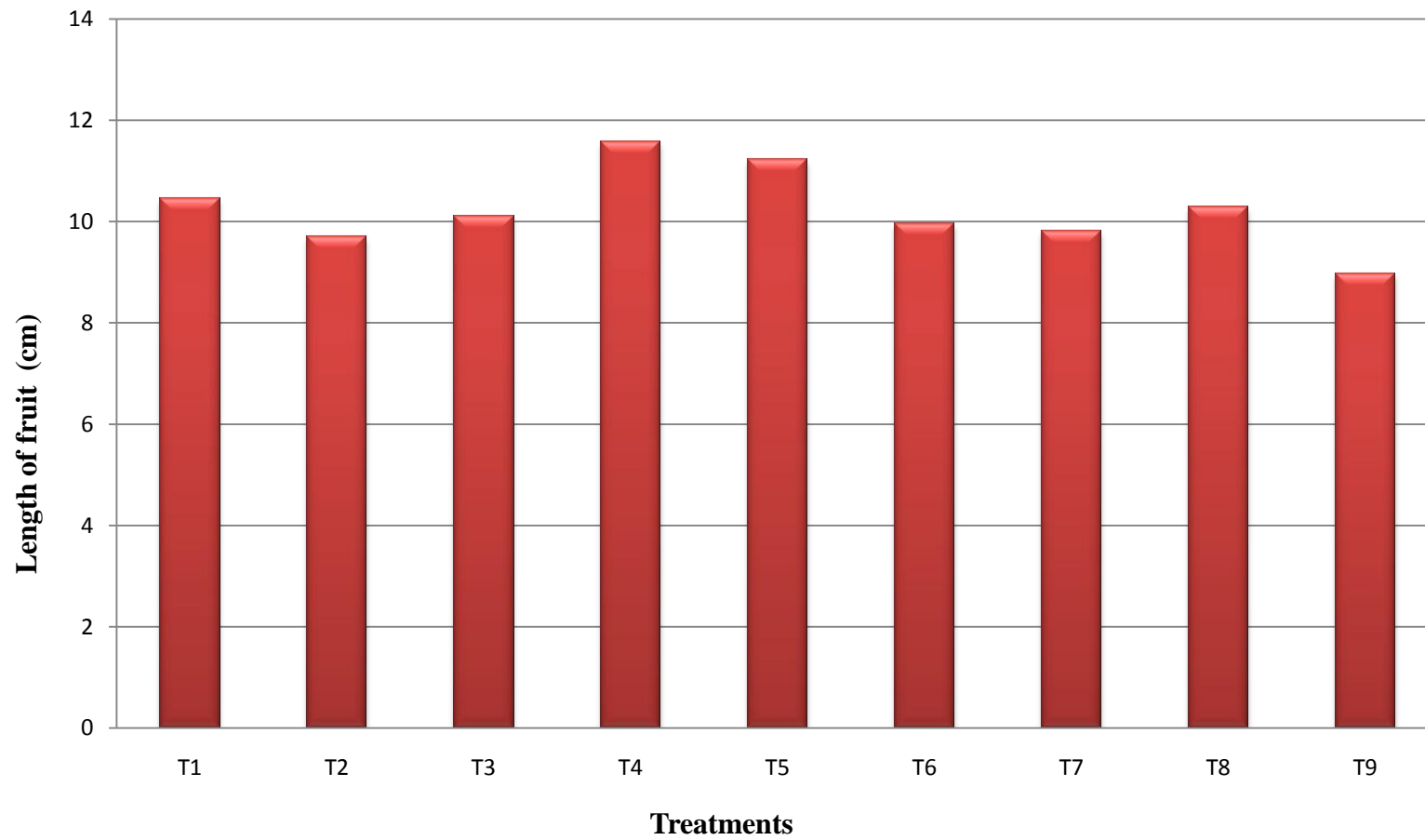


Fig. 4.8 : Effect of plant growth regulators and chemicals on length of fruit (cm) of mango var. Kesar



T₁-GA₃-35ppm



T₂-CPPU-5ppm



T₃-CPPU-10ppm



T₄-Triacontanol-750mg



T₅-NAA-50ppm



T₆-NAA+ZnSO₄(25ppm+0.5%)



T₇-NAA+FeSO₄(25ppm+0.5%)



T₈-NAA+Borax(25ppm+0.2%)



T₉-Control

different plant growth regulators and chemical treatments regarding the breadth of fruit were significant.

The data clearly revealed that, the maximum fruit breadth (7.09 cm) was recorded under the treatment T₄ *i.e.* (triacontanol 750 mg/l), which was at par with treatment T₅ (7.06 cm). It was followed by the treatments T₁ (7.04 cm) and T₈ (7.00 cm) which were statistically at par with each other. Treatment T₃ (CPPU 10 ppm) *i.e.* (6.84 cm), T₆ *i.e.* (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (6.73 cm), T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (6.44 cm) and treatment T₂ (CPPU 5 ppm) *i.e.* (6.21 cm) showed intermediate results among all treatments. The minimum breadth of fruit (6.03 cm) was noticed under control (T₉).

The promotive effect of triacontanol (750 mg/l) on breadth of fruit *i.e.* (7.09 cm) was maximum, this might be due to triacontanol enhance the physiological efficiency of cell division, elongation and thus exploits the genetic potential of plant to a large extent. Similar results were reported by Chowdhary *et al.* (2009) and Patil *et al.* (2005) in mango.

Table 4.9 Effect of plant growth regulators and chemicals on breadth of fruit (cm) of mango var. Kesar

Treatment No.	Treatments	Breadth of Fruit (cm)
T ₁	GA ₃ 35 ppm	7.04
T ₂	CPPU 5 ppm	6.21
T ₃	CPPU 10 ppm	6.84
T ₄	Triacantanol 750 mg/l	7.09
T ₅	NAA 50 ppm	7.06
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	6.73
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	6.44
T ₈	NAA 25 ppm+ Borax 0.2 %	7.00
T ₉	Control (No treatment)	6.03
S.E.(m±)		0.02
C.D. at 5%		0.04

4.2.3 Effect of plant growth regulators and chemicals on weight of fruit (g) of mango var. Kesar

The results pertaining to weight of fruit as affected by different treatments are presented Table 4.10 and depicted in Fig. 4.10. The results obtained in this regard were significant.

The maximum weight of fruit (270 g) was obtained in the treatment T₄ *i.e.* triacantanol (750 mg/l) which was statistically at par with treatment T₅ (NAA 50 ppm) *i.e.* (267 g). The best treatment was T₁ (GA₃ 35 ppm) *i.e.* (265.67 g) which was statistically at par with treatment T₈ (263.33 g).

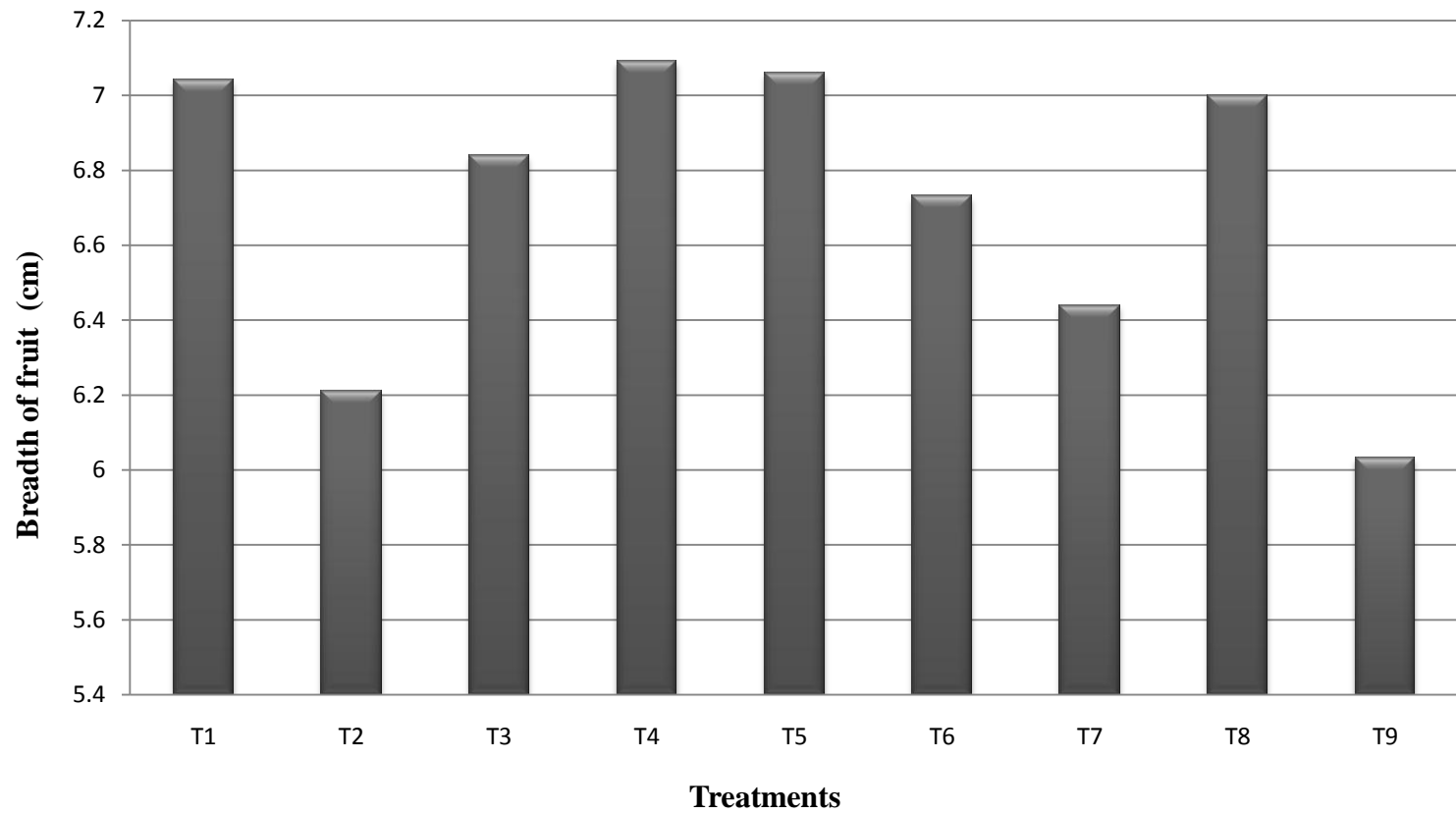


Fig. 4.9: Effect of plant growth regulators and chemicals on breadth of fruit (cm) of mango var. Kesar

Treatment T₃ (261.33 g) and T₆ (259.67 g) showed intermediate effect among treatments. The minimum weight of fruit (251 g) was obtained under the treatment control (T₉).

The treatment T₄ (triacontanol 750 mg/l) had significantly maximum weight of fruit *i.e.* (270 g), this might be due to triaccontanol increases the amino acid, sugars and carbohydrates accumulation in fruit resulting increases fruit weight, and minimum weight of fruit observed in treatment T₉ *i.e.* (251 g). Similar result were finding by Mahida *et al.* (2018), and Shinde *et al.* (2008)

Table 4.10 Effect of plant growth regulators and chemicals on weight of fruits (g) of mango var. Kesar

Treatment No.	Treatments	Weight of fruit (g)
T ₁	GA ₃ 35 ppm	265.67
T ₂	CPPU 5 ppm	254.33
T ₃	CPPU 10 ppm	261.33
T ₄	Triaccontanol 750 mg/l	270.00
T ₅	NAA 50 ppm	267.00
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	259.67
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	257.67
T ₈	NAA 25 ppm+ Borax 0.2 %	263.33
T ₉	Control (No treatment)	251.00
S.E.(m±)		1.2
C.D. at 5%		3.63

4.2.4 Effect of plant growth regulators and chemicals on volume of fruit of mango var. Kesar

The results regarding volume of fruit as affected by various treatments are presented in Table 4.11 and depicted in Fig. 4.11 the results obtained in this regard were significant.

As regards to maximum volume of fruit, (164.93) was obtained under the treatment T₄ *i.e.* (triacontanol 750 mg/l), which was statistically at par with the treatment T₅. It was followed by T₁ (GA₃ 35 ppm) *i.e.* (159) and T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (155.00) which were statistically at par with each other. Treatments T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (150.00), T₇, T₂ showed intermediate effect and were statistically at par with each other. The minimum volume of fruit (141.33) was obtained under the treatment control (T₉).

The promotive effect of triacontanol on volume of fruit *i.e.* (164.93) was maximum, this might be due to application of triacontanol, fruit size increases resulting volume of fruits ultimately increased. Similar result was finding by Halepotara *et al.* (2019) in mango.

The results are in agreement with the finding of Shinde *et al.* (2008) in mango.

