

**EFFECT OF CHEMICALS ON FRUIT RETENTION AND  
QUALITY OF MANGO (*Mangifera indica* L.)  
Cv. KESAR.**

**By**

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

**2018**

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***DISSERTATION***

*Submitted To*

*Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani in partial  
fulfillment of the requirements for the degree of*

**MASTER OF SCIENCE**

**(Horticulture)**

**IN**

**FRUIT SCIENCE**

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

**2018**

## CANDIDATE'S DECLARATION

*I hereby declare that the dissertation  
Or part thereof has not been  
Previously submitted by me  
For a degree of any  
University or  
Institute*

**Place** : Latur

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## **C E R T I F I C A T E – I**

This is to certify that the dissertation entitled “**EFFECT OF CHEMICALS ON FRUIT RETENTION AND QUALITY OF MANGO (*Mangifera indica* L.) Cv. KESAR**” submitted by **Mr. PARALKAR PURUSHOTTAM DATTATRAY** to the Vasantnao Naik Marathwada Krishi Vidyapeeth, Parbhani in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (Horticulture)** in the subject of **FRUIT SCIENCE** is record of original and bonafide research work carried out by him under my guidance and supervision. It is of sufficiently high standard to warrant its presentation for the award of the said degree.

I also certify that the dissertation or part thereof has not been previously submitted by him for a degree of any university.

Place: **Latur**

Date: / /2018

**(Dr. S. G. Patil)**

Research Guide  
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Chairman  
Advisory Committee.

## CERTIFICATE - II

This is to certify that the dissertation entitled “**EFFECT OF CHEMICALS ON FRUIT RETENTION AND QUALITY OF MANGO (*Mangifera indica* L.) Cv. KESAR**” submitted by **Mr. PARALKAR PURUSHOTTAM DATTATRAY** to the Vasantao Naik Marathwada Krishi Vidyapeeth, Parbhani in partial fulfillment of the requirement for the degree of **MASTER OF SCIENCE (Horticulture)** in the subject of **FRUIT SCIENCE** has been approved by the Student’s Advisory Committee after oral examination in collaboration with the External Examiner.

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**Date: / /2018.**

**(PARALKAR P.D.)**

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## LIST OF ABBREVIATIONS

@	:	At the rate
C.D.	:	Critical difference
Cm	:	Centimetre (s)
Cv.	:	Cultivar (s)
<sup>0</sup> C	:	Degree celsius (s)
<i>et al.</i>	:	Et alli (and so on)
etc.	:	Etcetera
Fig.	:	Figure
G	:	Gram (s)
Ha	:	Hectare
i.e.	:	That is
Kg	:	Kilogram (s)
KNO <sub>3</sub>	:	Potassium nitrate
lit.	:	Litre (s)
m	:	Metre (s)
mg	:	Milligram (s)
ml	:	Millilitre (s)
mm	:	Millimetre (s)
MT	:	Metric tonnes

CONT...

N	:	Normality
NAA	:	Nephthalic acetic acid
NHB	:	National Horticulture Board
N.S.	:	Non-significant
No.	:	Number (s)
%	:	Per cent
/	:	Per
ppm	:	Parts per million
PGRs	:	Plant growth regulators
S.E. $\pm$	:	Standard error
T	:	Tonne (s)
T.S.S.	:	Total soluble solids
<i>viz.</i>	:	Namely (Videlicet)



# ABSTRACT

## ABSTRACT

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**“EFFECT OF CHEMICALS ON FRUIT RETENTION AND QUALITY  
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By

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2018

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<b>Research Guide</b>	<b>:</b>	<b>Dr. S. G. Patil</b>
<b>Department</b>	<b>:</b>	<b>Horticulture</b>

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The present investigation entitled “Effect of chemicals on fruit retention and quality of mango (*Mangifera indica* L.) Cv. Kesar” was conducted at Fruit Research Station, Himayatbagh, Aurangabad. The objective of this experiment was to improve the fruit retention and quality of mango Cv. Kesar by using NAA, KNO<sub>3</sub>, Urea and Triacntanol. The experiment was laid out in Randomized Block Design (RBD) with three replication and 13 treatments. Comprising spraying of NAA (@ each 20, 40, 60 ppm), KNO<sub>3</sub> (@ each 2, 4, 6 %), Urea (@ each 1, 1.5, 2 %), Triacntanol (@ each 100, 300, 500 ppm) and control. The observations on different characters of fruit *Viz*, per cent fruit set per panicle, per cent fruit retention pea and marble stage, weight of fruit (g), volume of fruit (ml), Mesocarp-pulp (g), Exocarp- skin (g), Endocarp-stone (g), Number of fruit per tree, Yield per tree (kg), Yield per ha (t), per cent of total soluble solids (TSS), per cent of Acidity, per cent of reducing sugar, per cent of non-reducing sugar, per cent of total sugar. Were recorded.

Among the treatments, T<sub>13</sub> Triacntanol 500 ppm recorded maximum increase in fruit set per panicle, fruit retention pea stage, fruit retention at marble stage, weight of fruit (g), volume of fruit (ml), Mesocarp-pulp (g),

Exocarp-skin (g), Endocarp-stone (g), Number of fruit per tree, Yield per tree (kg), Yield per ha (t).

The total soluble solid (TSS) was maximum in treatment T<sub>3</sub> NAA @ 40 ppm. The minimum acidity was recorded under treatment T<sub>4</sub> NAA @ 60 ppm.

The maximum reducing sugar was recorded under treatment T<sub>5</sub> KNO<sub>3</sub> @ 2 per cent. The maximum non-reducing sugar was recorded under treatment T<sub>6</sub> KNO<sub>3</sub> @ 4 per cent. The maximum total sugar was recorded under treatment T<sub>5</sub> KNO<sub>3</sub> @ 2 per cent.



# *INTRODUCTION*

## CHAPTER - I

### INTRODUCTION

Mango (*Mangifera indica* L.) is the king of fruits in India and got a unique position in Indian Horticulture. It is native to India (Indo Burma region). Botanically mango belong to family *Anacardiaceae* and cultivated mango belongs to *Mangifera indica* species and wild mango belongs to *Mangifera sylvatica* and *Mangifera khaisana* are said to be exist in India.

The tree is large, spreading, and evergreen with a dence rounded or globular crown. The trunk is erect and thick. Branches are numerous, the lower ones spreading horizontally to a great extent, the upper ones gradually ascending till they become nearly in centre, branches are rather thick and robust, yellowish green when young with slightly prominent stars of the fallen leaves. Flowers are small, polygamous, monoecious, male and bisexual on the same panicle. The fruit is drupe, having a skin or the epicarp, the flesh or the mesocarp and the hard covering of the seed or stone known as the endocarp.

The mango fruit has been in cultivation in Indian continent for well over 4000 years and has been the favorite of the kings and commoners because of its nutritive value, taste, attractive fragrance and health promoting qualities and now it is recognized as one of the best fruits in the world market.

Mango fruit is used in all its stages of development. The unripe fruit is used for making pickles and chutney. Ripe fruit is mainly used for table purpose and is partly converted into squash, jam, preserves, mango leather and amchur. There is also scope for diversification by making other products likes mango bar, mango jelly and mango ice-cream.

Mango is not only delicious but also full of nutritional value. It is high in beta-carotene, a precursor of vitamin-A and is a rich source of the vitamin-C. The ripe mangoes are reported to have 83.46 - 86.70% moisture, 0.82 g protein, 0.38 g fat, 14.98 g carbohydrate, 11 mg calcium, 14 mg

phosphorus, 0.16 mg iron, 0.135 - 1.872 Vitamin-A (mg/100g  $\beta$ -Carotene), 0.038 g/100 g riboflavin and 36.4 mg/100g ascorbic acid, 12.0-23.0 TSS ( $^{\circ}$ Brix) and 0.12-0.38% acidity.

The total area under cultivation of mango in India is 2273 (000 ha) and production is around 19218 (000MT) according to NHB (2016-2017). In India states Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Tamil Nadu, Chhattisgarh, Bihar and Uttar Pradesh are the leading in production of mango.

It has great adaptability and thrives in a wide range of climatic and soil conditions. It is grown throughout the length and breadth of the country under a wide range of agro climatic situations, except temperate regions. It has low cost of cultivation and maintenance. Mango can be grown on wide variety of soils under varied climatic conditions. The temperature between 24 and 27  $^{\circ}$ C is ideal for its cultivation. It can be grown best in region with a rainfall between 25 and 250 cm. Regions having bright sunny days and moderate humidity during flowering are ideal for mango growing.

Kesar is a leading variety of Gujarat with a red blush on the shoulders. It is a superior chance seedling of Junagarh but resembles in nature with South-Indian mangoes. It has been observed that, a large area is under cultivation of this variety in Maharashtra particularly in Marathwada. This variety has export potential. However, the farmers are facing problems of low fruit set, fruit drop and poor quality in terms of size of fruit. In mango production, yield and quality is influenced by several factors including nutritional and environmental factors. Imbalanced fertilization is considered to be one of the major contributing factors for the low productivity.

Marathwada region is famous for mango plantation mostly of seedling origin. It is extensively grown in almost all districts of Marathwada region particularly Aurangabad, Beed and Nanded district. The orchard of Himayatbagh is the collection of mango made by the Nizam Among these all varieties of mango, Kesar are high yield potential, almost regular bearer, mid-

season variety, having good consumer acceptance, attractive shape, size, saffron colored pulp and very good keeping quality. In light of the views mentioned above, the present study “Effect of chemicals on fruit retention and quality of mango (*Mangifera indica* L.) Cv. Kesar” was taken up under the agro climatic conditions prevailing at Fruit Research Station, Aurangabad with the following objectives:

1. To improve the fruit retention and quality of mango Cv. Kesar by using NAA, KNO<sub>3</sub>, Urea and Triacantanol.



**REVIEW  
OF  
LITERATURE**



## CHAPTER - II

### REVIEW OF LITERATURE

An attempt has been made to present a brief review on the influence of NAA, Urea, KNO<sub>3</sub> and Triacntanol on fruit retention and quality of mango fruits. The use of plant growth regulators during recent years has become a common practice for increasing fruit set and controlling the fruit drop to obtain higher yield (Prasad and Pathak, 1972; and Singh and Ram, 1983). 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 on fruit set

Arvindakshan *et al.* (1979) studied the effect of planofix on fruit set in mango variety Neelum. Planofix (containing NAA) at 10,20 and 30 ppm was applied twice at 5 days intervals in 1<sup>st</sup>, 2<sup>nd</sup> or 3<sup>rd</sup> week after fertilization during the mustard, pea and marbal stage, respectively. Planofix improved fruit set compared with control. The most effective stage of application was the marble which gave 28.2 per cent fruit set at optimum concentration of 20 ppm. Fruit set at 10 and 30 ppm was 27.8 and 24.0 per cent respectively and in control it was 19.28 per cent.

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

Nkansah *et al.* (2012) observed the NAA 25 ppm gave best result in term of increasing the fruit set in mango.

Zaeneldeen (2014) observed that, maximum fruit set was recorded in the treatment urea 2% + GA<sub>3</sub> 50 ppm (4.82 & 4.62%) followed by urea 2% + GA<sub>3</sub> 25 ppm (4.81 & 4.61%) and urea 1% + GA<sub>3</sub> 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 maximum percentage of fruit set (76.33%) was observed with 0.2 per cent boron + NAA 150 ppm, which was at par with 0.2 per cent boron + NAA 100 ppm in guava.

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 in mango.

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

Patel *et al.* (2016) observed that, foliar application of 1.0% KNO<sub>3</sub> in mid October followed by 1.0% thiourea in mid November was found best for increased 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 that, the effect of foliar sprays mango by NAA at 10ppm, NAA at 20ppm, NAA at 40ppm concentrations was very effective in fruit set.

Somwanshi *et al.* (2017) observed that, application urea (1%) + GA<sub>3</sub> (70 ppm) recorded maximum fruit set (67.67) in sweet orange.