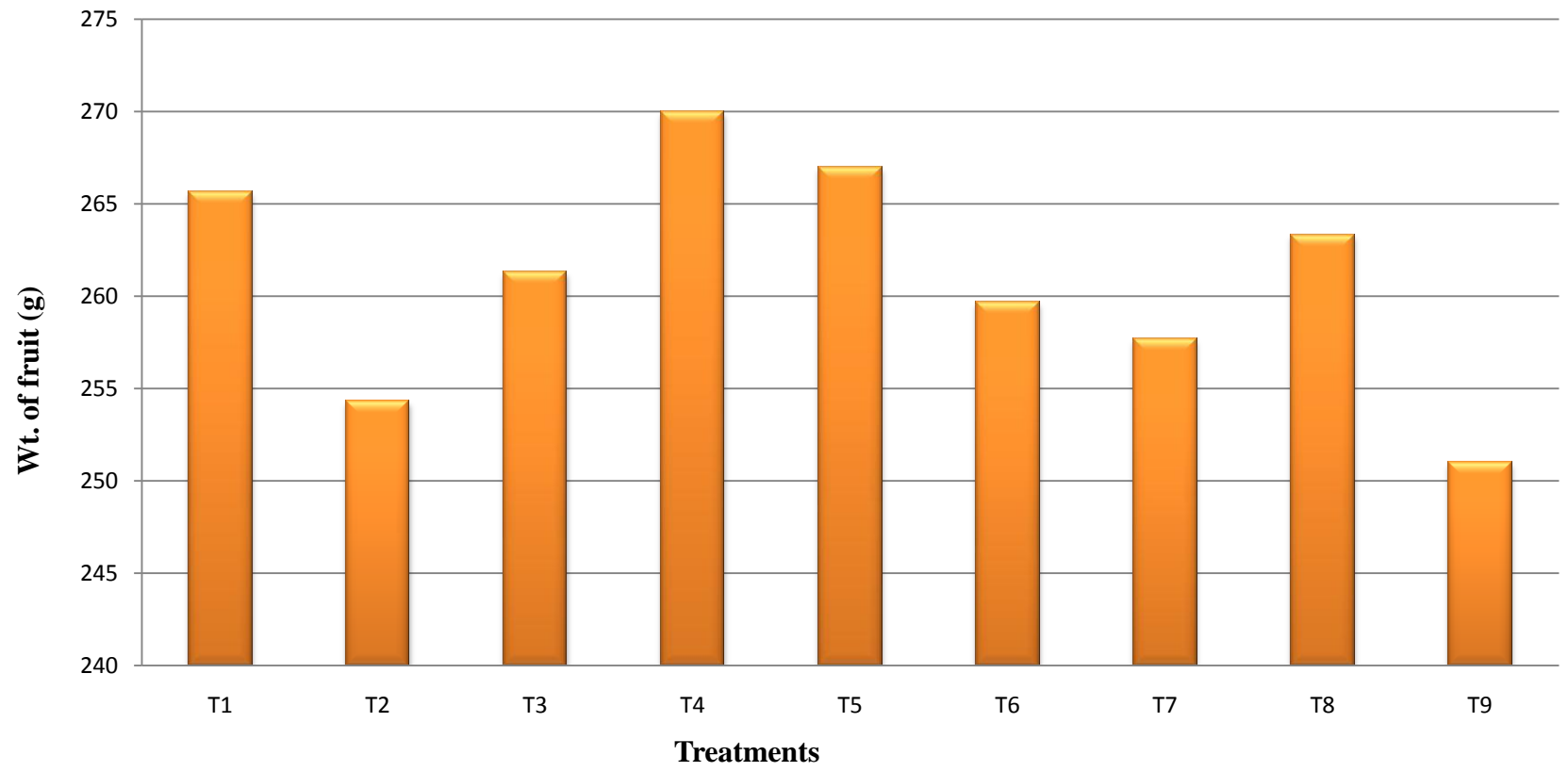


Fig. 4.10: Effect of plant growth regulators and chemicals on weight of fruits (g) of mango var. Kesar

Table 4.11 Effect of plant growth regulators and chemicals on volume of fruit (cc) of mango var. Kesar

Treatment No.	Treatments	Volume of fruit (cc)
T ₁	GA ₃ 35 ppm	159.00
T ₂	CPPU 5 ppm	146.00
T ₃	CPPU 10 ppm	153.67
T ₄	Triacantanol 750 mg/l	164.93
T ₅	NAA 50 ppm	162.33
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	150.00
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	149.33
T ₈	NAA 25 ppm+ Borax 0.2 %	155.00
T ₉	Control (No treatment)	141.33
S.E.(m±)		1.63
C.D. at 5%		4.92

4.2.5 Effect of plant growth regulators and chemicals on number of fruit per plant at harvest of mango var. Kesar

The results pertaining to fruit per plant at harvest as affected by different treatments are presented Table 4.12 and depicted in Fig. 4.12. The results obtained in this regard were significant.

The maximum number of fruit (87.67) was obtained in the treatment T₄ *i.e.* (triacantanol 750 mg/l), which was superior over control, it was followed by treatment T₅ (NAA 50 ppm) *i.e.* (84.67) which were statistically at par with each other. Treatment T₁ (77.67) and T₈ (74.67) were next best treatments which were statistically at par with each other.

Treatment T₃, T₆ and T₇ showed intermediate effect among the treatments. The minimum number of fruit per plant at harvested (50.33) was recovered under the treatment T₉ *i.e.* control.

The maximum number of fruits per plant observed under treatment T₄ (triacontanol 750 mg/l) *i.e.* (87.67). This might be due to triacontanol helps to reduce fruit drop at pea and marble stage *i.e.* (inhibits formation of abscission layer at fruit neck) resulting fruit retention at harvesting stage is higher since number of fruit at harvesting stage is higher comparative to control treatment and minimum number of fruit per plant at harvesting observed in treatment T₉ *i.e.* (50.33). Similar result were also reported by Shinde *et al.* (2008) and Momin *et al.* (2016) in mango.

Table 4.12 Effect of plant growth regulators and chemicals on number of fruit par plant at harvest of mango var. Kesar

Treatment No.	Treatments	Number of fruit/plant at harvest
T ₁	GA ₃ 35 ppm	77.67
T ₂	CPPU 5 ppm	59.00
T ₃	CPPU 10 ppm	72.33
T ₄	Triacontanol 750 mg/l	87.67
T ₅	NAA 50 ppm	84.67
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	69.00
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	63.00
T ₈	NAA 25 ppm+ Borax 0.2 %	74.67
T ₉	Control (No treatment)	50.33
S.E.(m±)		1.17
C.D. at 5%		3.51

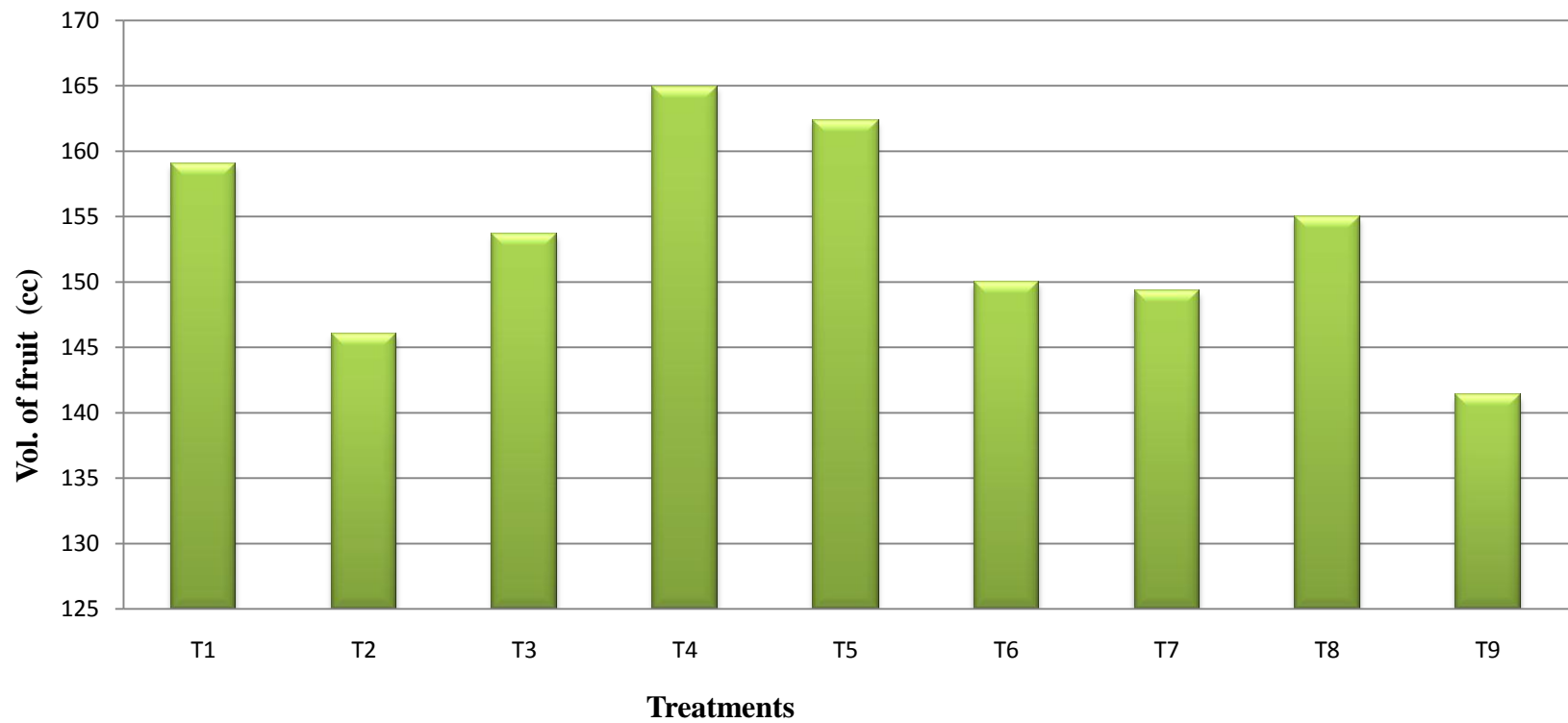


Fig. 4.11: Effect of plant growth regulators and chemicals on volume of fruit (cc) of mango var. Kesar

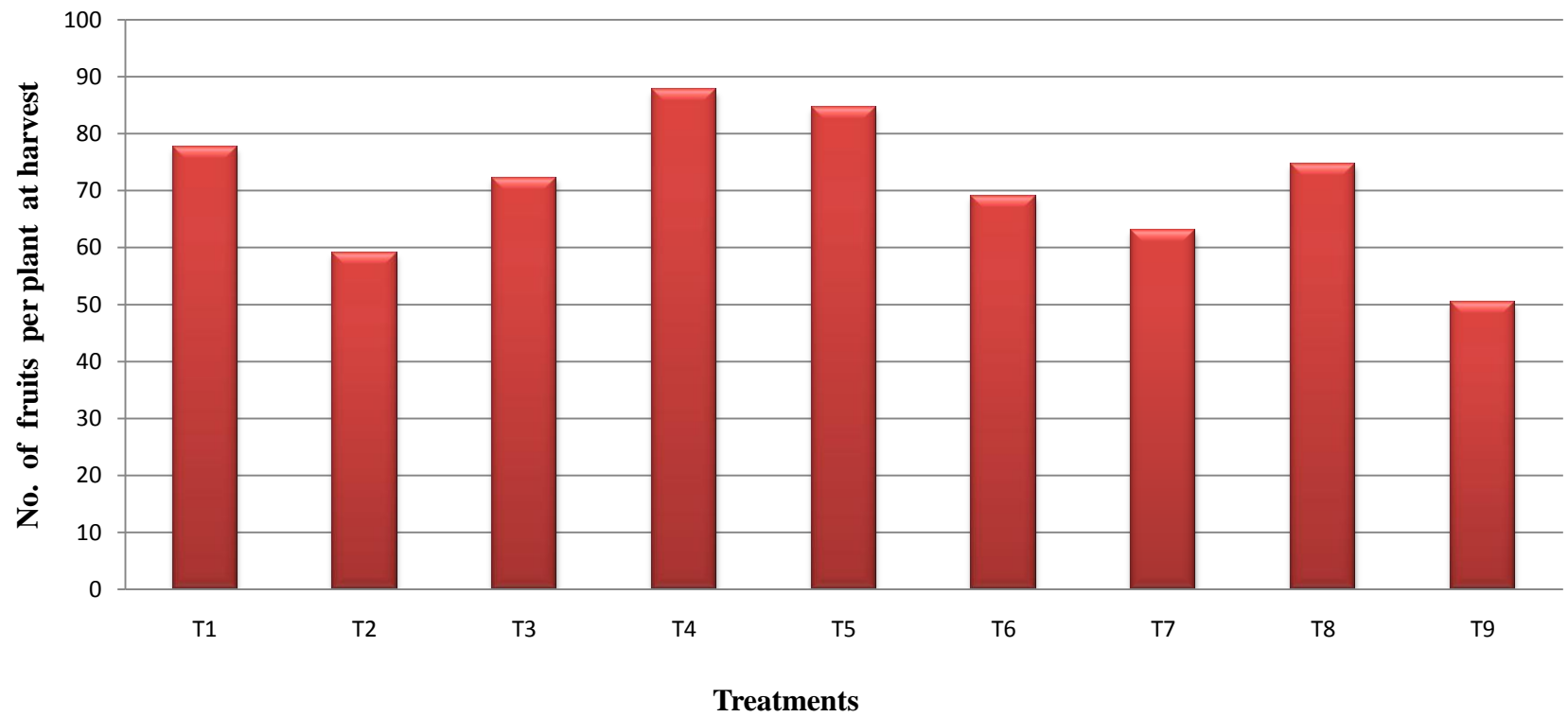


Fig. 4.12: Effect of plant growth regulators and chemicals on number of fruits per plant at harvest of mango var. Kesar

4.2.6 Fruit set (%)

4.2.6.1 Effect of plant growth regulators and chemicals on fruit set at pea stage (%) of mango var. Kesar

The results regarding of fruit set at pea stage as affected by various treatments are presented in Table 4.13 and depicted in Fig. 4.13. The results obtained in this regard were significant.

The maximum fruit set at pea stage (14.17 %) was reported under the treatment T₄ *i.e.* (triacontanol 750 mg/l), which was significantly superior over all other treatments. It was followed by treatment T₅, T₁, T₈, and T₃. The treatment T₆, T₇ showed intermediate effect. The minimum number of fruit set per cent at pea stage (10.73 %) was obtained under the treatment (T₉).

Maximum fruit set per cent at pea stage was observed in treatment T₄ (triacontanol 750 mg/l) *i.e.* (14.17 %), because triacontanol reduces synthesis of ABA and abscission layer at fruit neck hence reduce fruit drop. Which was minimum fruit set at pea stage was observed in treatment T₉ control *i.e.* (10.73 %). Similar result are agreement with Sudha *et al.* (2012) and Momin *et al.* (2016) in mango. Patil *et al.* (2005), Mandal and Kumar (1999) also found maximum fruit set in guava.

Table 4.13 Effect of plant growth regulators and chemicals on fruit set at pea stage (%) of mango var. Kesar

Treatment No.	Treatments	Fruit set at pea stage (%)
T ₁	GA ₃ 35 ppm	13.89 (21.88)
T ₂	CPPU 5 ppm	11.52 (19.84)
T ₃	CPPU 10 ppm	13.02 (21.15)
T ₄	Triacantanol 750 mg/l	14.17 (22.11)
T ₅	NAA 50 ppm	14.02 (21.98)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	12.81 (20.97)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	12.11 (20.36)
T ₈	NAA 25 ppm+ Borax 0.2 %	13.34 (21.42)
T ₉	Control (No treatment)	10.73 (19.12)
S.E.(m±)		0.01
C.D. at 5 %		0.03

(* Figure in parenthesis denotes angular transformation of percent values)

4.2.6.2 Effect of plant growth regulators and chemicals on fruit set at marble stage (%) of mango var. Kesar

The results regarding of fruit set at marble stage as affected by various treatments are presented in Table 4.14 and depicted in Fig. 4.14 the results obtained in this regard were significant.

Data clearly indicate that, the maximum fruit set at marble stage (7.52 %) was obtained under the treatment T₄ *i.e.* (triacantanol 750 mg/l), which was significantly superior over rest of the treatments under study. It was followed by treatment T₅ (7.44 %), T₁ (7.23 %). The treatments T₈ (6.91 %), T₃ (6.78 %), T₆ (6.45 %) showed intermediate effect. The minimum number of fruit set per cent at marble stage (5.19 %) was obtained under the treatment (T₉).

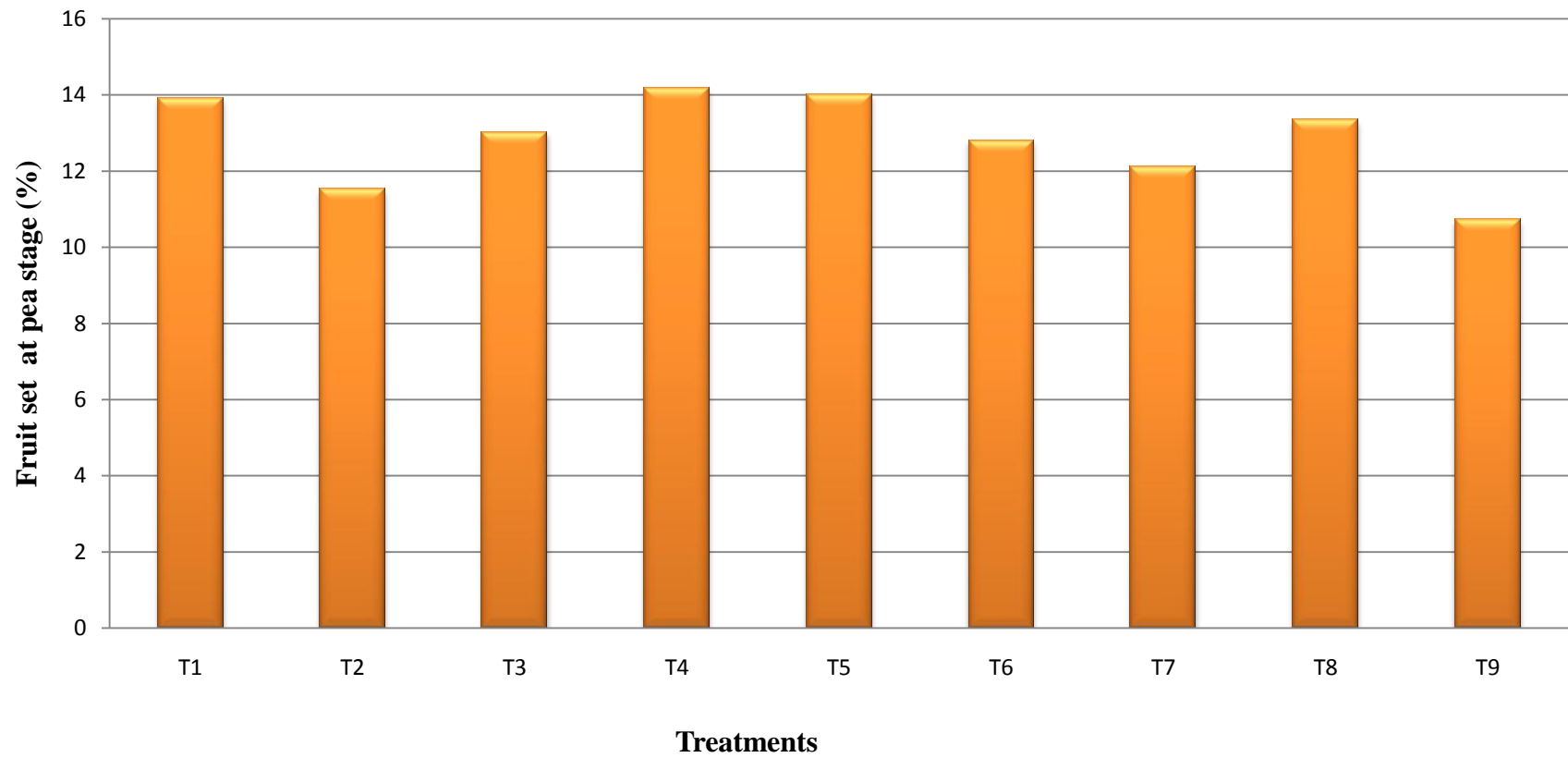


Fig. 4.13: Effect of plant growth regulators and chemicals on fruit set at pea stage (%) of mango var. Kesar

Maximum fruit set per cent at marble stage was observed in treatment T₄ (triacontanol 750 mg/l) *i.e.* (7.52 %), because triacontanol reduces synthesis of ABA and abscission layer at fruit neck hence reduce fruit drop. And minimum fruit set at marble stage was observed in treatment T₉ *i.e.* (5.19 %). The results obtained in the present study is in agreement with that reported by Sudha *et al.* (2012) and Momin *et al.* (2016) in mango. Patil *et al.* (2005) in guava.

Table 4.14 Effect of plant growth regulators and chemicals on fruit set at marble stage (%) of mango var. Kesar

Treatment No.	Treatments	Fruit set at marble stage (%)
T ₁	GA ₃ 35 ppm	7.23 (15.59)
T ₂	CPPU 5 ppm	5.89 (14.04)
T ₃	CPPU 10 ppm	6.78 (15.09)
T ₄	Triaccontanol 750 mg/l	7.52 (15.91)
T ₅	NAA 50 ppm	7.44 (15.82)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	6.45 (14.71)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	6.30 (14.53)
T ₈	NAA 25 ppm+ Borax 0.2 %	6.91 (15.24)
T ₉	Control (No treatment)	5.19 (13.16)
S.E.(m±)		0.01
C.D. at 5 %		0.03

(* Figure in parenthesis denotes angular transformation of percent values)

4.2.7 Effect of plant growth regulators and chemicals on fruit drop (%) of mango var. Kesar

The data regarding fruit drop per cent as affected by various treatments is presented in Table 4.15 and depicted in Fig. 4.15. The responses to the application of different plant growth regulators and chemical treatments regarding the fruit drop were significant.

The data clearly reported that the minimum fruit drop per cent (86.66 %) was recorded under the treatment T₄ *i.e.* (triacontanol 750 mg/l), which was superior over control and it was at par with treatment T₅ *i.e.* (86.79 %).

It was followed by the treatments T₁ (87.42 %), T₈ (88.04 %), T₃ (89.48 %). Next best treatments was treatment T₆ (90.49 %), T₇ (91.9 %), T₂ (92.59 %). The maximum fruit drop (95.18 %) was noticed under treatment (T₉) *i.e.* control.

Minimum fruit drop was observed in treatment T₄ (triacontanol 750 mg/l) *i.e.* (86.66 %) because triacontanol aids reduce synthesis of ABA and abscission promoters resulting reduces fruit drop. The similar finding was reported by Momin *et al.* (2016).

Table 4.15 Effect of plant growth regulators and chemicals on fruit drop (%) of mango var. Kesar

Treatment No.	Treatments	Fruit drop (%)
T ₁	GA ₃ 35 ppm	87.42 (69.22)
T ₂	CPPU 5 ppm	92.59 (74.20)
T ₃	CPPU 10 ppm	89.48 (71.07)
T ₄	Triaccontanol 750 mg/l	86.66 (68.57)
T ₅	NAA 50 ppm	86.79 (68.68)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	90.49 (72.03)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	91.9 (73.46)
T ₈	NAA 25 ppm+ Borax 0.2 %	88.04 (69.76)
T ₉	Control (No treatment)	95.18 (77.31)
S.E.(m±)		0.06
C.D. at 5 %		0.19

(* Figure in parenthesis denotes angular transformation of percent values)

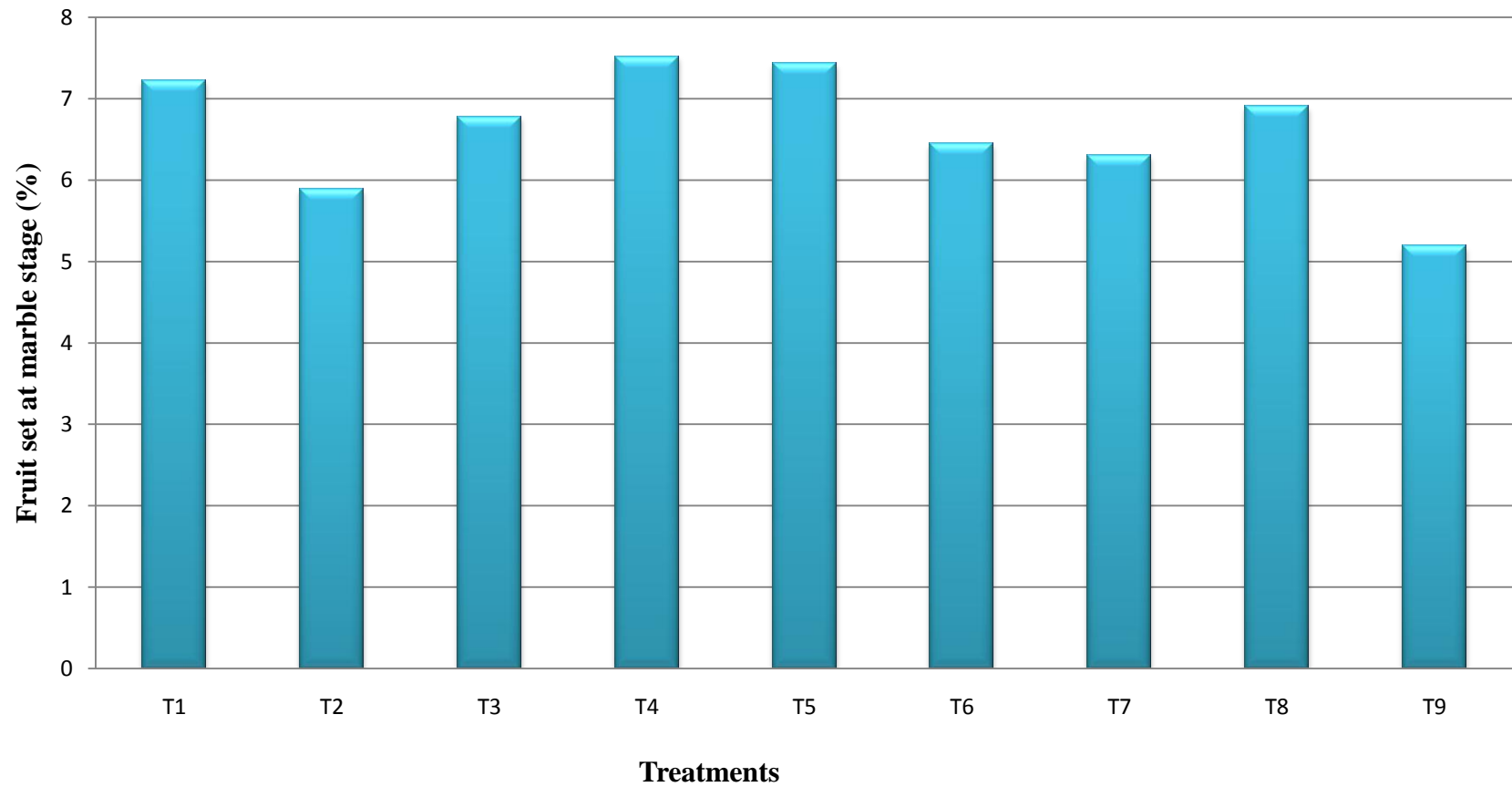


Fig. 4.14: Effect of plant growth regulators and chemicals on fruit set at marble stage (%) of mango var. Kesar

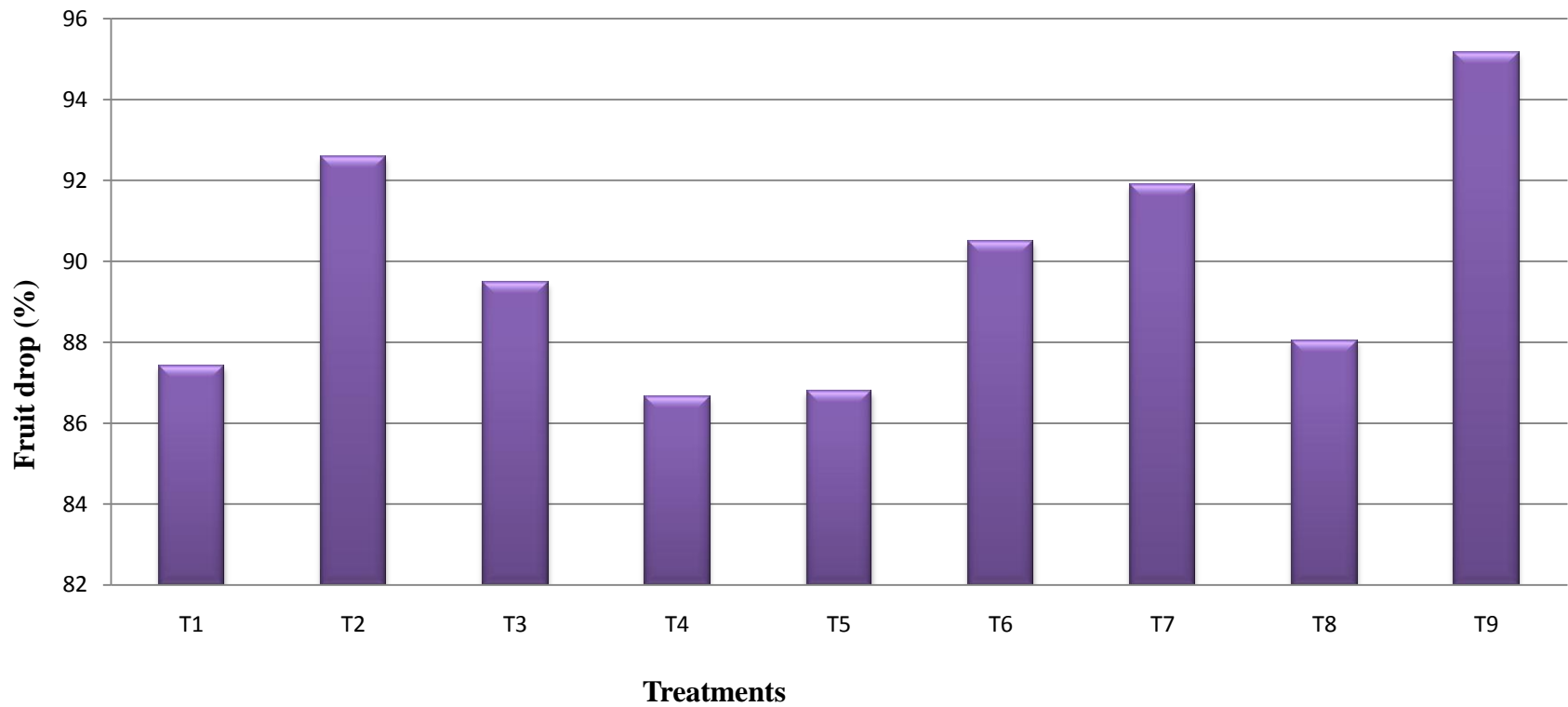


Fig. 4.15 : Effect of plant growth regulators and chemicals on fruit drop (%) of mango var. Kesar

4.2.8 Effect of plant growth regulators and chemicals on yield per plant (kg) of mango var. Kesar

The results pertaining to yield per plant as affected by different treatments are presented Table 4.16 and depicted in Fig. 4.16. The results obtained in this regard were significant.