## **2.2 Effect on fruit drop**

Rawash *et al.* (1983) observed that, the spraying of 40 ppm NAA on 1<sup>st</sup> April significantly reduced the fruit drop compared with control in cultivars Langra and Ewais under Lucknow condition. While, minimum fruit drop was

observed on panicles treated with NAA 20 ppm in Alphonso mango under konkan condition.

Bhamare *et al.* (2014) observed that, the treatment NAA @ 20mg/litre gave significantly lowest fruit drop (55.54, 81.82 and 91.97 % respectively), which was closely followed by treatment NAA @ 30mg/litre and NAA @40mg/litre. External application of NAA might have made up for internal deficiencies and hence, led to reduced fruit drop in mango.

Zaeneldeen (2014) observed that, sprayed treatment by urea at 1% and 2% or sprayed treatments by GA<sub>3</sub> 25 ppm and 50 ppm had decreased fruit drop percentage compared with control in mango.

Rajput *et al.* (2015) concluded that, the minimum percentage of fruit drop (23.00%) was observed in 0.2 per cent boron + NAA 150 ppm, which was at par with 0.2 per cent boron + NAA 200 ppm in guava.

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 drop in mango.

Momin *et al.* (2016) observed that, the minimum fruit drop at harvest stage of fruits per panicle in treatment tricontanol @ 750 mg/liter in mango.

Somwanshi *et al.* (2017) observed that, application plant growth regulators NAA sprayed at 15 ppm (14.19%), which was followed by NAA (20 ppm), most effective against the control of fruit drop in sweet orange.

### **2.3 Effect on fruit retention**

Prasad and Pathak (1972) observed that, the most effective treatment for increasing the fruit retention was 25 ppm NAA in variety Dashehari which recorded maximum retention of fruits (8.65 %) over control (2.20 %) in mango.

Maurya and Singh (1979) reported that, the highest fruit retention as compared to control was recorded with the concentration 40 ppm NAA sprayed at pea stage in variety Langra in mango.

Singh and Ram (1983) found 300 per cent retention with spray of NAA 40 ppm in the variety Dashehari. It was further reported that, the higher concentration of NAA was required at pea stage than that of at pre bloom and marble stage under pant nagar condition in cultivar Dashehari in mango.

Baghel *et al.* (1987) obtained highest fruit retention till harvest with 6 % urea spray (4.29 %) over control treatment (2.61 %) in variety sunderja under Jabalpur condition. They further found, the pre flowering spray of NAA at 120 ppm more effective giving highest percentage of fruit retention (3.58 %) over control (2.61 %) in variety sundarja under Jabalpur condition in mango.

Konhar and Singh (1988) revealed that, treatment of growth regulators like Nutron (triacentanol), ethrel (ethephon) and planofix (NAA) as sprays given first time on 21<sup>st</sup> December and trice more at fifteen day interval on ten year old cashew variety No.1 resulted in highest percentage of fruit retention (925.8 %) was obtained with nutron (Triacentanol) at 500 ppm followed by ethrel (ethophon) at 50 ppm (25.4%), planofix (NAA) at 45 ppm (22.8 %) and the control percentage was (7.28 %) in cashew.

Naqvi *et al.* (1990) reported that, the when mango tree Cv. Dashehari were sprayed with 20 mg NAA per liter, 100 mg AgNO<sub>3</sub> per liter or 100 mg Co (NO<sub>3</sub>)<sup>2</sup> per liter when fruits attained pea and marble size, the treatments increased fruit retention at all concentration tested.

Vejendla *et al.* (2008) stated that application of 50 ppm NAA at pea and marble stage of fruit growth was beneficial in improving the fruit retention of mango Cv. Amrapali.

Ghosh *et al.* (2009) studied that, spray of NAA at 10 ppm was the best to increase fruit retention in aonla.

Bhowmick and Banik (2011) stated that, maximum fruit retention percentage (7.25%) as well as maximum number of fruits at harvest (790.17/tree) was recorded with NAA at 40 ppm in mango.

Nkansah *et al.* (2012) observed that, the NAA 25 ppm gave best result in term of increasing the fruit retention in mango.

Sudha *et al.* (2012) observed that, the maximum number of fruit set (17.0%) was obtained with foliar spray of  $\text{KNO}_3$  at 2% concentration 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.

Bhamare *et al.* (2014) observed that, maximum fruit retention was observed in treatment NAA@ 20mg/litre in mango.

Amarcholi *et al.* (2016) observed that, plant treated with  $\text{KNO}_3$  (1.0 %) found the significantly higher fruit retention in mango.

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

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 retention in mango.

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

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

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.

Omnanarayan *et al.* (2018) observed that, application of growth regulator NAA 20 ppm at pea and gravel stage increased the fruit retention to 45.00 % as compared to in control 24.00 % in Nagpur mandarin.

#### **2.4 Effect on physical characters of fruit**

Singh *et al.* (1991) observed that, the highest fruit weight (135.95 g) with 5 % Urea spray over control (112.32 g) in variety Amrapali at Varanasi in mango.

Shinde *et al.* (2008) observed that, sprayed at flowering, pea and marble stage of fruit development stage Triaccontanol 700 ppm showed significantly maximum volume (336.58 cm<sup>3</sup>), weight (330.41g) and mesocarp (69.92 %) as compared to rest of treatments under study in mango.

Debaje *et al.* (2011) observed that, application of two foliar spray of KNO<sub>3</sub> 2% and GA<sub>3</sub> 100 ppm increased fruit weight and fruit volume of acid lime.

Wahdan *et al.* (2011) stated that, spraying Urea 2 %, fruit weight (413.8 g) was the highest within all treatments with significantly increment than control. While, Urea showed the superiority effect in mango.

Nkansah *et al.* (2012) observed that, the NAA 25 ppm gave best result in term of increasing the fruit weight in mango.

Maji *et al.* (2015) observed that, the Urea @ 15% showed highest increase in morphological characters in guava Cv. Sardar.

Rajput *et al.* (2015) concluded that the weight of fruits (86.02 g) was observed in the 0.2 % boron + NAA 150 ppm, which was at par with the 0.2 % boron + NAA 200 ppm days interval was beneficial for improving the fruit weight of mango Cv. Amrapali under red and laterite zone of west Bengal.

Ghosh (2016) concluded that two times application of NAA @ 50 ppm during pea stage at 21 days interval was beneficial for improving the fruit weight of mango Cv. Amrapali under red and laterite zone of west Bengal.

Abd El-Rhman *et al.* (2017) observed that, effect of foliar sprays mango by NAA at 10 ppm, NAA at 20 ppm and NAA at 40 ppm concentrations was very effective in fruit weight in mango.

Patoliya *et al.* (2017) reported that, foliar application of  $\text{KNO}_3$  @ 2% treatment was significantly the maximum average fruit weight in mango.

Saha *et al.* (2017) observed that, treatment with  $\text{KH}_2\text{PO}_4$  1 % +  $\text{KNO}_3$  1% produced maximum (510.67) average fruit weight in mango.

Sandeep Kaur and Amarjeet Kaur (2017) observed that, foliar application of NAA 100 ppm were recorded maximum fruit weight (203.0 g) Cv. Allahabad safeda in guava.

## **2.5 Effect on yield characters**

Reddy and Mujumdar (1985) reported that, the increased yield of mango by 88 % over control when 2 % Urea was sprayed in September, November and March.

Shinde *et al.* (2006) studied that, foliar spray of nutrients Urea 2%, NAA 20 ppm and micronutrient mixture 50 ppm in combination produced significantly higher fruit yield in mango.

Vejendla *et al.* (2008) stated that, application of 50 ppm NAA treatment on Cv. Amrapali produced highest number of fruit/plant (88 fruits) & yield/plant (16.24 kg) followed by NAA at 25 ppm in mango.

Nkansah *et al.* (2012) observed that, the NAA 25 ppm gave best result in term of increasing the fruit yield in mango.

Sudha *et al.* (2012) observed that, the maximum number of fruits (146.0/tree) and fruit yield (43.8 kg/tree) was obtained with foliar spray of  $\text{KNO}_3$  at 2% concentration in mango.

Sarkar and Rahim (2013) observed that, plant treated with  $\text{KNO}_3$  at 4% noted the highest number of fruits per plant (136.67) compared to control (62.67) in mango.

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

Gharge *et al.* (2014) found that, fruit yield was highest in terms of number (184.17) was noticed in treatment T<sub>7</sub> (Urea 2% at pea stage, MPP 0.5% each at marble and egg stages in mango).

Zaeneldeen (2014) observed that, fruit yield (51.2 & 52.5kg) was maximum when foliar spray of urea 2% +  $\text{GA}_3$  50 ppm was applied in 2012 and 2013 respectively, as compared with other foliar spray. While, minimum fruit yield/tree (35.7 & 37.0 kg) obtained from control treatment in mango.

Mandal *et al.* (2015) observed that, the highest yield per tree (16.21 kg) was recorded under plant treated with SA 200 ppm in combination with Urea 2 % in mango.

Amarcholi *et al.* (2016) observed that, plant treated with KNO<sub>3</sub> (1.0 %) found the significantly increased number of fruit per panicle and number of fruits per tree and ultimately resulted in higher fruit yield in mango.

Dheeraj *et al.* (2016) observed that, the spray NAA@ 80 ppm increases in yield (20.96%) over control in mango.

Ghosh (2016) concluded that, two times application of NAA@50 ppm during pea stage at 21 days interval was beneficial for improving the total number of fruits of mango Cv. Amrapali under red and laterite zone of west Bengal in mango.

Momin *et al.* (2016) observed that, the maximum number of fruit per tree in treatment tricontanol @ 750 mg/liter in mango.

Patel *et al.* (2016) observed that, foliar application of 1.0% KNO<sub>3</sub> in mid October followed by 1.0% thiourea in mid November was found best for increased number of fruit per tree (281.30) and yield (77.02 kg/tree) Cv. Kesar mango.

Abd El-Rhman *et al.* (2017) observed that, effect of foliar sprays by NAA at 10 ppm, NAA at 20 ppm, NAA at 40 ppm concentrations was very effective in yield as kg/tree and number of fruits in mango.

Hifny *et al.* (2017) observed that, foliar spraying of 20 ppm GA<sub>3</sub> and 25 ppm of NAA one week after fruit set gave the highest values of yield kg/tree in orange.

Kulkarni *et al.* (2017) indicated that, the foliar spray of PGRs NAA (40 ppm) and CPPU (10 and 20 ppm) during mustard, pea and marble stages of fruit development were beneficial for increasing yield of mango Cv. Kesar.

Patoliya *et al.* (2017) reported that, the foliar application of  $\text{KNO}_3$  @ 2% treatment was significantly the maximum number of fruits and yield (kg/tree) in mango.

Saha *et al.* (2017) observed that, the maximum highest number of fruits per panicle (3.44), fruits per plant (93.80) and yield (46.71 kg/plant) was noted with  $\text{K}_2\text{HPO}_4$  1 % +  $\text{KNO}_3$  1 % in mango.

## **2.6 Effect on quality characters of fruit**

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

Debaje *et al.* (2011) observed that, application of two foliar spray of  $\text{KNO}_3$  2% and  $\text{GA}_3$  100 ppm. In acid lime was improved fruit quality.

Gharge *et al.* (2014) observed that, treatment  $T_1$  ( $\text{KNO}_3$  1% each at pea, marble and egg stages) recorded the highest TSS (20.97 °Brix), total sugars (15.71%) than control. However, the control recorded the highest titratable acidity (0.46%) in mango.

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.

Ghosh (2016) concluded that, two times application of NAA @ 50 ppm during pea stage at 21 days interval was beneficial for improving the quality of mango Cv. Amrapali under red and laterite zone of west bangal.

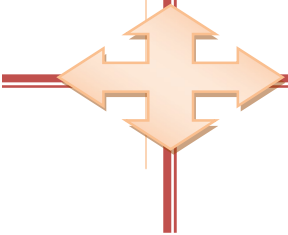
Chaudhari *et al.* (2017) observed that, spraying of plant growth regulators like GA<sub>3</sub> 50 ppm and NAA 200 ppm had significant effect on TSS, acidity, reducing sugar, non-reducing sugar, total sugar and ascorbic acid in custard apple.

Patoliya *et al.* (2017) reported that, foliar application of KNO<sub>3</sub> @ 2% treatment improved the quality parameters like shelf life, TSS, total sugar, non-reducing sugar, reducing sugar, fruit firmness, ascorbic acid and minimum titrable acidity in Dashehari mango under ultra high density plantation.

Saha *et al.* (2017) observed that, treatment with KH<sub>2</sub>PO<sub>4</sub> 1 % + KNO<sub>3</sub> 1% recorded maximum TSS (20.70 °Brix), reducing sugar (8.07g/100g pulp), non-reducing sugar (9.93g/100g pulp), total sugar (18.01g/100g pulp) and sugar-acid ratio (67.72) in mango.

Sandeep Kaur and Amarjeet Kaur (2017) observed that, foliar application of NAA 100 ppm maximum TSS: acid ratio (35.89) in guava Cv. Chittidar.

***MATERIALS  
AND  
METHODS***



## **CHAPTER - III**

### **MATERIALS AND METHODS**

The present investigation were carried out to ascertain the usefulness of NAA, KNO<sub>3</sub>, Urea and Triacontanol spray to control fruit drop and increase fruit retention and quality in mango Cv. Kesar.

#### **3.1 MATERIALS**

##### **3.1.1 Experimental site**

The present investigation was conducted during 2016-2017 on grafted mango cultivars grown at mango orchard, Fruits Research Station Aurangabad.

##### **3.1.2 Location and climate**

Aurangabad is situated at 19<sup>0</sup> and 20<sup>0</sup> North latitude and 74<sup>0</sup> and 76<sup>0</sup> East longitude and altitude 409 meter above mean sea level. The climate is generally dry for eight months of the year and wet during south-west monsoon season. The mean rainfall is approximately 662 mm and is received from June to September. Rainfall is not well distributed in all the parts of district and year. The maximum temperature in summer month goes up to 41.6 °C. The cold weather commences from the middle of November when temperature starts falling and minimum temperature goes down up to 10 °C. Thus Aurangabad is fairly cool in winter and sufficiently hot in summer, the mean relative humidity ranges from 12 to 90 per cent.

##### **3.1.3 Soil**

The orchard was established on well drained, black cotton soil, and topography of land was fairly leveled. The soil had moderate moisture retention capacity.

## 3.2 METHODS

The orchard was established by procuring uniform mango graft of Kesar, Fruit Research Station, Aurangabad during 2008. The trees were planted at spacing 5 X 5 m. These grafts were maintained with uniform horticultural practices. Out of above Cv. Kesar was selected to study “Effect of chemicals on fruit retention and quality of mango (*Mangifera indica* L.)”.

### 3.2.1 Experimental details

1. Name of crop : Mango
2. Family : Anacardiaceae
3. Variety : Kesar
4. Age of orchard : 9 Years
5. Spacing : 5 X 5 m
6. Number of treatments : 13
7. Number of replication : 03
8. Experimental design : Randomized Block Design
9. Number of plants/treatments : 03
10. Total number of plants : 117

### 3.2.2 Details of layout

The experiment titled “Effect of chemicals on fruit retention and quality of mango (*Mangifera indica* L.) Cv. Kesar” was laid out in Randomized Block Design with thirteen treatments.

Design : Randomized Block Design

Replications : Three

Treatments : Thirteen

### **3.2.3 Selection of trees**

One hundred seventeen uniform growing trees were selected randomly leaving border rows.

### **3.2.4 Details of treatments**

T <sub>1</sub>	:	Control
T <sub>2</sub>	:	NAA@20ppm
T <sub>3</sub>	:	NAA@40ppm
T <sub>4</sub>	:	NAA@60ppm
T <sub>5</sub>	:	KNO <sub>3</sub> @2%
T <sub>6</sub>	:	KNO <sub>3</sub> @4%
T <sub>7</sub>	:	KNO <sub>3</sub> @6%
T <sub>8</sub>	:	Urea@1%
T <sub>9</sub>	:	Urea@1.5%
T <sub>10</sub>	:	Urea@2%
T <sub>11</sub>	:	Triacantanol@100ppm
T <sub>12</sub>	:	Triacantanol@300ppm
T <sub>13</sub>	:	Triacantanol@500ppm

### **3.2.5 Selection of panicles**

For recording the observations on the various parameters, four uniform bearing panicles on the North, South, East and West site of the tree were selected during peak period of flowering randomly on each tree and tagged with labels.

### **3.2.6 Treatment application**

The chemicals as per the treatments, were applied as a foliar spray to panicles at full bloom stage (flowering), pea size stage and at marble

size stage of fruits with the help of knapsack hand sprayer. The sprayer was thoroughly washed with distilled water after application of every chemical.

### **3.3 OBSERVATIONS**

Following observations were recorded during the present investigation.

#### **3.3.1 Fruit set per panicle (%)**

Randomly four panicles from all the sides were selected on each tree and average numbers of fruit set per panicle were recorded.

#### **3.3.2 Fruit retention (%)**

For recording the observation on fruit retention, the panicles from all four sides of the tree were selected and tagged. The observations of fruit retention per panicle were recorded at each stage. The stages were:

1. Pea size stage
2. Marble size stage

#### **3.3.3 Physical characters of fruits**

Four fully mature fruits, one from each treated panicle were used for recording the observation and average was computed.

##### **3.3.3.1 Weight of fruits (g)**

Four fruits one from each treated panicle were selected. Weight of each fruit was noted on electronic balance. Average for each treatment in gram was computed.

##### **3.3.3.2 Volume of fruits (ml)**

The volume of each fruit was estimated by water displacement method. The average was computed for each treatment and given in ml.

### **3.3.3.3 Mesocarp-pulp (g)**

The pulp was extracted by hand, knife and weight was recorded presented as gram of total fruit weight.

### **3.3.3.4 Exocarp-skin (g)**

The skin was removed, made free from pulp and weight was taken and computed as gram of total fruit weight.

### **3.3.3.5 Endocarp-stone (g)**

The stone was cleaned so that no pulp remained adhering with the stone and the weight of stone was taken in gram.

## **3.3.4 Yield characters**

### **3.3.4.1 Number of fruits per tree**

The number of fruits per tree were counted at each harvest after the completion of harvest the total number of fruits record.

### **3.3.4.2 Yield per tree (kg)**

The fruit harvested from each plant, weight separately and total weight harvest record in kg.

### **3.3.4.3 Yield per ha (t)**

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

## **3.3.5 Quality characters of fruits**

The mango fruits were harvested on the basis of the development of fruits size and maturity indices in two pickings and fruits were randomly sampled from the first picking (peak harvest) and utilized for qualitative estimations. Fruits were allowed to ripen by embedding in newspaper and paddy straw. After ripening the quality parameters were studied.

### 3.3.5.1 Total soluble solids (%)

After harvest fully ripe mango fruit cut with the help of knife and from this pulp of mango fruits, 2 to 3 drops of mango juice were taken on hand refractometer. The total soluble solids was recorded by using hand refractometer and expressed in %. The average was computed for each treatment and given in per cent.

### 3.3.5.2 Acidity (%)

The titrable 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 per cent acidity of the juice was expressed as citric acid in gram in 100 g of fruit juice by using following formula.

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

### 3.3.5.3 Reducing Sugar (%)

Reducing sugar is determined by Lane and Eynon method (1960) in a known weight of composite sample using lead acetate for precipitation (clarifying) of the extraneous material and potassium oxalate is to remove excess of 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 by the same method in a solution of hydrolysed sucrose (after acid hydrolysis) with concentrated HCl followed by neutralization of excess acid with NaOH.

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

#### 3.3.5.4 Non-reducing sugar (%)

The difference in percentage between total sugar and reducing sugar was taken for the estimation of non-reducing sugar.

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

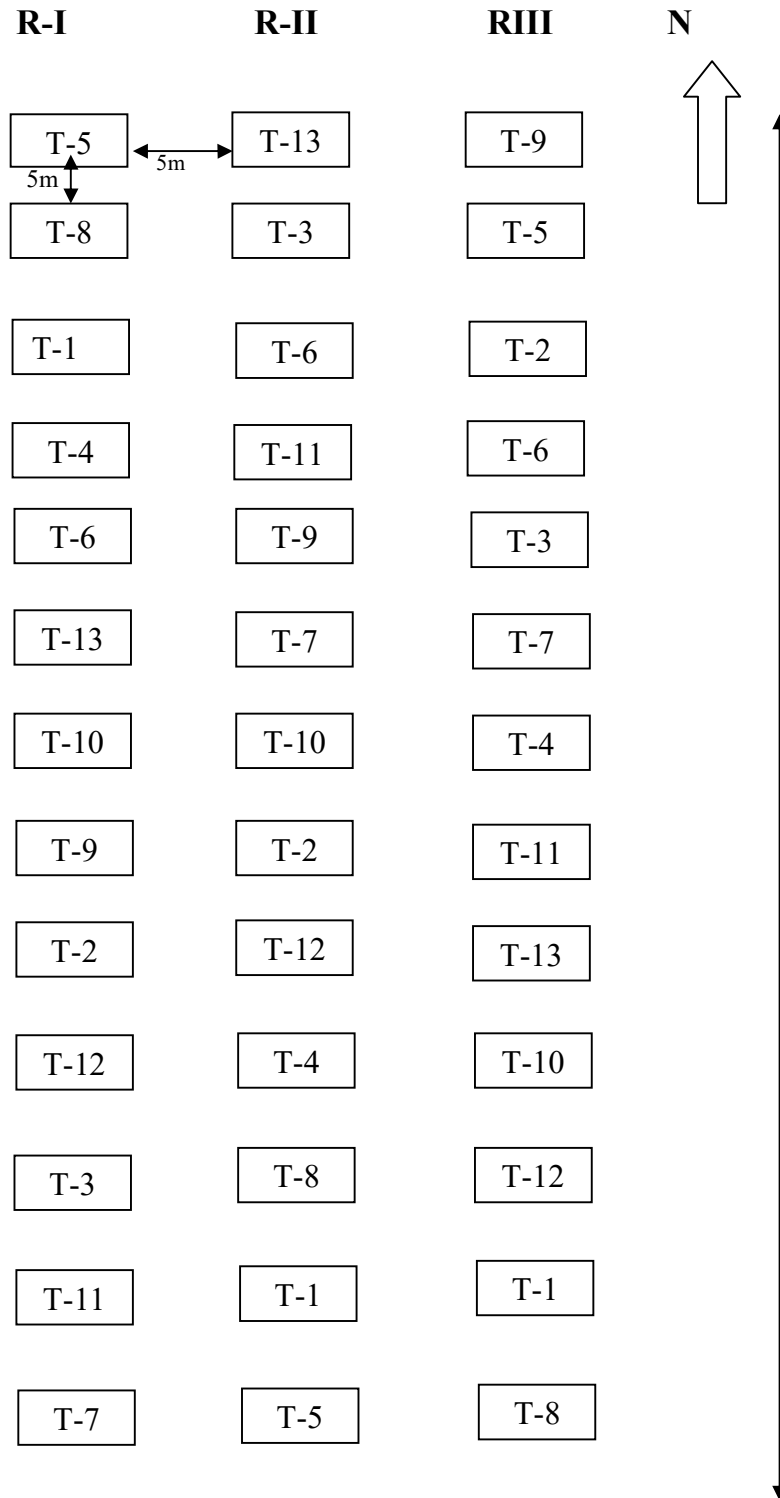
#### 3.3.5.5 Total sugar (%)

For estimation of total sugar, 20 ml of fruit juice solution was taken in a beaker and 5 ml of concentrated HCl was added and then the solution was boiled on water bath for five minutes for the hydrolysis to convert the non-reducing sugar into reducing sugar. After cooling, the excess of acid was neutralised by sodium carbonate solution. The solution was transferred in a 100 ml. volumetric flask and volume was made up to mark by adding distilled water. This solution was taken in a burette and titrated with the Fehling's solution "A" and "B" similar as was done in reducing sugar. The total sugar in percentage was calculated with the help of following formula.