The maximum yield per plant (23.67 kg) was obtained in the treatment T₄ *i.e.* (triacentanol 750 mg/l), which was superior over control. It was followed by treatments T₅ (22.61 kg), T₁ (20.63 kg). Next best treatments were treatment T₈ (19.66 kg), which was at par with T₃ (18.90 kg). Treatments T₆ (17.92 kg) and T₇ (16.24 kg) showed intermediate effect. The minimum yield per plant (12.63 kg) was obtained under the treatment T₉. *i.e.* control.

The treatment T₄ (triacentanol 750 mg/l) had significantly maximum yield *i.e.* (23.67 kg). This might be due to photosynthetic rate and rate of accumulation of carbohydrates in fruit is higher since yield was increased comparative to control treatment. Parauha and Pandey (2019) in mango. The result of present study was supported by Neem and Khan *et al.* (2011).

Table 4.16 Effect of plant growth regulators and chemicals on yield per plant (kg) of mango var. Kesar

Treatment No.	Treatments	Yield/plant (kg)
T ₁	GA ₃ 35 ppm	20.63
T ₂	CPPU 5 ppm	15.00
T ₃	CPPU 10 ppm	18.90
T ₄	Triacantanol 750 mg/l	23.67
T ₅	NAA 50 ppm	22.61
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	17.92
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	16.24
T ₈	NAA 25 ppm+ Borax 0.2 %	19.66
T ₉	Control (No treatment)	12.63
S.E.(m±)		0.29
C.D. at 5%		0.88

4.2.9 Effect of plant growth regulators and chemicals on yield per ha (t/ha) of mango var. kesar

The data regarding yield per ha as affected by various treatments is presented in Table 4.17 and illustrated in Fig. 4.17. The responses to the application of different plant growth regulators and chemical treatments regarding the yield per ha were significant.

The data clearly indicated that the maximum yield per ha (11.83 t/ha) was recorded under the treatment T₄ *i.e.* (triacantanol 750 mg/l), which was superior over control. It was followed by treatment T₅ (11.30 t/ha) and T₁ (10.31 t/ha). Next best treatments were T₈ (9.83 t/ha) and T₃ (9.45 t/ha) which were at par with each other. The treatments T₆ (8.96 t/ha), T₇ (8.12 t/ha), T₂ (7.50 t/ha) which was showed

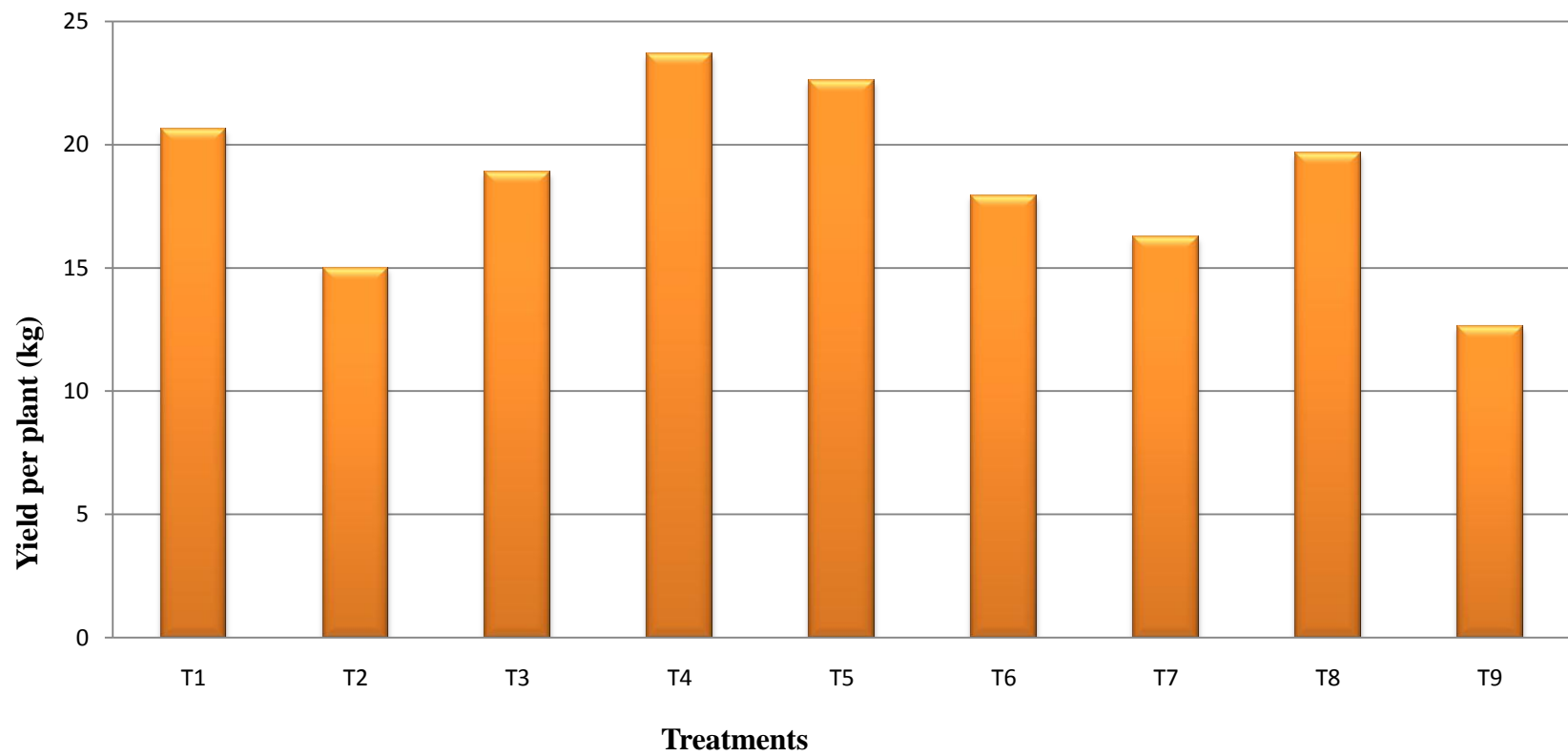


Fig. 4.16: Effect of plant growth regulators and chemicals on yield per plant (kg) of mango var. Kesar

intermediate result among treatments. The minimum yield (6.32 t/ha) was noticed under treatment T₉ *i.e.* control.

The treatment T₄ (triacontanol 750 mg/l) had significantly maximum yield *i.e.* (11.83 t/ha). This might be due to photosynthetic rate and rate of accumulation of carbohydrates in fruit is higher since yield is increased comparative to control treatment, and minimum yield observed treatment T₉ *i.e.* (6.32). Similar result were found by Amarcholi *et al.* (2016) in mango. Sharma *et al.* (2008) in apple and Kumar *et al.* (2012) in strawberry.

Table 4.17 Effect of plant growth regulators and chemicals on yield (t/ha) of mango var. Kesar

Treatment No.	Treatments	Yield (t/ha)
T ₁	GA ₃ 35 ppm	10.31
T ₂	CPPU 5 ppm	7.50
T ₃	CPPU 10 ppm	9.45
T ₄	Triaccontanol 750 mg/l	11.83
T ₅	NAA 50 ppm	11.30
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	8.96
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	8.12
T ₈	NAA 25 ppm+ Borax 0.2 %	9.83
T ₉	Control (No treatment)	6.32
S.E.(m±)		0.15
C.D. at 5%		0.44

4.3 Quality or chemical parameters observations

4.3.1 Total soluble solids (%)

The data regarding total soluble solids as affected by various treatments is presented in Table 4.18 and depicted in Fig. 4.18. The responses to the application of different plant growth regulators and chemical treatments regarding the total soluble solids were significant.

The data clearly indicated that, the maximum total soluble solids (18.7 %) was recorded under the treatment T₁ *i.e.* (GA₃ 35 ppm), which was superior over rest of the treatments. It was followed by treatment T₅ (NAA 50 ppm) *i.e.* (18.4 %). The next best treatment was treatment T₄ (triacontanol 750 mg/l) *i.e.* (18.08 %) which was statistically at par with treatment T₃ (CPPU 10 ppm) *i.e.* (17.91 %). Treatment T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (17.66 %) which was statistically at par with T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (17.55 %) showed intermediate effect. The minimum total soluble solids (16.3 %) was noticed under T₉ treatment.

The maximum total soluble solids reported under treatment T₁ (GA₃ 35 ppm) *i.e.* (18.7 %). This might be due to, during ripening hydrolysis of polysaccharides, conversion of organic acid in soluble sugars and enhanced solubilisation of insoluble starch and pectin present in cell wall and middle lamella. Similar results were found by Bhalekar *et al.* (2016) in kesar mango, Sharma *et al.* (2008) in apple.

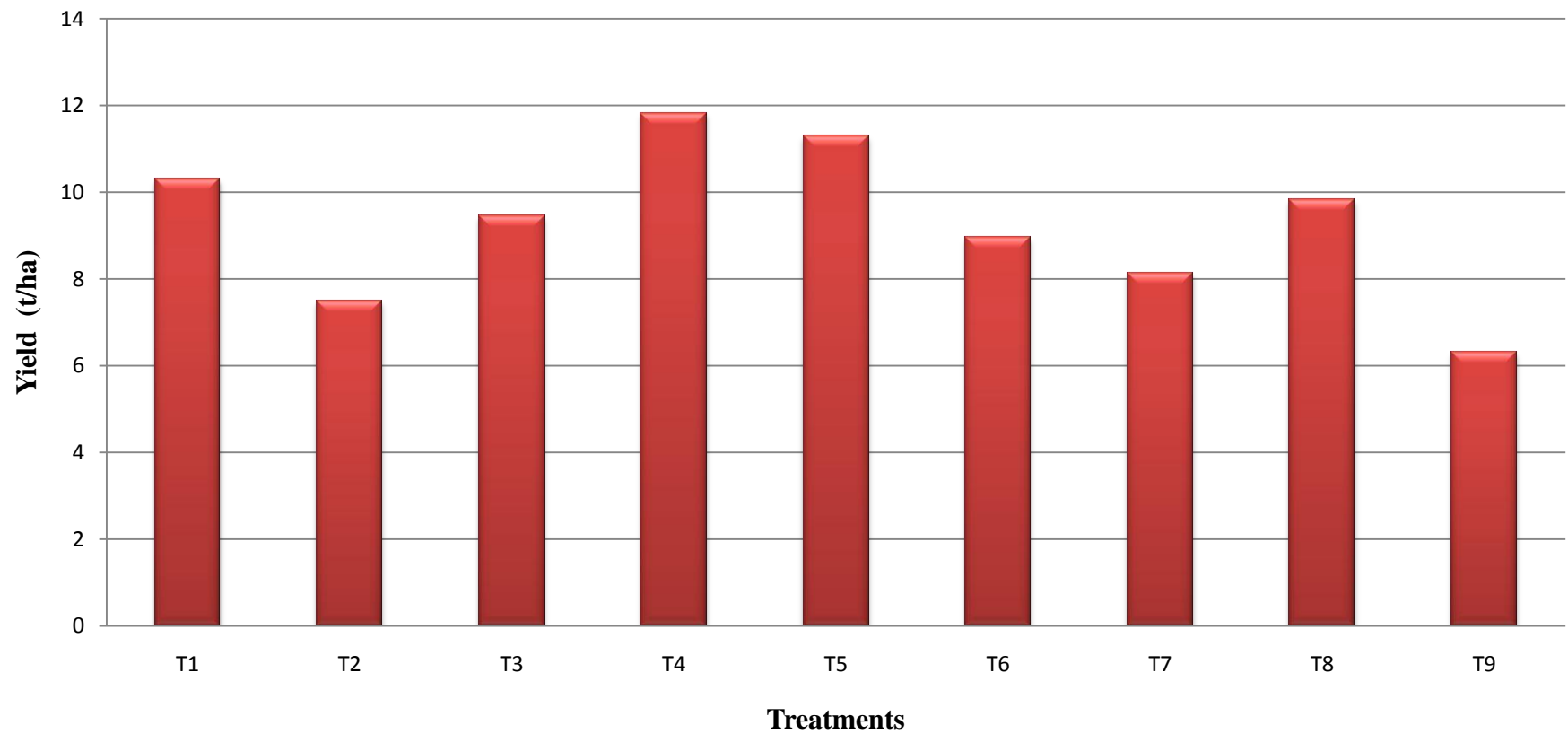


Fig. 4.17: Effect of plant growth regulators and chemicals on yield (t/ha) of mango var. Kesar

Table 4.18 Effect of plant growth regulators and chemicals on total soluble solids (%) of mango var. Kesar

Treatment No.	Treatments	Total Soluble Solid (%)
T ₁	GA ₃ 35 ppm	18.7 (25.62)
T ₂	CPPU 5 ppm	16.77 (24.17)
T ₃	CPPU 10 ppm	17.91 (25.03)
T ₄	Triaccontanol 750 mg/l	18.08 (25.16)
T ₅	NAA 50 ppm	18.4 (25.40)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	17.66 (24.84)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	17.55 (24.76)
T ₈	NAA 25 ppm+ Borax 0.2 %	17.37 (24.63)
T ₉	Control (No treatment)	16.3 (23.81)
S.E.(m±)		0.08
C.D. at 5 %		0.23

(* Figure in parenthesis denotes angular transformation of percent values)

4.3.2 Titratable acidity (%)

The results pertaining to titratable acidity of riped fruit was affected by different treatments are presented Table 4.19 and depicted in Fig. 4.19 the results obtained in this regard were significant.

Minimum titratable acidity was reported under the treatment T₁ (GA₃ 35 ppm) *i.e.* (0.25 %) which was statistically at par with T₅ (NAA 50 ppm). It was followed by treatment T₃ (0.26 %), T₈ (0.27 %), T₆ (0.27 %), T₄ (0.27 %). Treatment T₇ and T₂ showed intermediate effect. Treatment T₉ *i.e.* (0.29 %) which showed highest titratable acidity among all the treatments.

Minimum titratable acidity obtained in treatment T₁ (GA₃ 35ppm) *i.e.* (0.25 %) This might be due to higher accumulation of sugars, better translocation of sugar into fruit tissue and conversion of organic acid into sugars, resulting increases total soluble

solids and ultimately acidity was reduced. Results are agreement with Beniwal *et al.* (1992), and Bhalekar *et al.* (2016) in mango.

Table 4.19 Effect of plant growth regulators and chemicals on titratable acidity (%) of mango var. kesar

Treatment No.	Treatments	Titratable acidity (%)
T ₁	GA ₃ 35 ppm	0.25 (2.86)
T ₂	CPPU 5 ppm	0.28 (3.03)
T ₃	CPPU 10 ppm	0.26 (2.92)
T ₄	Triacantanol 750 mg/l	0.27 (2.97)
T ₅	NAA 50 ppm	0.25 (2.86)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	0.27 (2.97)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	0.28 (3.03)
T ₈	NAA 25 ppm+ Borax 0.2 %	0.27 (2.97)
T ₉	Control (No treatment)	0.29 (3.08)
S.E.(m±)		0.004
C.D. at 5 %		0.012

(* Figure in parenthesis denotes angular transformation of percent values)

4.3.3 Total sugar (%)

The data regarding total sugar affected by various treatments are presented in Table 4.20 and depicted in Fig. 4.20. The responses to the application of different plant growth regulators and chemical treatments regarding the total sugar were significant.