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

### 3.4 STATISTICAL ANALYSIS

The experimental data were analyzed by Randomized Block Design (RBD). All the parameters pertaining to different flushes were subjected to the statistical analysis, for proper interpretation according to the procedure described by Panse and Sukhatme (1967) and significance of difference was tested by (F) test at 5% probability level.

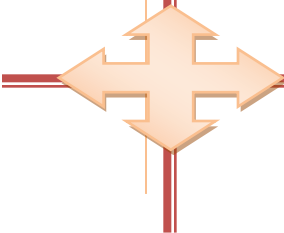


**Fig.1. Plan of experimental layout**



**PLATE 1: GENERAL VIEW OF THE EXPERIMENTAL PLOT**

# RESULTS



## CHAPTER - IV

### RESULTS

Effect of chemicals on fruit retention and quality of mango Cv. Kesar was studied and experiment results are presented in appropriate headings. Mean values obtained from all the observation for each character are presented in form of tables and briefly explained with help of graphs.

#### 4.1 Fruit set per panicle (%)

The data on fruit set per panicle (%) is influenced by different treatments have presented in Table 1 and graphically presented in Fig 2.

The data revealed that, the chemicals found better in increasing fruit set per panicle as compared to control. Maximum fruit set per panicle (97.75%) was recorded in treatment T<sub>13</sub> Triaccontanol 500 ppm, was statistically significant followed by treatment T<sub>3</sub> NAA 40 ppm (87.41%), T<sub>4</sub> NAA 60 ppm (85.57%). T<sub>5</sub> KNO<sub>3</sub> 2 % (78.66%), T<sub>7</sub> KNO<sub>3</sub> 6 % (77.00%) and T<sub>10</sub> Urea 2 (74.75%). Whereas, minimum fruit set per panicle (63.25%) was observed in treatment T<sub>1</sub> (control).

#### 4.2 Fruit retention at pea stage (%)

The data on fruit retention at pea stage (%) is influenced by different treatments have presented in Table 1 and graphically presented in Fig 2.

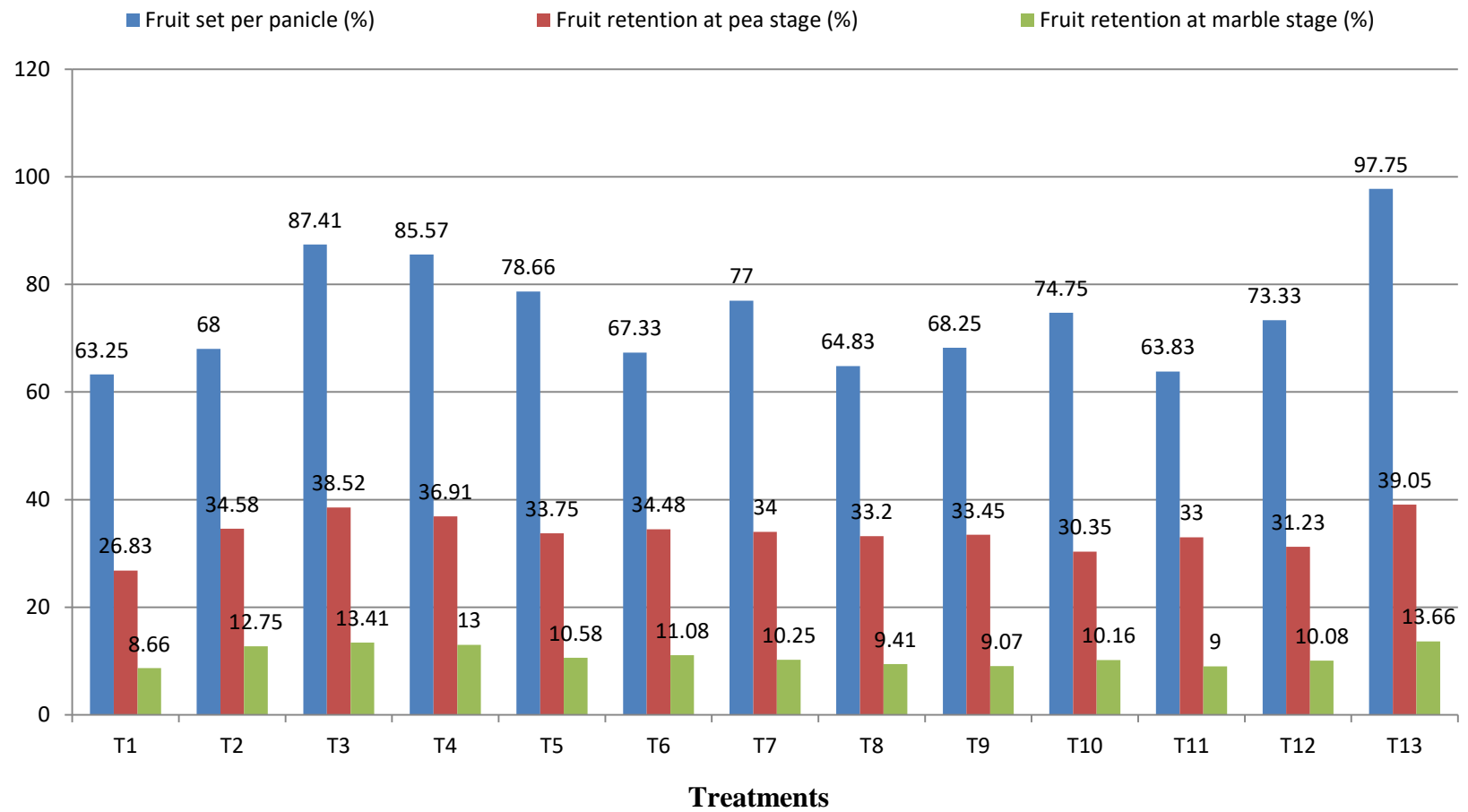
The data indicated that, the chemicals showed significantly maximum pea stage fruit retention as compared to control. Maximum pea stage fruit retention (39.05%) was noticed in treatment T<sub>13</sub> Triaccontanol 500 ppm, which was at par with treatment T<sub>3</sub> NAA 40 ppm (38.52%) T<sub>4</sub> NAA 60 ppm (36.91%), Treatment T<sub>2</sub> NAA 20 ppm (34.58%) and T<sub>6</sub> KNO<sub>3</sub> 4 % (34.48%) whereas, minimum fruit retention (26.83%) was observed in treatment T<sub>1</sub> (control).

**Table 1: Effect of spraying of chemicals on per cent fruit set per panicle, per cent fruit retention at pea stage and marble stage of mango.**

<b>Sr. No.</b>	<b>Treatment details</b>	<b>Fruit set per panicle (%)</b>	<b>Fruit retention at pea stage (%)</b>	<b>Fruit retention at marble stage (%)</b>
T <sub>1</sub>	Control	63.25	26.83	8.66
T <sub>2</sub>	NAA@20ppm	68.00	34.58	12.75
T <sub>3</sub>	NAA@40ppm	87.41	38.52	13.41
T <sub>4</sub>	NAA@60ppm	85.57	36.91	13.00
T <sub>5</sub>	KNO <sub>3</sub> @2%	78.66	33.75	10.58
T <sub>6</sub>	KNO <sub>3</sub> @4%	67.33	34.48	11.08
T <sub>7</sub>	KNO <sub>3</sub> @6%	77.00	34.00	10.25
T <sub>8</sub>	Urea@1%	64.83	33.20	9.41
T <sub>9</sub>	Urea@1.5%	68.25	33.45	9.07
T <sub>10</sub>	Urea@2%	74.75	30.35	10.16
T <sub>11</sub>	Triacantanol@100ppm	63.83	33.00	9.00
T <sub>12</sub>	Triacantanol@300ppm	73.33	31.23	10.08
T <sub>13</sub>	Triacantanol@500ppm	97.75	39.05	13.66
<b>S.E.m ±</b>		<b>3.50</b>	<b>1.62</b>	<b>0.56</b>
<b>C.D. at 5 %</b>		<b>10.23</b>	<b>4.73</b>	<b>1.65</b>

#### **4.3 Fruit retention at marble stage (%)**

The data on fruit retention at marble stage (%) was influenced by different treatments have presented in Table 1 and graphically presented in Fig 2.



**Fig. 2. Effect of spraying of chemicals on per cent fruit set per panicle, percent fruit retention at pea stage and marble stage of mango.**

The data indicated that, the chemicals showed significantly Maximum marble stage fruit retention as compared to control. Maximum marble stage fruit retention (13.66%), was noticed in treatment T<sub>13</sub> Triacontanol 500 ppm, which was at par with T<sub>3</sub> NAA 40 ppm (13.41%), T<sub>4</sub> NAA 60 ppm (13.00%) and T<sub>2</sub> NAA 20 ppm (12.75%). Whereas, minimum fruit retention marble stage (8.66%) was observed in treatment T<sub>1</sub> (control).

#### **4.4 Weight of fruit (g)**

The data on weight of fruit (g) was influenced by different treatments have presented in Table 2 and graphically presented in Fig 3.

The data indicated that, the chemicals showed significantly maximum fruit weight noticed as compared to control. Maximum fruit weight (289.68 g) was noticed in treatment T<sub>13</sub> Triacontanol 500 ppm which was at par with T<sub>3</sub> NAA 40 ppm (265.48 g). Lowest weight of fruit (177.02 g) was noticed in treatment T<sub>1</sub> control.

#### **4.5 Volume of fruit (ml)**

The data on volume of fruit (ml) was influenced by different treatments have presented in Table 2 and graphically presented in Fig. 4.

Perusal of data from table 2 revealed that significantly maximum volume of fruit (284.25 ml) was noticed in treatment T<sub>13</sub> Triacontanol 500 ppm, which was at par with T<sub>3</sub> NAA 40 ppm (260.71 ml). Minimum fruit volume was observed in treatment T<sub>1</sub> control (171.02 ml).

#### **4.6 Mesocarp-pulp (g)**

The data on mesocarp-pulp (g) was influenced by different treatments have presented in Table 2 and graphically presented in Fig. 5.

Perusal of data from table 2 indicated that significantly maximum mesocarp- pulp (192.23 g) was noticed in T<sub>13</sub> Triacontanol 500 ppm which was at

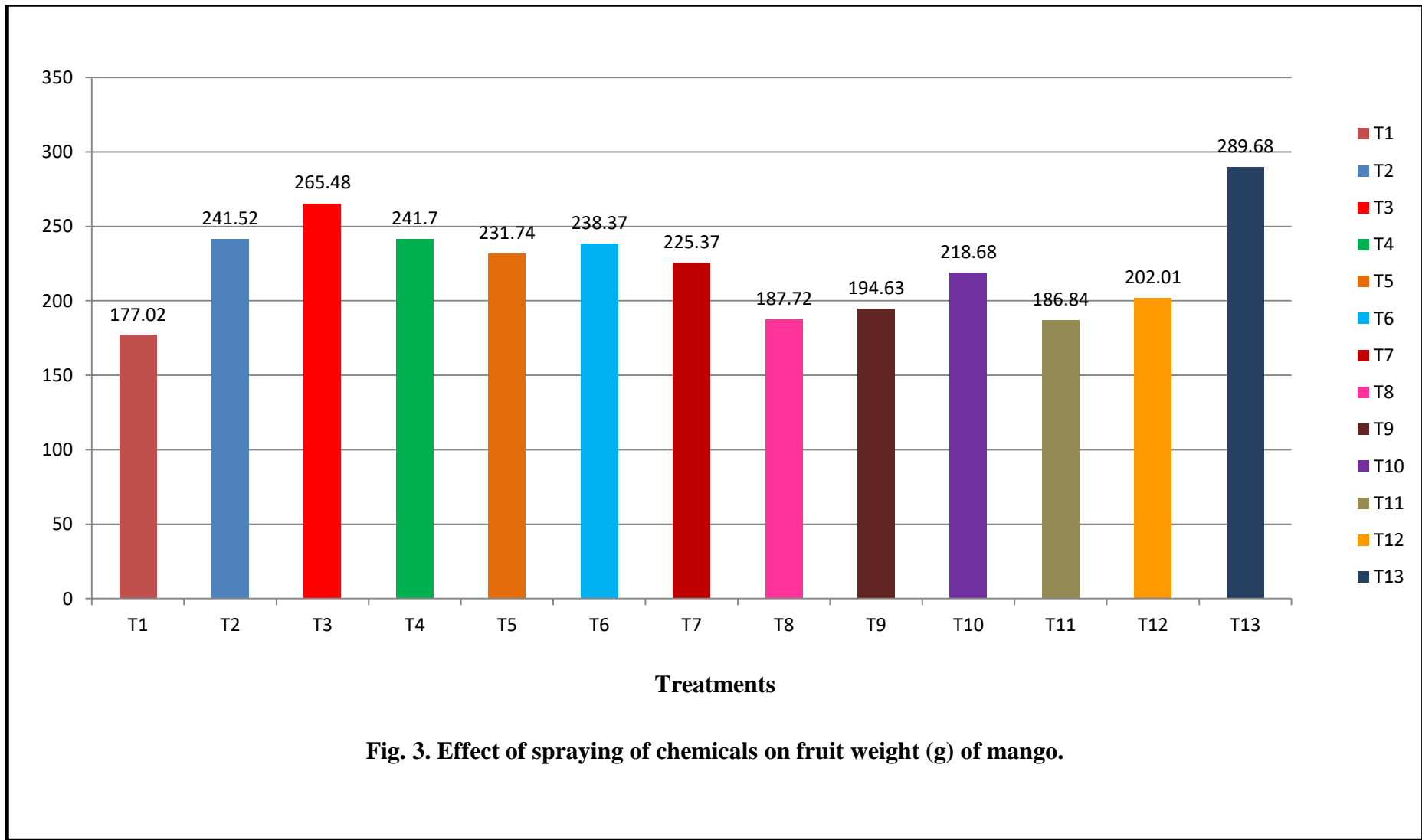
par with treatment T<sub>3</sub> NAA 40 ppm (174.96 g). However, minimum mesocarp-pulp (107.89 g) was observed in treatment T<sub>1</sub> control.

**Table 2: Effect of spraying of chemicals on weight of fruit (g), volume of fruit (ml) and mesocarp-pulp (g) of mango**

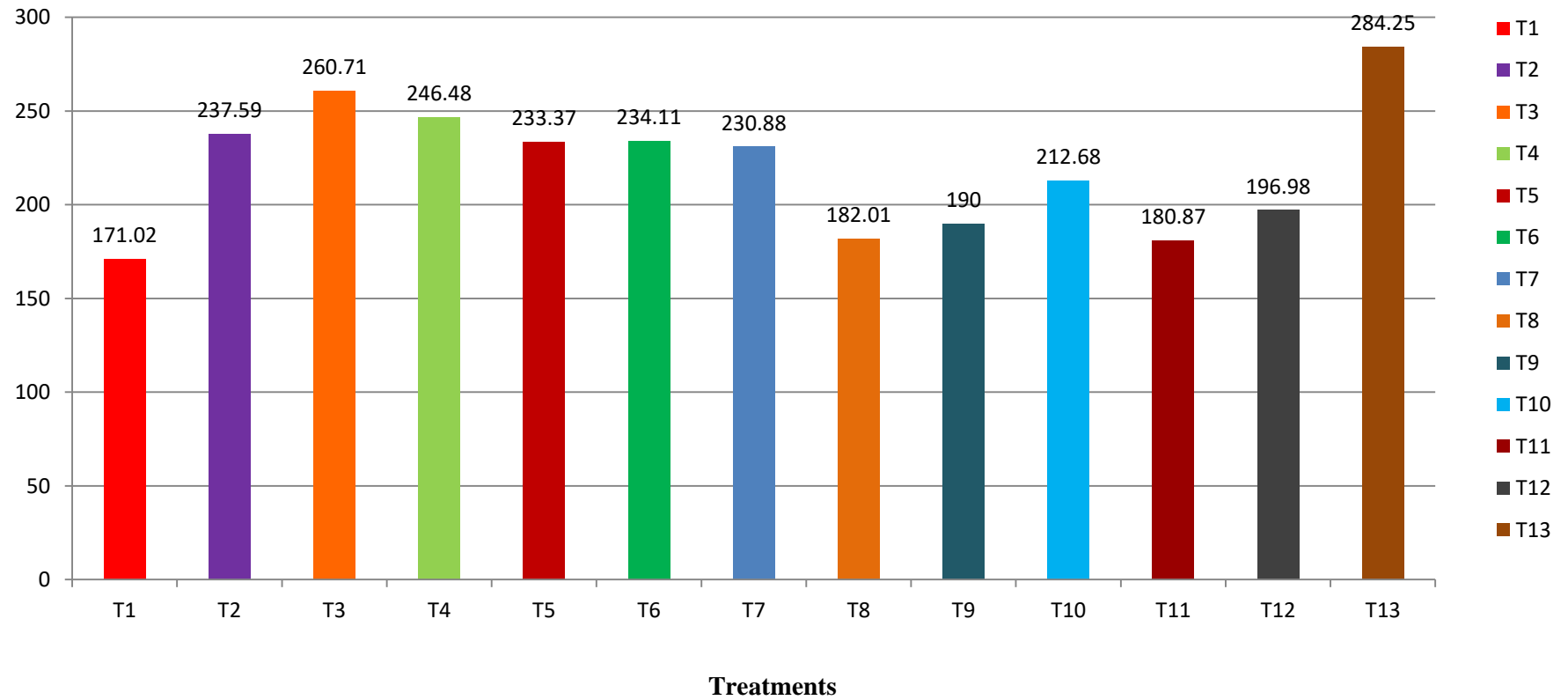
<b>Sr. No.</b>	<b>Treatment details</b>	<b>Weight of fruit (g)</b>	<b>Volume of fruit (ml)</b>	<b>Mesocarp-pulp (g)</b>
T <sub>1</sub>	Control	177.02	171.02	107.89
T <sub>2</sub>	NAA@20ppm	241.52	237.59	154.98
T <sub>3</sub>	NAA@40ppm	265.48	260.71	174.96
T <sub>4</sub>	NAA@60ppm	241.70	246.48	158.99
T <sub>5</sub>	KNO <sub>3</sub> @2%	231.74	233.37	146.06
T <sub>6</sub>	KNO <sub>3</sub> @4%	238.37	234.11	151.53
T <sub>7</sub>	KNO <sub>3</sub> @6%	225.37	230.88	147.77
T <sub>8</sub>	Urea@1%	187.72	182.01	115.84
T <sub>9</sub>	Urea@1.5%	194.63	190.00	121.27
T <sub>10</sub>	Urea@2%	218.68	212.68	136.39
T <sub>11</sub>	Triacantanol@100ppm	186.84	180.87	114.94
T <sub>12</sub>	Triacantanol@300ppm	202.01	196.98	125.95
T <sub>13</sub>	Triacantanol@500ppm	289.68	284.25	192.23
<b>S.E.m ±</b>		<b>10.50</b>	<b>10.33</b>	<b>6.72</b>
<b>C.D. at 5 %</b>		<b>30.65</b>	<b>30.15</b>	<b>19.62</b>

#### **4.7 Exocarp-skin (g)**

The data on exocarp-skin (g) was influenced by different treatments have presented in Table 3 and graphically presented in Fig. 5.



**Fig. 3. Effect of spraying of chemicals on fruit weight (g) of mango.**



**Fig. 4. Effect of spraying of chemicals on fruit volume (ml) of mango.**

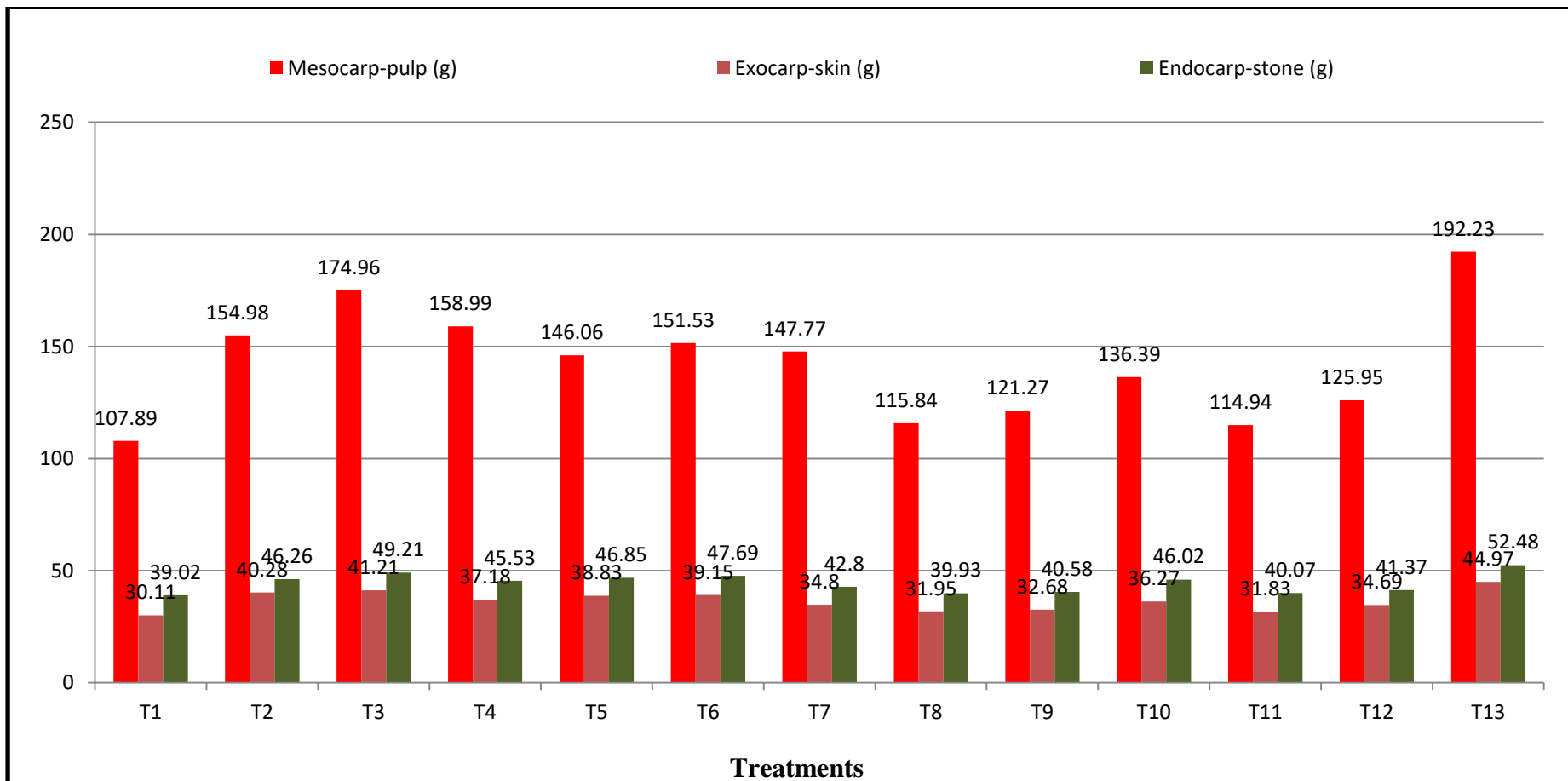
Perusal of data from table 3 indicated that significantly maximum exocarp-skin (44.97 g) was noticed in T<sub>13</sub> Triacantanol 500 ppm, which was at par with treatment T<sub>3</sub> NAA 40 ppm (41.21 g) and T<sub>2</sub> NAA 20 ppm (40.28 g). However, lowest exocarp-skin (30.11 g) was observed in treatment T<sub>1</sub> control.