The data clearly revealed that, significantly maximum total sugars (15.20 %) was recorded under the treatment T₁ *i.e.* (GA₃ 35 ppm). It was followed by treatments T₅ (14.78 %), T₄ (14.4 %), T₃ (13.89 %) and T₈ (13.35 %). Treatment T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (13.15 %) which was statistically at par with treatment T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (12.97 %).

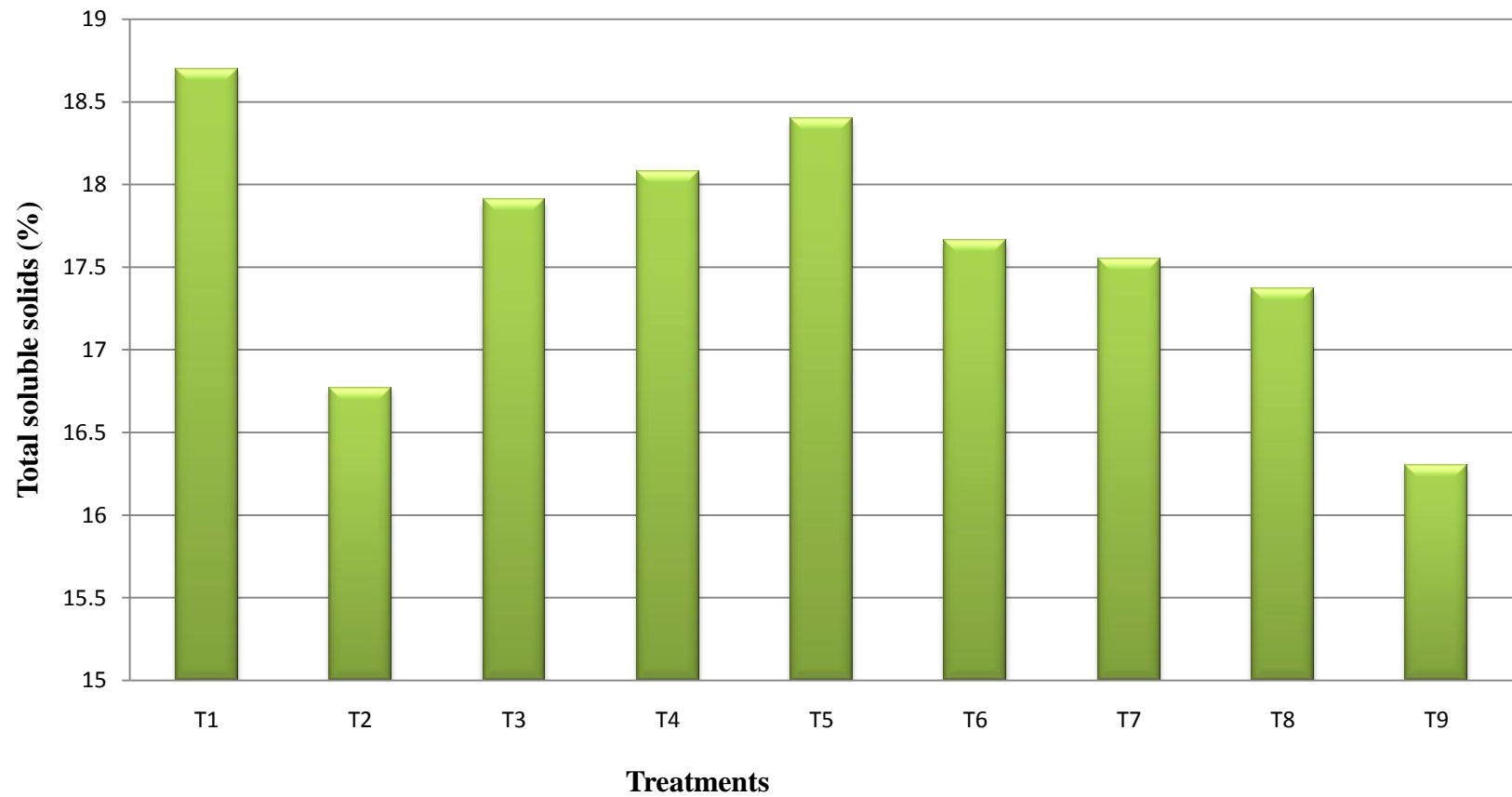


Fig. 4.18: Effect of plant growth regulators and chemicals on total soluble solids (%) of mango var. Kesar

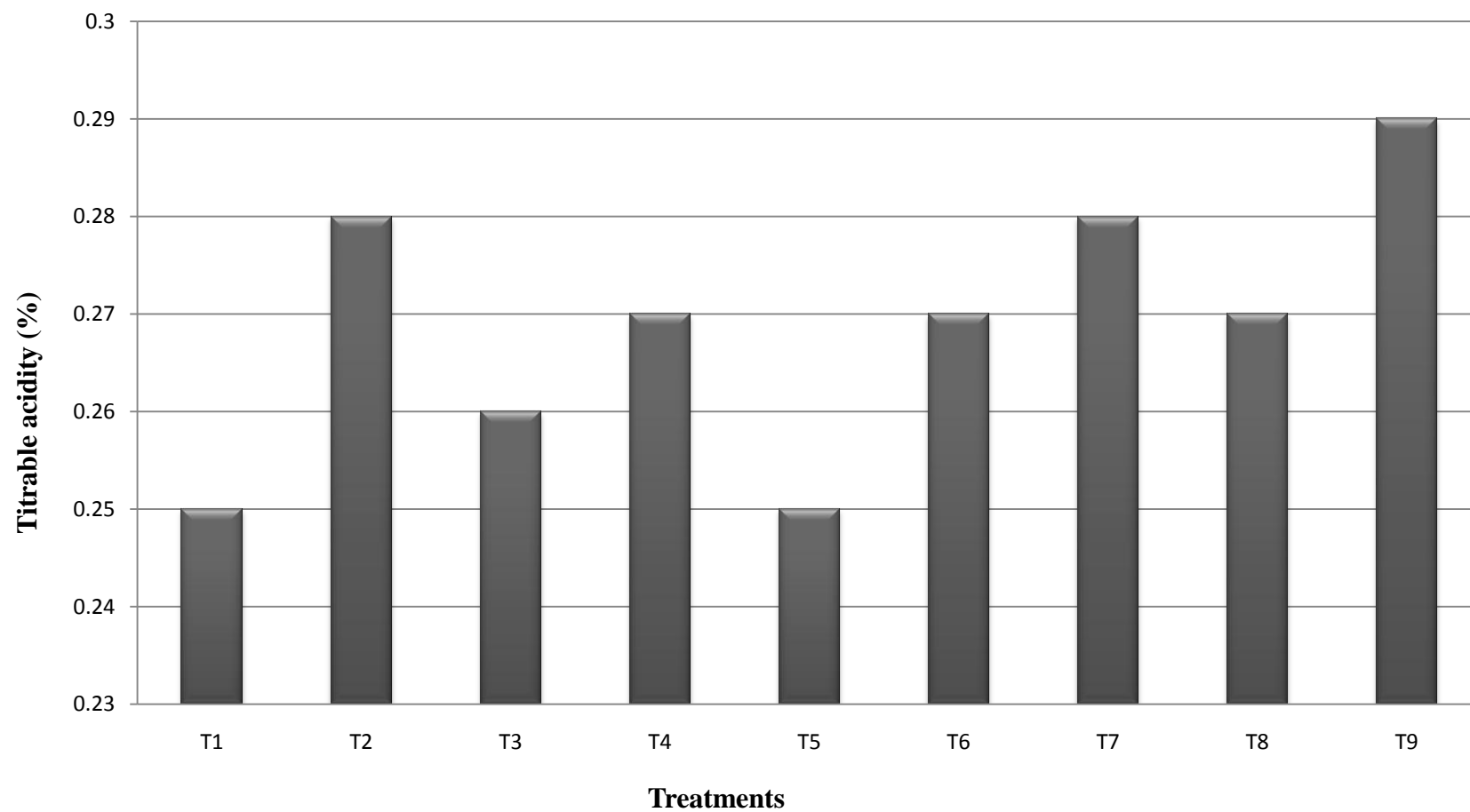


Fig. 4.19: Effect of plant growth regulators and chemicals on titrable acidity (%) of mango var. Kesar

Treatments T₅ (NAA 50 ppm) *i.e.* (14.78 %), T₄ (triacontanol 750 mg/l) *i.e.* (14.4 %), T₃ (CPPU 10 ppm) *i.e.* (13.89 %), T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (13.35 %), T₂ (CPPU 5 ppm) *i.e.* (12.84 %) was showed intermediate effect.

The minimum total sugar (12.48 %) was noticed under control (T₉), Among the different treatments total sugar observed in treatment T₁ (GA₃ 35 ppm) had the highest total sugar *i.e.* (15.20 %), because involvement of GA₃ in the breakdown of organic acid into sugars at the time of fruit ripening.

According to Krishnamoorthy (2015), gibberellins actively participate in the hydrolysis of sucrose and starch, it play crucial role in the sugar metabolism of fruit. In treatment T₁ (GA₃ 35 ppm) showed maximum total sugar (15.20 %). Similar result were reported by Kulkarni *et al.* (2017) in mango, Mehata *et al.* (1990) in apricot, Singh *et al.* (1996) in litchi.

Table 4.20 Effect of plant growth regulators and chemicals on total sugar (%) of mango var. Kesar

Treatment No.	Treatments	Total sugar (%)
T ₁	GA ₃ 35 ppm	15.20 (22.94)
T ₂	CPPU 5 ppm	12.84 (20.99)
T ₃	CPPU 10 ppm	13.89 (21.88)
T ₄	Triacontanol 750 mg/l	14.4 (22.30)
T ₅	NAA 50 ppm	14.78 (22.60)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	12.97 (21.10)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	13.15 (21.26)
T ₈	NAA 25 ppm+ Borax 0.2 %	13.35 (21.43)
T ₉	Control (No treatment)	12.48 (20.68)
S.E.(m±)		0.061
C.D. at 5 %		0.19

4.3.4 Reducing sugar (%)

The observation recorded in respect of reducing sugar was affected by various treatments is presented in Table 4.21 and depicted in Fig. 4.21. The responses to the application of different plant growth regulators and chemical treatments regarding the reducing sugar were significant.

The data revealed that, the maximum reducing sugar (4.57 %) was recorded under the treatment T₁ *i.e.* (GA₃ 35 ppm), which was superior over control and it was statistically at par with treatment T₅ (NAA 50 ppm) *i.e.* (4.44 %). It was followed by treatment T₄ (4.33 %), T₃ (4.17 %), T₈ (4.17 %). The next best treatment was T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (4.05 %), which was statistically at par with T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (3.99 %). The minimum reducing sugar (3.84 %) was noticed under control treatment.

Treatment T₁ (GA₃ 35 ppm) showed maximum reducing sugar (4.57 %) This might be due to conversion of starch and polysaccharides into simple sugar with the advancement of storage was responsible for the increases the reducing sugar, (Kahlon and Uppal, 2005). Similar result were finding by Kulkarni *et.al.* (2017), Jindal and Dwivedi (1986) in plum.

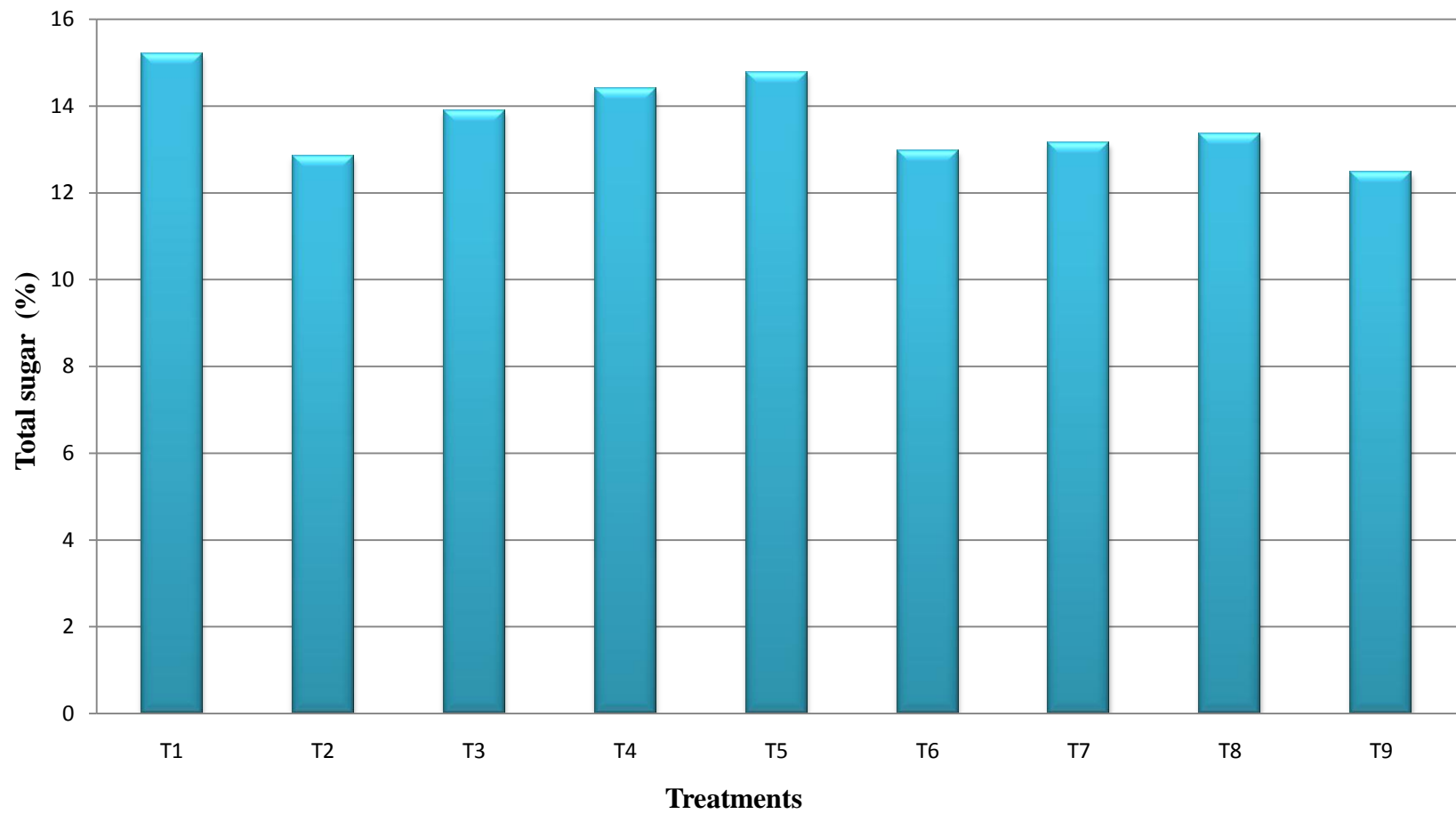


Fig. 4.20: Effect of plant growth regulators and chemicals on total sugar (%) of mango var. Kesar

Table 4.21 Effect of plant growth regulators and chemicals on reducing sugar (%) of mango var. Kesar

Treatment No.	Treatments	Reducing sugar (%)
T ₁	GA ₃ 35 ppm	4.57 (12.34)
T ₂	CPPU 5 ppm	3.86 (11.33)
T ₃	CPPU 10 ppm	4.17 (11.78)
T ₄	Triacantanol 750 mg/l	4.33 (12.01)
T ₅	NAA 50 ppm	4.44 (12.16)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	3.99 (11.52)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	4.05 (11.60)
T ₈	NAA 25 ppm+ Borax 0.2 %	4.17 (11.78)
T ₉	Control (No treatment)	3.84 (11.30)
S.E.(m±)		0.05
C.D. at 5 %		0.16

(* Figure in parenthesis denotes angular transformation of percent values)

4.3.5 Non reducing sugar (%)

The results pertaining to non reducing sugar affected by various treatments are presented in Table 4.22 and depicted in Fig. 4.22. The responses to the application of different plant growth regulators and chemical treatments regarding the non reducing sugar were significant.