**Table 3: Effect of spraying of chemicals on exocarp – skin (g) and endocarp stone (g) of mango**

<b>Sr. No.</b>	<b>Treatment details</b>	<b>Exocarp–skin (g)</b>	<b>Endocarp-stone (g)</b>
T <sub>1</sub>	Control	30.11	39.02
T <sub>2</sub>	NAA@20ppm	40.28	46.26
T <sub>3</sub>	NAA@40ppm	41.21	49.21
T <sub>4</sub>	NAA@60ppm	37.18	45.53
T <sub>5</sub>	KNO <sub>3</sub> @2%	38.83	46.85
T <sub>6</sub>	KNO <sub>3</sub> @4%	39.15	47.69
T <sub>7</sub>	KNO <sub>3</sub> @6%	34.80	42.80
T <sub>8</sub>	Urea@1%	31.95	39.93
T <sub>9</sub>	Urea@1.5%	32.68	40.58
T <sub>10</sub>	Urea@2%	36.27	46.02
T <sub>11</sub>	Triacantanol@100ppm	31.83	40.07
T <sub>12</sub>	Triacantanol@300ppm	34.69	41.37
T <sub>13</sub>	Triacantanol@500ppm	44.97	52.48
	<b>S.E.m ±</b>	<b>1.96</b>	<b>2.26</b>
	<b>C.D. at 5 %</b>	<b>5.73</b>	<b>6.60</b>

#### **4.8 Endocarp-stone (g)**

The data on endocarp-stone (g) was influenced by different treatments have presented in Table 3 and graphically presented in Fig. 5.



**Fig. 5. Effect of spraying of chemicals on mesocarp-pulp (g), exocarp-skin (g) and endocarp-stone (g) of mango.**

Perusal of data from table 3 indicated that, significantly maximum endocarp-stone (52.48 g) was noticed in T<sub>13</sub> Triacontanol 500 ppm, which was at par with treatment, T<sub>3</sub> NAA 40 ppm (49.21 g), T<sub>6</sub> KNO<sub>3</sub> 4% (47.69 g), T<sub>5</sub> KNO<sub>3</sub> 2% (46.85 g), T<sub>2</sub> NAA 20 ppm (46.26 g), and T<sub>10</sub> urea 2% (46.02 g) However, lowest endocarp-stone (39.02 g) was noticed in treatment T<sub>1</sub> control.

#### **4.9 Number of fruit per tree**

The data on number of fruit per tree was influenced by different treatments have presented in Table 4 and graphically presented in Fig. 6.

Perusal of data from table 4 indicated that, significantly maximum number of fruit per tree (204.46) was noticed in T<sub>13</sub> Triacontanol 500 ppm, which was at par with treatment T<sub>3</sub> NAA 40 ppm (196.88), T<sub>4</sub> NAA 60 ppm (192.52), T<sub>2</sub> NAA 20 ppm (186.40), and T<sub>6</sub> KNO<sub>3</sub> 4% (183.41). Whereas, minimum number of fruits (146.31) was observed in treatment T<sub>1</sub> control.

#### **4.10 Yield per tree (kg)**

The data on yield per tree (kg) was influenced by different treatments have presented in Table 4 and graphically presented in Fig. 7.

Perusal of data from table 4 revealed that, the maximum yield per tree (55.76 kg) was noticed in treatment T<sub>13</sub> Triacontanol 500 ppm, which was at par with treatment T<sub>3</sub> NAA 40 ppm (52.24 kg). Whereas, minimum yield per tree (25.89 kg) was observed in treatment T<sub>1</sub> (control).

#### **4.11 Yield per ha (t)**

The data on yield per ha (t) was influenced by different treatments have presented in Table 4 and graphically presented in Fig. 8.

Perusal of data from table 4 revealed that, the maximum yield per ha (22.30 t) was noticed in treatment T<sub>13</sub> Triacontanol 500 ppm, which was at par

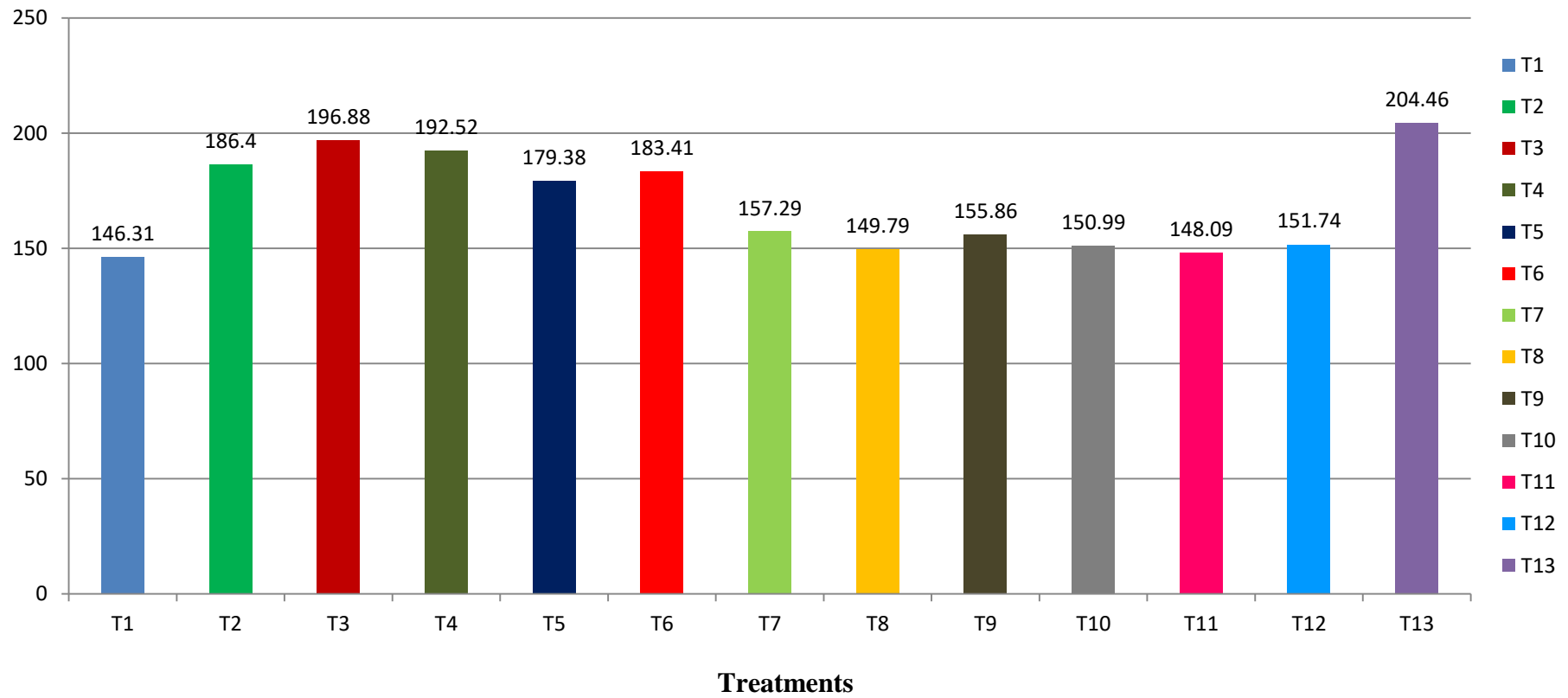
with treatment T<sub>3</sub> NAA 40 ppm (20.89t). Whereas, minimum yield per ha (10.35t) was observed in treatment T<sub>1</sub> (control).

**Table 4: Effect of spraying of chemicals on number of fruit per tree, yield per tree (kg) and yield per hecter (t) of mango**

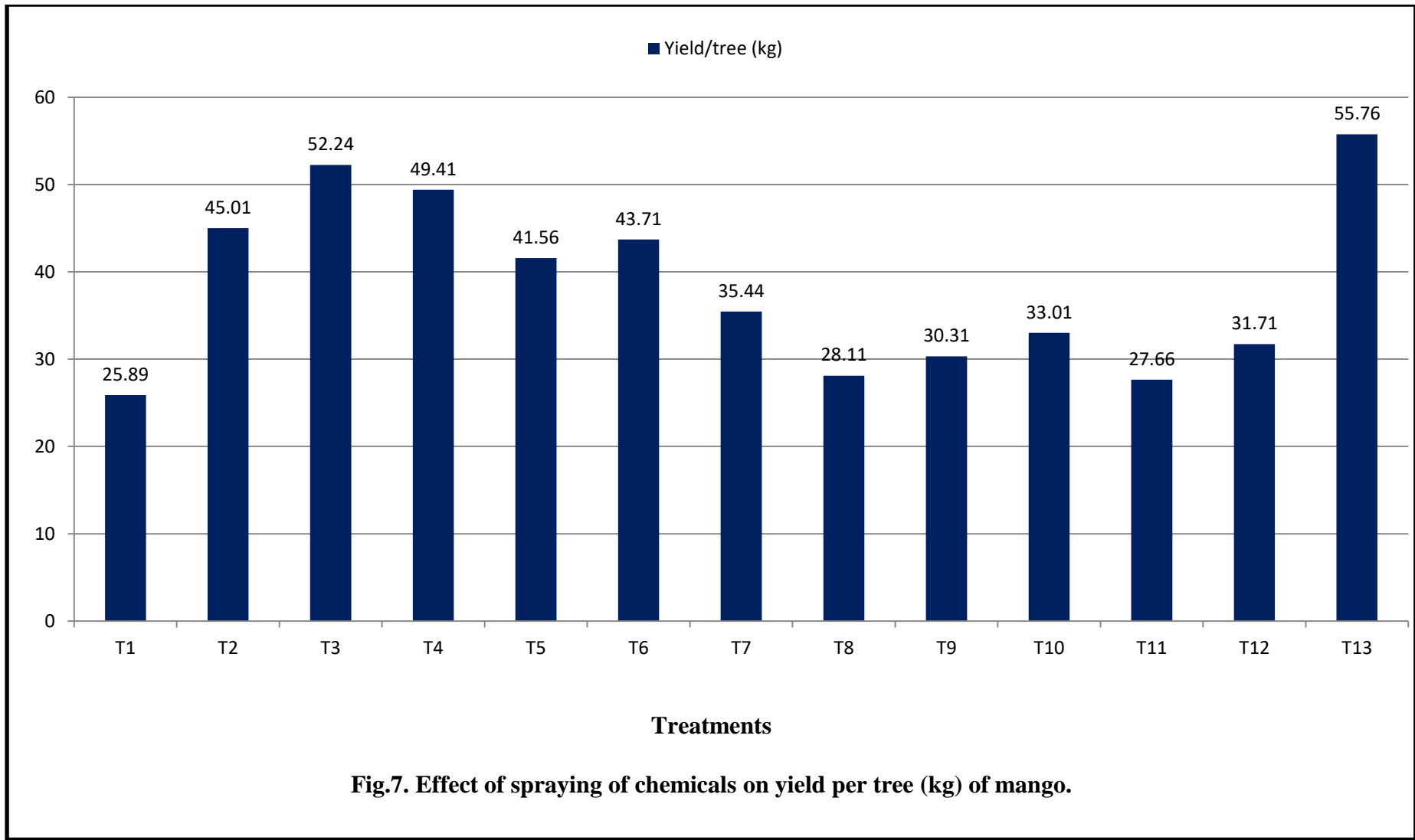
Sr. No.	Treatment details	Number of fruit per tree	Yield / tree (kg)	Yield /ha. (t)
T <sub>1</sub>	Control	146.31	25.89	10.35
T <sub>2</sub>	NAA@20ppm	186.40	45.01	18.00
T <sub>3</sub>	NAA@40ppm	196.88	52.24	20.89
T <sub>4</sub>	NAA@60ppm	192.52	49.41	19.76
T <sub>5</sub>	KNO <sub>3</sub> @2%	179.38	41.56	16.62
T <sub>6</sub>	KNO <sub>3</sub> @4%	183.41	43.71	17.48
T <sub>7</sub>	KNO <sub>3</sub> @6%	157.29	35.44	14.17
T <sub>8</sub>	Urea@1%	149.79	28.11	11.24
T <sub>9</sub>	Urea@1.5%	155.86	30.31	12.12
T <sub>10</sub>	Urea@2%	150.99	33.01	13.20
T <sub>11</sub>	Triacantanol@100ppm	148.09	27.66	11.06
T <sub>12</sub>	Triacantanol@300ppm	151.74	31.71	12.28
T <sub>13</sub>	Triacantanol@500ppm	204.46	55.76	22.30
<b>S.E.m ±</b>		<b>8.19</b>	<b>2.02</b>	<b>0.75</b>
<b>C.D. at 5 %</b>		<b>23.93</b>	<b>5.90</b>	<b>2.20</b>

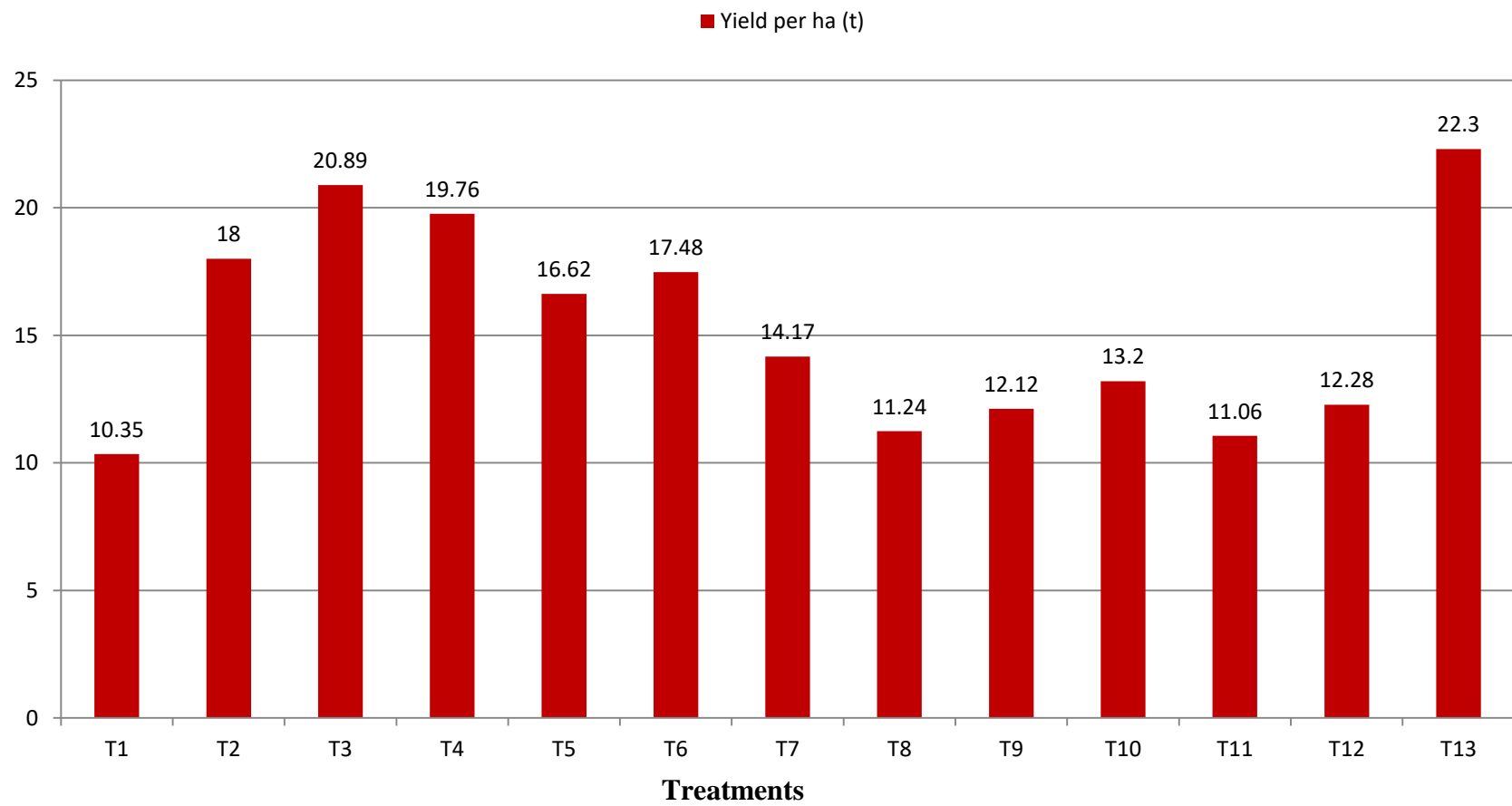
#### 4.12 TSS (%)

The data on TSS (%) was influenced by different treatments have presented in Table 5 and graphically presented in Fig. 9.



**Fig. 6. Effect of spraying of chemicals on number of fruit per tree of mango.**





**Fig. 8. Effect of spraying of chemicals on yield per ha (t) of mango.**

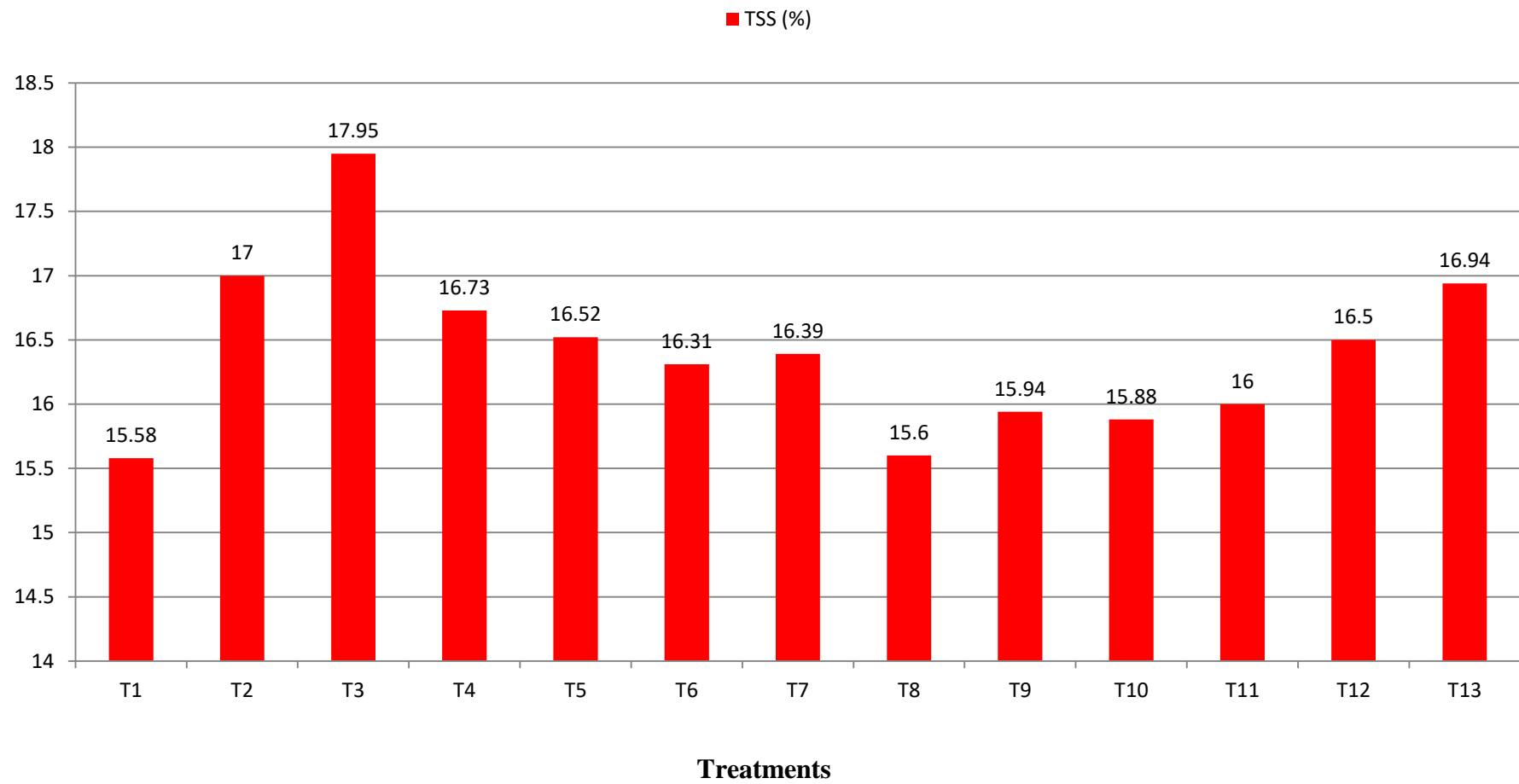
Perusal of data from table 5 revealed that, the maximum TSS (17.95%) was noticed in treatment T<sub>3</sub> NAA 40 ppm, which was at par with treatment T<sub>2</sub> NAA 20 ppm (17.00 %) and T<sub>13</sub> triacontanol 500 ppm (16.94%). Whereas, minimum TSS (15.58 %) was observed in treatment T<sub>1</sub> (control).