The data clearly indicated that, the significantly maximum non reducing sugar (10.63 %) was recorded under the treatment T₁ *i.e.* (GA₃ 35 ppm). It was followed by treatment T₅, (10.34 %), T₄ (10.07 %), T₃ (9.71 %). Treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (9.18 %) which was statistically at par with treatment T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (9.10 %) showed intermediate effect.

The minimum non reducing sugar (8.64 %) was noticed under treatment control. similar result was finding by Kulkarni *et al.* (2017).

Table 4.22 Effect of plant growth regulators and chemicals on non reducing sugar (%) of mango var. Kesar

Treatment No.	Treatments	Non reducing sugar (%)
T ₁	GA ₃ 35 ppm	10.63 (19.02)
T ₂	CPPU 5 ppm	8.98 (17.43)
T ₃	CPPU 10 ppm	9.71 (18.15)
T ₄	Triaccontanol 750 mg/l	10.07 (18.50)
T ₅	NAA 50 ppm	10.34 (18.75)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	8.98 (17.43)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	9.10 (17.55)
T ₈	NAA 25 ppm+ Borax 0.2 %	9.18 (17.63)
T ₉	Control (No treatment)	8.64 (17.09)
S.E.(m±)		0.10
C.D. at 5 %		0.29

(* Figure in parenthesis denotes angular transformation of percent values)

4.3.6 TSS:Acid ratio

The data revealed that, the tss:acid ratio affected by various treatments is presented in Table 4.23 and depicted in Fig. 4.23 The responses to the application of different plant growth regulators and chemical treatments regarding the tss:acid ratio were significant.

The data pertaining to the significantly maximum tss:acid ratio (74.8) was recorded under the treatment T₁ *i.e.* (GA₃ 35 ppm), it was followed by treatment T₅ (73.6). The next best treatment was T₃ (CPPU 10 ppm) *i.e.* (68.88) T₄ (66.96), T₆ (65.41) which were at par with each other. Treatment T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (62.68) was statistically at par with treatment T₈ (NAA 25 ppm + Borax 0.2) *i.e.* (64.33) showed intermediate effect. The minimum tss:acid ratio (56.21) was noticed under control treatment.

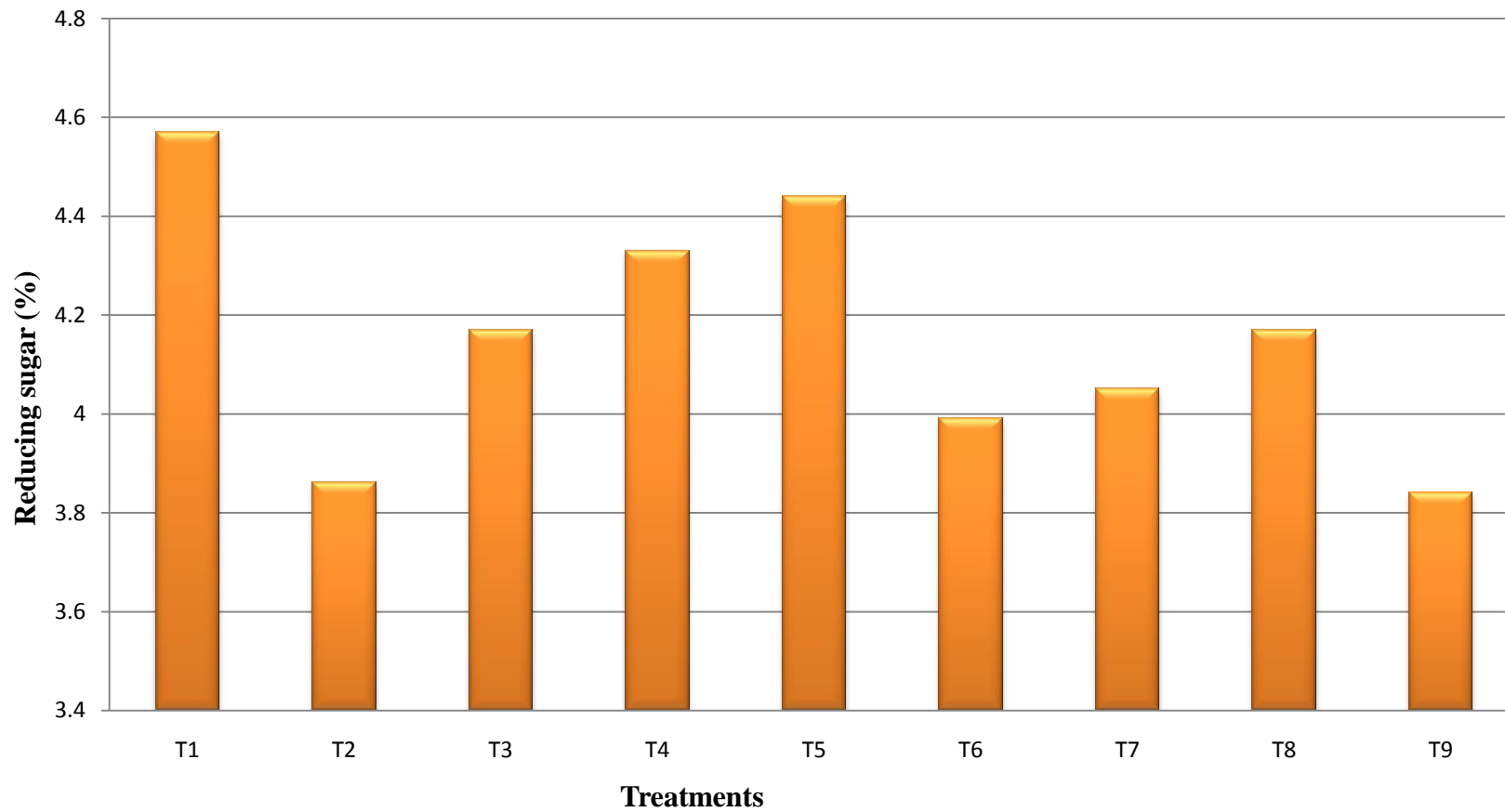


Fig. 4.21: Effect of plant growth regulators and chemicals on reducing sugar (%) of mango var. Kesar

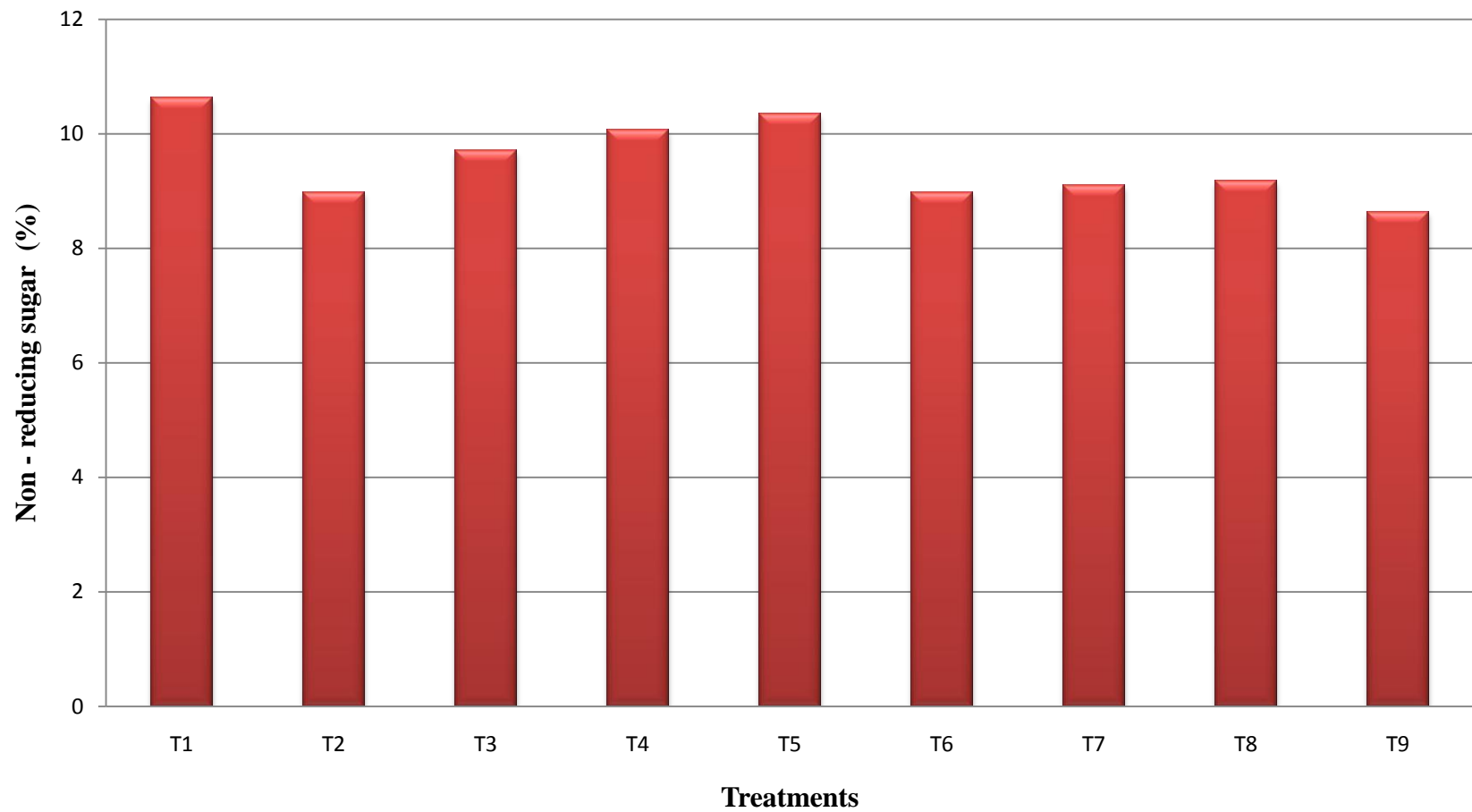


Fig. 4.22: Effect of plant growth regulators and chemicals on non reducing sugar (%) of mango var. Kesar

The result obtained under present study was in accordance with Kumari *et.al.* (2020) in mango.

Table 4.23 Effect of plant growth regulators and chemicals on TSS:Acid ratio of mango var. Kesar

Treatment No.	Treatments	TSS:Acid ratio
T ₁	GA ₃ 35 ppm	74.8
T ₂	CPPU 5 ppm	59.89
T ₃	CPPU 10 ppm	68.88
T ₄	Triacantanol 750 mg/l	66.96
T ₅	NAA 50 ppm	73.6
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	65.41
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	62.68
T ₈	NAA 25 ppm+ Borax 0.2 %	64.33
T ₉	Control (No treatment)	56.21
S.E.(m±)		0.77
C.D. at 5 %		2.34

4.3.7 Ascorbic acid content (mg/100 gram)

The data regarding ascorbic acid content affected by various treatments is presented in Table 4.24 and depicted in Fig. 4.24. The responses to the application of different plant growth regulators and chemical treatments regarding the ascorbic acid were significant.

The data clearly indicated that, the maximum ascorbic acid content observed under the treatment T₈ *i.e.* (NAA 25 ppm + Borax 0.2 %) *i.e.* (46.38), which was statistically at par with treatment T₆ (46.14), T₄ (45.74), and T₅ (45.68). The next best treatment was T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (44.26), which was statistically at

par with treatment T₃ (44.19), T₁ (43.77) and T₂ (43.29). The minimum ascorbic acid content (42.24) was noticed under treatment control *i.e.* (T₉).

Maximum ascorbic acid content observed under treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (46.38), This might be due to catalytic influence of growth regulators on its bio-synthesis from its precursor glucose-6-phosphates throughout the development of fruit which is throughout to be the precursor of vitamin C. Similar trend were found by Chovatiya *et al.* (2015) in mango, Sud and Thakur (1999) in peach, Singh *et al.* (1996) in litchi.

Table 4.24 Effect of plant growth regulators and chemicals on ascorbic acid content (mg/100 g) of mango var. Kesar

Treatment No.	Treatments	Ascorbic acid content (mg/100 gram)
T ₁	GA ₃ 35 ppm	43.77
T ₂	CPPU 5 ppm	43.29
T ₃	CPPU 10 ppm	44.19
T ₄	Triacantanol 750 mg/l	45.74
T ₅	NAA 50 ppm	45.68
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	46.14
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	44.26
T ₈	NAA 25 ppm+ Borax 0.2 %	46.38
T ₉	Control (No treatment)	42.24
S.E.(m±)		0.34
C.D. at 5 %		1.02

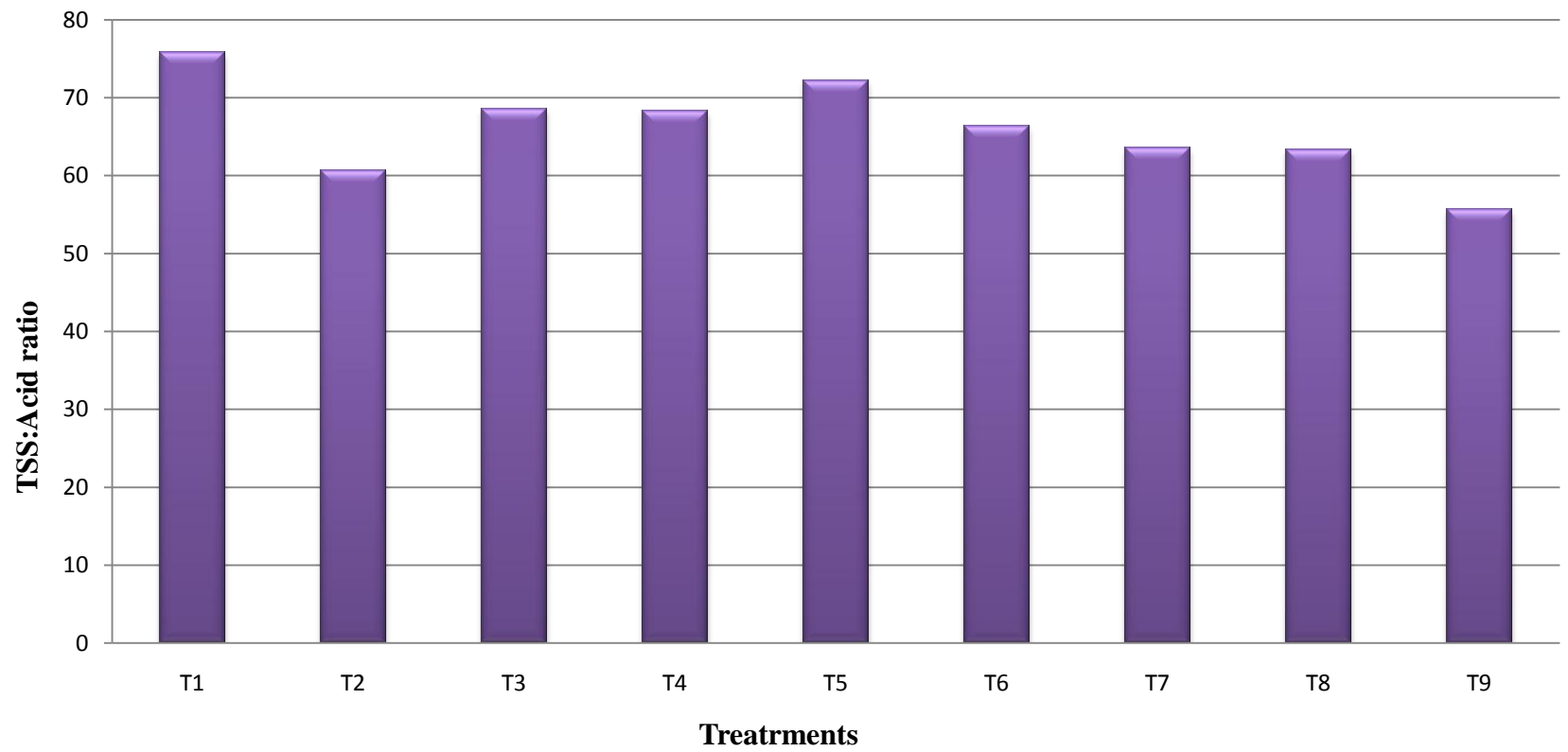


Fig. 4.23: Effect of plant growth regulators and chemicals on TSS:Acid ratio of mango var. Kesar

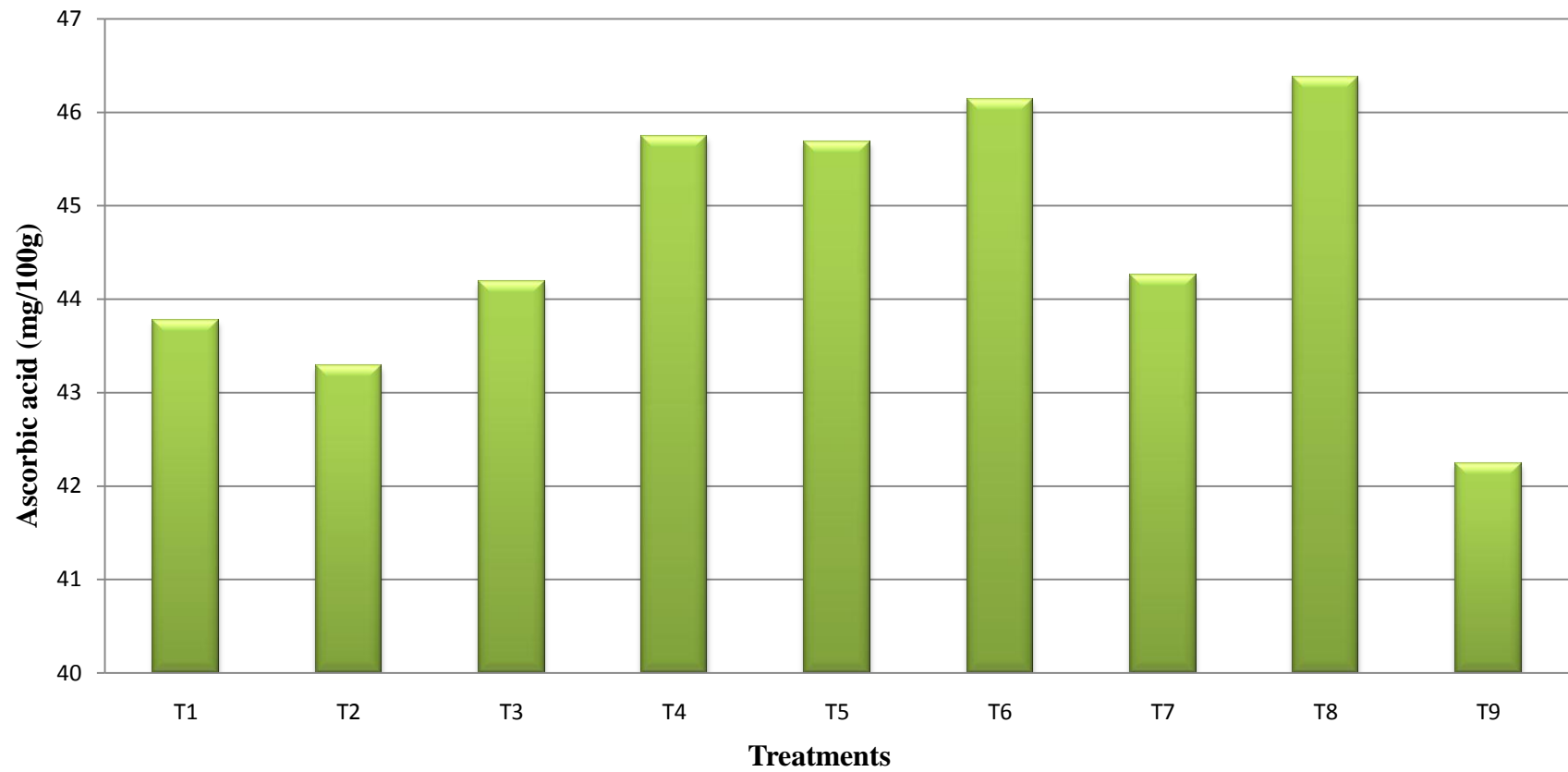


Fig. 4.24: Effect of plant growth regulators and chemicals on ascorbic acid content (mg/100 g) of mango var. Kesar

4.3.8 Ripe fruit weight (g)

The results pertaining to weight of ripe fruit as affected by different treatments are presented Table 4.25 and depicted in Fig. 4.25. The results obtained in this regard were significant.

The maximum weight of ripe fruit (252.67 g) was obtained in the treatment T₄ *i.e.* (triacontanol 750 mg/l), which was superior over control. It was followed by treatment T₅ (NAA 50 ppm) *i.e.* (249 g).

Treatments T₁ (GA₃ 35 ppm) *i.e.* (246.67 g) which was statistically at par with treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (243.33 g). The next best treatment was T₃ (CPPU 10 ppm) *i.e.* (241 g) was statistically at par with T₆ (NAA 25 ppm + ZnSO₄ 0.5 %) *i.e.* (239 g). Treatment T₇ (NAA 25 ppm + FeSO₄ 0.5 %) *i.e.* (236.33 g) and T₂ (233.67 g) showed intermediate effect. The minimum weight of ripe fruit (228 g) was noticed under control treatment.

The results are in accordance with the finding of Sharma *et al* (1990), Patel (1991), Hairdry *et al.* (1997), Shinde *et al.* (2006), and Dheeraj *et al.* (2016) in mango.

Table 4.25 Effect of plant growth regulators and chemicals on ripe fruit weight of mango var. Kesar

Treatment No.	Treatments	Ripe fruit weight (g)
T ₁	GA ₃ 35 ppm	246.67
T ₂	CPPU 5 ppm	233.67
T ₃	CPPU 10 ppm	241.00
T ₄	Triacantanol 750 mg/l	252.67
T ₅	NAA 50 ppm	249.00
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	239.00
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	236.33
T ₈	NAA 25 ppm+ Borax 0.2 %	243.33
T ₉	Control (No treatment)	228.00
S.E.(m±)		1.19
C.D. at 5 %		3.60

4.3.9 Physiological loss of fruit weight (%)

The data regarding physiological weight loss of fruit affected by various treatments is presented in Table 4.26 and depicted in Fig. 4.26. The responses to the application of different plant growth regulators and chemical treatments regarding the physiological loss of fruit weight were significant.

The data clearly reported that, the minimum weight loss (6.41 %) was recorded under the treatment T₄ *i.e.* (triacantanol 750 mg/l), which was statistically at par with T₅ (NAA 50 ppm) *i.e.* (6.74 %) and T₁ (GA₃ 35 ppm) *i.e.* (7.16 %). The next best treatment was treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (7.59 %) which was statistically at par with treatment T₃ (7.78), T₆ (7.96 %), T₂ (8.13 %) and T₇ (8.29 %).

Maximum fruit weight loss observed under treatment control (T₉).

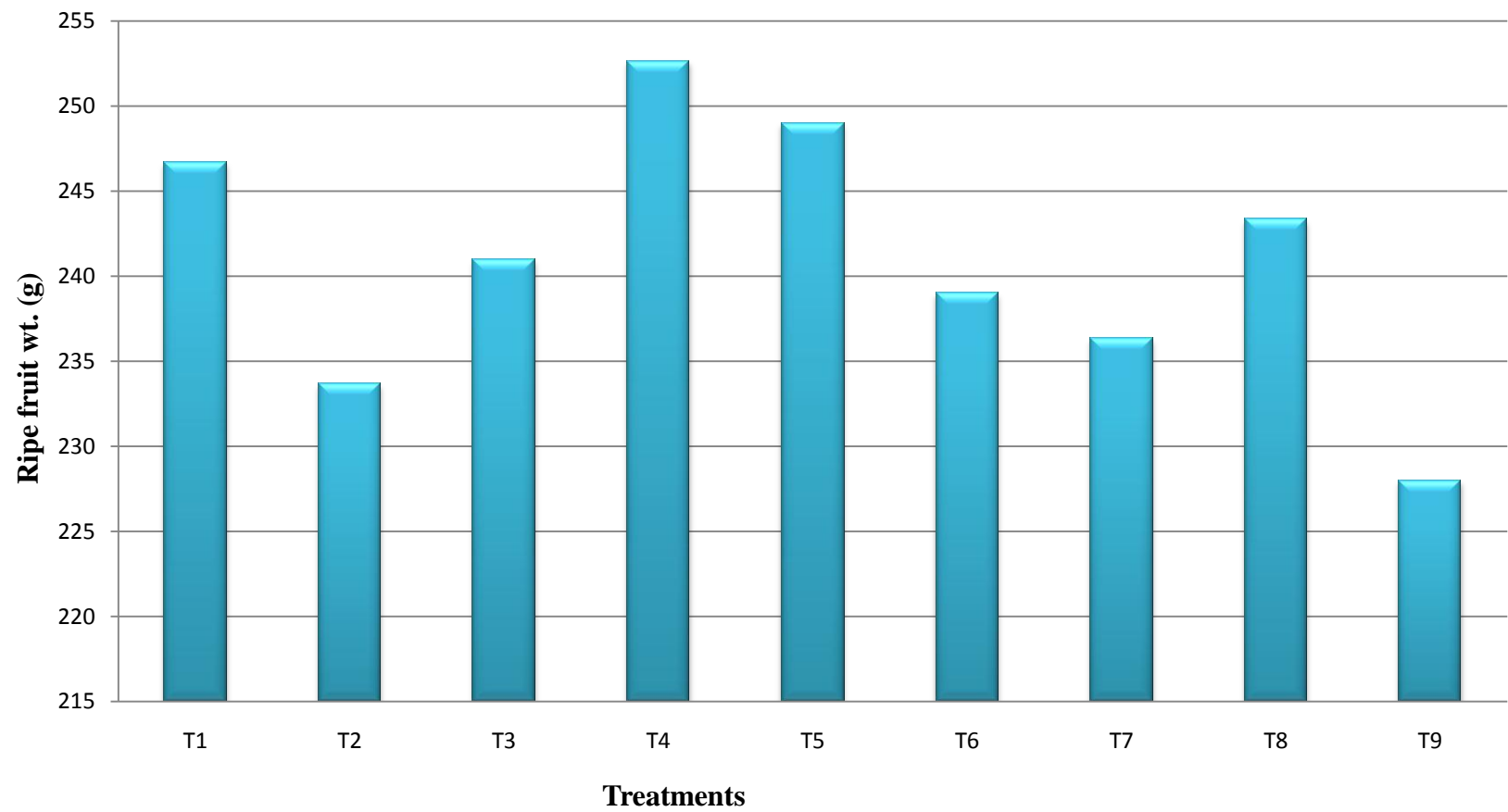


Fig. 4.25: Effect of plant growth regulators and chemicals on ripe fruit weight of mango var. Kesar

According to Makwana *et al.* (2014) weight loss depends on, reduction in rate of respiration and evapotranspiration as well delaying in ripening due to restricted ethylene accumulation in the treated fruits. Similar results are in agreement with Thupten Tsomu (2019).

Table 4.26 Effect of plant growth regulators and chemicals on physiological loss of fruit weight (%) of mango var. Kesar

Treatment No.	Treatments	Fruit weight (g) (Initial/unripe stage)	Ripe fruit weight (g)	Physiological loss of fruit weight (%)
T ₁	GA ₃ 35 ppm	265.67	246.67	7.16 (15.52)
T ₂	CPPU 5 ppm	254.33	233.67	8.13 (16.56)
T ₃	CPPU 10 ppm	261.33	241.00	7.78 (16.19)
T ₄	Triacontanol 750mg/l	270.00	252.67	6.41 (14.66)
T ₅	NAA 50 ppm	267.00	249.00	6.74 (15.04)
T ₆	NAA 25 ppm + ZnSO ₄ 0.5 %	259.67	239.00	7.96 (16.38)
T ₇	NAA 25 ppm + FeSO ₄ 0.5 %	257.67	236.33	8.29 (16.73)
T ₈	NAA 25 ppm + Borax 0.2 %	263.33	243.33	7.59 (15.99)
T ₉	Control (No treatment)	251.00	228.00	9.16 (17.61)
S.E.(m±)		1.2	1.19	0.30
C.D. at 5 %		3.63	3.60	0.90

(* Figure in parenthesis denotes angular transformation of percent values)

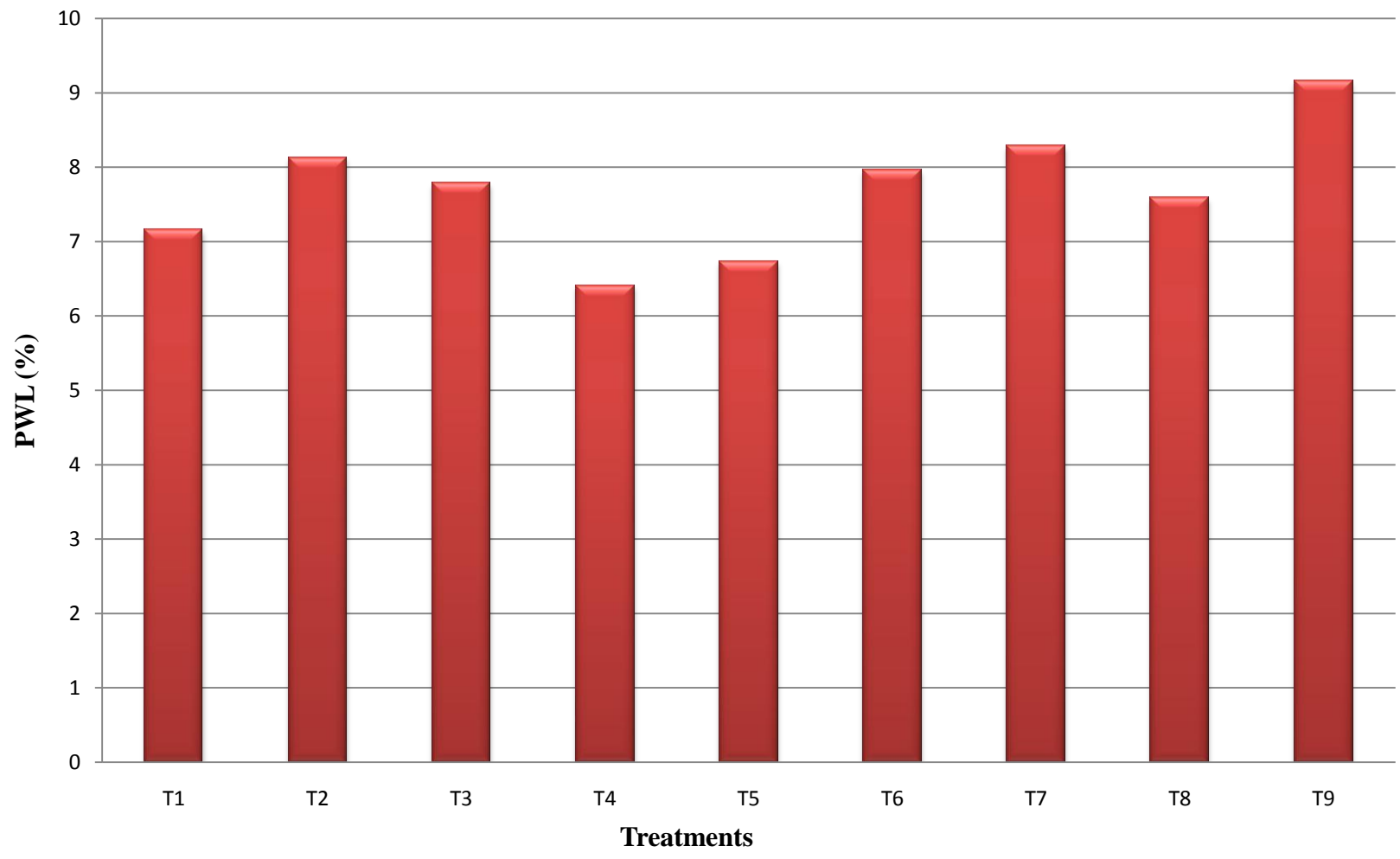


Fig. 4.26: Effect of plant growth regulators and chemicals on physiological loss of fruit weight (%) of mango var. Kesar

CHAPTER -V

SUMMARY AND CONCLUSIONS

CHAPTER -V

SUMMARY AND CONCLUSIONS

The present investigation entitled, “Effect of plant growth regulators and chemicals on fruit setting, yield and quality of mango (*Mangifera indica* L) var. Kesar” was under taken with the objective to study the effect of plant growth regulators and chemicals on fruiting, yield and quality of mango (*Mangifera indica* L) var. Kesar.

The experiment was laid out in Randomized Block Design with nine treatments which were replicated thrice. The treatments are GA₃ (35 ppm), CPPU (5 ppm) and (10 ppm), triacontanol (750 mg/l), NAA (50 ppm), (NAA 25 ppm + ZnSO₄ 0.5 %), (NAA 25 ppm + FeSO₄ 0.5 %), (NAA 25 ppm + Borax 0.2 %) and control for comparison between treatments. Plant growth regulators and chemicals sprayed at pea and marble stage of fruit developmental stages at one time. The observation recorded in respect of various characters are summarised as under.

6.1 Flowering parameters before spraying of plant growth regulators and chemicals.

Flowering parameters *i.e.* length of panicle (cm), breadth of panicle (cm), number of flowers per panicle, number of hermaphrodite flowers per panicle, days taken from flowering to fruit setting, results were non-significant.

Sex ratio (male to hermaphrodite flowers) was maximum in treatment T₄ *i.e.* (20.00). maximum number of male flowers also observed in treatment T₄ *i.e.* (3054.67).

6.2 Effect of plant growth regulators and chemicals on physical parameters of fruit.

As regard to the physical parameters of fruits, the data recorded on the effect of plant growth regulators and chemicals on fruit significantly influenced by different levels of concentrations. The maximum value of physical parameters of mango fruits like length of fruit (11.58 cm), breadth of fruit (7.09 cm), volume of fruit (164.93 cc),

weight of fruit (270 g), ripe fruit weight (252.67 g) were observed in treatment T₄ (triacontanol 750 mg/l).

The minimum value of physical parameters like length of fruit (8.97 cm), breadth of fruit (6.03 cm), volume of fruit (141.33 cc), weight of fruit (251 g), ripe fruit weight (228 g) were observed in treatment T₉ (control).

6.3 Effect of plant growth regulators and chemicals on yield parameters of mango.

The data regarding different yield parameters of mango influenced by various plant growth regulators and chemicals concentration gradients. The maximum value of yield related observation *i.e.* yield per plant (23.67 kg), yield (11.83 t/ha), fruit retention at harvesting stage (1.00%), number of fruits per plant at harvest (87.67), fruit set at pea stage (14.17 %), fruit set at marble stage (7.52 %) were observed in treatment T₄ (triacontanol 750 mg/l) which was best result among other treatments. Minimum fruit drop (86.66 %) and number of days required for fruit set to harvest was (99 days) reported in treatment T₄ (triacontanol 750 mg/l).

Overall yield point of view treatment T₄ (triacontanol 750 mg/l) gave best result amongst treatment.

6.4 Effect of plant growth regulators and chemicals on quality parameters of fruits after ripening of mango.

The different treatments showed positive response on chemical quality attributes of mango. The maximum value of chemical quality parameters like total soluble solids (18.7 %), total sugar (15.20 %), reducing sugar (4.57 %), non reducing sugar (10.63 %), tss:acid ratio (74.8) were reported in treatment T₁ *i.e.* (GA₃ 35 ppm).

The minimum titrable acidity was observed under treatment T₁ and T₅ *i.e.* (0.25 %). The maximum ascorbic acid content reported in treatment T₈ (NAA 25 ppm + Borax 0.2 %) *i.e.* (46.38 mg/100 g). The minimum physiological loss of fruit weight per cent was reported in treatment T₄ (triacontanol 750 mg/l) *i.e.* (6.41 %) which was superior over treatment T₉ (9.16 %).

Overall treatment T₄ (triacontanol 750 mg/l) was superior among all the treatments with respect to fruit retention and yield parameters. However treatment T₁ (GA₃ 35 ppm) was best with respect to quality parameters.

- Benefit cost ratio was 5.71

CONCLUSIONS

The result and the discussion of the present study showed that, the different treatment has significant influence on fruiting, yield and quality of mango. From the critical evaluation of results of the present investigation, the following conclusion can be drawn.

- ❖ Spraying triacontanol (750 mg/l) at pea and marble stage of fruit development not only increased physical attributes of fruit *i.e.* length, breadth, volume and weight of fruit, but also fruit setting, fruit retention per cent and yield.
- ❖ Spraying of GA₃ (35 ppm) at pea and marble stage of fruit growing stage, which results after ripening improve chemical quality parameters of mango like total soluble solids, total sugar, reducing sugar, non reducing sugar and tss:acid ratio.
- ❖ Maximum ascorbic acid content reported in treatment T₈ (NAA 25 ppm + Borax 0.2 %) after fruit ripening.

However, these results are based on one season experimentation, which needs further confirmation.

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LITERATURE CITED

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* - Original not seen

APPENDIX

APPENDIX I

Weekly meteorological data for the year (May 2020 to Dec. 2020)

MW	Period	Rainfall (mm)	R.D.	Temperature °C		Humidity (%)	
				Max.	Min.	RH I	RH II
18	30-06 May	0.0	0.0	40.9	24.4	57.6	29.6
19	07-13 May	0.0	0.0	41.0	24.1	52.1	23.4
20	14-20 May	0.0	0.0	40.1	24.9	55.6	25.7
21	21-27 May	0.0	1.0	42.0	25.2	41.1	21.4
22	28-03 June	28.0	2.0	39.4	23.1	70.4	38.1
23	04-10 June	32.7	3.0	32.6	20.2	81.6	51.6
24	11-17 June	102.5	5.0	33.2	20.6	90.0	64.5
25	18-24 June	87.5	4.0	32.9	21.1	87.0	56.5
26	25-01 July	135.0	5.0	34.1	21.4	90.1	64.4
27	02-08 July	32.5	3.0	32.2	21.9	89.9	67.4
28	09-15 July	49.1	3.0	32.7	21.2	88.9	66.0
29	16-22 July	46.0	0.0	31.1	21.4	88.0	74.1
30	23-29 July	64.5	0.0	31.4	21.0	92.1	71.9
31	30-05 Aug	94.6	4.0	31.8	21.3	89.7	76.8
32	06-12 Aug	36.0	2.0	30.9	20.9	89.6	72.5
33	13-19 Aug	82.0	1	26.1	19.9	94.3	90.0
34	20-26 Aug	31.0	3.0	28.6	20.1	92.1	72.9
35	27-02 Sept	36.0	2.0	30.1	20.2	89.7	73.4
36	03-09 Sep	49.5	2.0	33.1	21.1	85.7	63.0
37	10-16 Sep	15.7	2.0	31.6	20.9	89.9	72.0
38	17-23 Sep	92.0	5.0	30.9	21.5	88.0	78.1
39	24-30 Sep	122.0	2.0	29.8	19.6	89.7	72.1
40	01-07 Oct.	0.0	0.0	33.0	20.0	81.4	54.7
41	08-14 Oct.	47.5	3.0	31.4	20.1	87.4	64.1
42	15-21 Oct.	44.0	2.0	31.4	20.9	82.7	58.1
43	22-28 Oct.	30.7	4.0	31.1	18.2	92.7	67.8
44	29-04 Nov.	0.0	0.0	33.4	15.3	75.1	36.0
45	05-11 Nov.	0.0	0.0	33.2	12.7	75.0	33.7
46	12-18 Nov.	0.0	0.0	31.3	15.6	71.0	49.1
47	19-25 Nov.	0.0	0.0	32.6	16.7	68.1	48.4
48	26-02 Dec.	0.0	0.0	30.1	15.7	67.6	36.1

49	03-09 Dec.	0.0	0.0	31.5	13.9	67.1	40.1
50	10-16 Dec.	0.0	0.0	30.0	16.1	68.3	45.4
51	17-23 Dec.	0.0	0.0	29.6	11.8	65.0	42.4
52	24-31 Dec.	0.0	0.0	30.1	13.4	70.3	44.0

Weekly meteorological data for the year (Jan. 2021 to May 2021)

MW Week	Period	Temperature		Relative Humidity		Rainfall
		Max.	Min.	I	II	
1	1-7 Jan	30.7	19.4	90.2	70.1	00
2	8-14 Jan	29.9	18.6	88.2	64.2	00
3	15-21 Jan	31.0	18.1	80.7	57.5	00
4	22-28Jan	27.4	13.9	87.6	52.5	00
5	29-4 Feb	29.5	12.6	79.9	49.8	00
6	5-11 Feb	29.9	12.3	65.7	35.4	00
7	12-18 Feb	33.0	16.8	71.0	43.5	00
8	19-25 Feb	35.8	14.7	79.7	47.8	00
9	26-04 Mar	32.9	17.9	59.3	32.4	00
10	05-11 Mar	33.9	17.4	53.9	27.0	00
11	12-18 Mar	36.3	19.4	59.9	31.0	00
12	19-25 Mar	37.6	19.0	71.0	44.2	00
13	26-01 Apr	40.0	18.1	42.2	21.7	00
14	02-08 Apr	40.6	22.1	47.2	23.7	00
15	09-15 Apr	41.1	21.9	54.4	33.0	00
16	16-22 Apr	37.9	22.9	44.7	28.1	00
17	23-29 Apr	42.1	21.3	43.4	26.4	00
18	30-06 May	40.4	22.5	59.0	41.1	00
19	07-13May	40.0	23.7	55.9	36.5	00
20	14-20 May	40.7	24.9	76.0	60.7	00
21	21-27 May	42.1	24.7	73.2	39.9	00

Source: NARP, Aurangabad

CURRICULUM VITAE

CURRICULUM VITAE

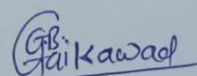
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on fruit setting, yield and quality of mango
(*Mangifera indica* L.) var. Kesar.

Academic qualification

Course/ Degree	Name of the college/ institute	University/ Board	Year of passing	Percentage (%) / CGPA	Class/ Grade
SSC	Janata Vidya Mandir Kanhur Pathar.	Maharashtra State Board, Pune.	2013	72.20	I st Class
Agricultural Polytechnique	Institute of Agriculture and Dairy sciences, Loni (Pravara)	MPKV,Rahuri.	2016	84.83	I st Class with Distinction
B.Sc. (Agri.)	College of Agriculture Pune, 05	MPKV,Rahuri.	2019	78.40	I st Class

Place: Badnapur

Date:



Signature of the candidate