**Table 5: Effect of spraying of chemicals on TSS (%) and Acidity (%) of mango**

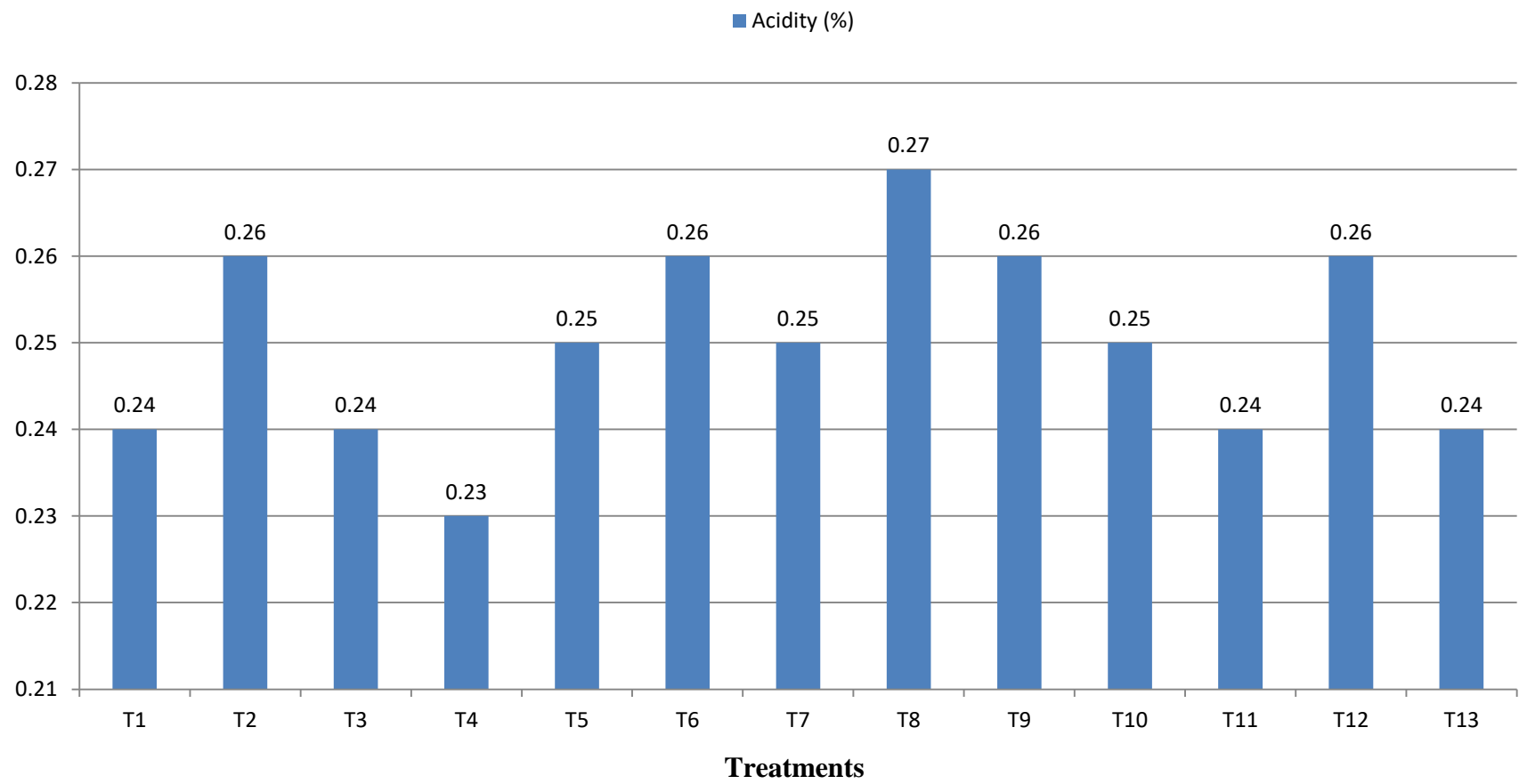
Sr. No.	Treatment details	TSS (%)	Acidity (%)
T <sub>1</sub>	Control	15.58	0.24
T <sub>2</sub>	NAA@20ppm	17.00	0.26
T <sub>3</sub>	NAA@40ppm	17.95	0.24
T <sub>4</sub>	NAA@60ppm	16.73	0.23
T <sub>5</sub>	KNO <sub>3</sub> @2%	16.52	0.25
T <sub>6</sub>	KNO <sub>3</sub> @4%	16.31	0.26
T <sub>7</sub>	KNO <sub>3</sub> @6%	16.39	0.25
T <sub>8</sub>	Urea@1%	15.60	0.27
T <sub>9</sub>	Urea@1.5%	15.94	0.26
T <sub>10</sub>	Urea@2%	15.88	0.25
T <sub>11</sub>	Triacantanol@100ppm	16.00	0.24
T <sub>12</sub>	Triacantanol@300ppm	16.50	0.26
T <sub>13</sub>	Triacantanol@500ppm	16.94	0.24
<b>S.E.m ±</b>		<b>0.34</b>	<b>0.01</b>
<b>CD at 5%</b>		<b>1.01</b>	<b>NS</b>

#### 4.13 Acidity (%)

The data on acidity (%) have presented in Table 5 and graphically presented in Fig. 10.



**Fig. 9. Effect of spraying of chemicals on TSS (%) of mango.**



**Fig. 10. Effect of spraying of chemicals on acidity (%) of mango.**

The data revealed that, the minimum acidity (0.23%) was recorded under treatment T<sub>4</sub> NAA 60 ppm. The maximum acidity (0.27%) was recorded under treatment T<sub>8</sub> urea 1%. However, remarkable difference was not observed among all the treatment included under this investigation for this attribute. Hence, the treatment was statistically non-significant.

#### **4.14 Reducing sugar (%)**

The data on reducing sugar (%) was influenced by different treatments have presented in Table 6 and graphically presented in Fig. 11.

Perusal of data from table 6 revealed that, the maximum reducing sugar (3.80%) was significantly increased in treatment T<sub>5</sub> KNO<sub>3</sub> 2 %, which was at par with treatment T<sub>6</sub> KNO<sub>3</sub> 4 % (3.71%) and T<sub>4</sub> NAA 60 ppm (3.59%). Whereas, minimum reducing sugar (3.17%) was observed in treatment T<sub>1</sub> (control).

#### **4.15 Non-reducing sugar (%)**

The data revealed that, the maximum non-reducing sugar (8.65%) was recorded under treatment T<sub>6</sub> KNO<sub>3</sub> 4%. The minimum non-reducing sugar (7.95%) was recorded under treatment T<sub>1</sub> (control). However, remarkable difference was not observed among all the treatment included under this investigation for this attribute. Hence, the treatment was statistically non-significant. It have presented in Table 6 and graphically presented in Fig. 11.

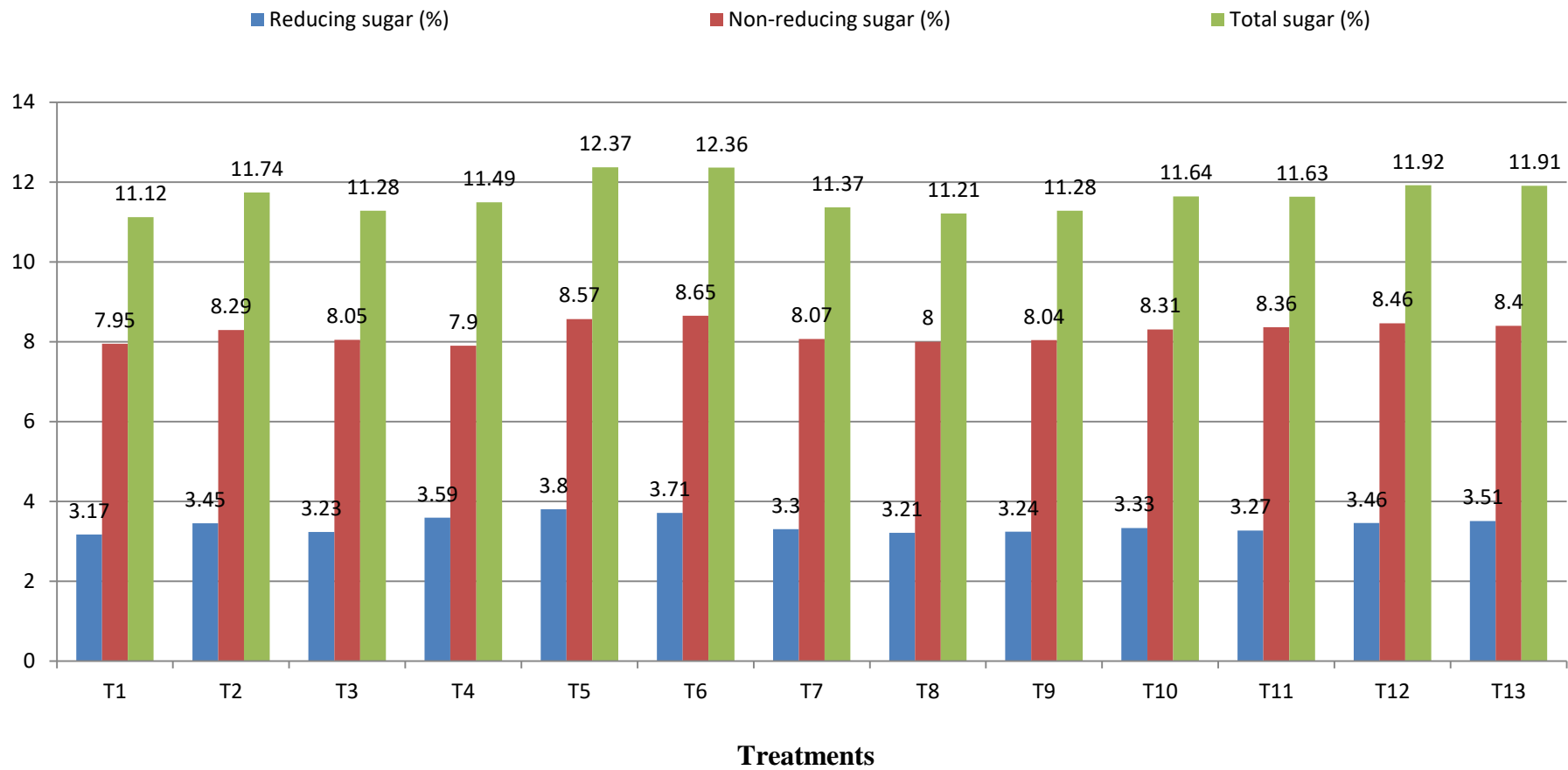
#### **4.16 Total sugar (%)**

Perusal of data from table 6 and graphically presented in Fig. 11. revealed that, the maximum total sugar (12.37%) was significantly increased in treatment T<sub>5</sub> KNO<sub>3</sub> 2%, which was at par with treatment T<sub>6</sub> KNO<sub>3</sub> 4% (12.36%), T<sub>12</sub> triacontanol 300 ppm (11.92%), T<sub>13</sub> triacontanol 500 ppm (11.91%), T<sub>2</sub> NAA

20 ppm (11.74%), T<sub>10</sub> urea 2% (11.64%) and T<sub>11</sub> triacontanol 100 ppm (11.63%). Whereas, minimum total sugar (11.12%) was observed in treatment T<sub>1</sub> (control).

**Table 6: Effect of spraying of chemicals on Reducing sugar (%), Non-reducing sugar (%) and Total sugar (%) of mango**

Sr. No.	Treatment details	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)
T <sub>1</sub>	Control	3.17	7.95	11.12
T <sub>2</sub>	NAA@20ppm	3.45	8.29	11.74
T <sub>3</sub>	NAA@40ppm	3.23	8.05	11.28
T <sub>4</sub>	NAA@60ppm	3.59	7.90	11.49
T <sub>5</sub>	KNO <sub>3</sub> @2%	3.80	8.57	12.37
T <sub>6</sub>	KNO <sub>3</sub> @4%	3.71	8.65	12.36
T <sub>7</sub>	KNO <sub>3</sub> @6%	3.30	8.07	11.37
T <sub>8</sub>	Urea@1%	3.21	8.00	11.21
T <sub>9</sub>	Urea@1.5%	3.24	8.04	11.28
T <sub>10</sub>	Urea@2%	3.33	8.31	11.64
T <sub>11</sub>	Triaccontanol@100ppm	3.27	8.36	11.63
T <sub>12</sub>	Triaccontanol@300ppm	3.46	8.46	11.92
T <sub>13</sub>	Triaccontanol@500ppm	3.51	8.40	11.91
<b>S.E.m ±</b>		<b>0.08</b>	<b>0.44</b>	<b>2.28</b>
<b>CD at 5 %</b>		<b>0.24</b>	<b>NS</b>	<b>0.82</b>



**Fig. 11. Effect of spraying of chemicals on reducing sugar (%), non-reducing sugar (%), total sugar (%) of mango.**



**Plate 2: Effect of Chemicals on fruits of mango Cv. Kesar.  
Treatment (T<sub>1</sub>) control**



**Plate 3: Effect of Chemicals on fruit of mango Cv. Kesar.  
Treatment (T<sub>13</sub>) Triacantanol 500 ppm**



# DISCUSSION



## CHAPTER - V

### DISCUSSION

An effort has been made in this chapter to discuss critically the important findings of the present study of the “Effect of chemicals on fruit retention and quality of mango (*Mangifera indica* L.) Cv. Kesar conducted during 2016-2017. The results of the present studies are below.

#### 5.1 Fruit set per panicle

#### 5.2 Fruit retention stage

#### 5.3 Physical characters of fruit

#### 5.4 Yield characters

#### 5.5 Quality characters

##### 5.1 Fruit set per panicle (%)

The experiment revealed that, the beneficial role of chemicals tested on increasing the fruit set in mango Cv. Kesar. Treatment T<sub>13</sub>-Triacontanol at 500 ppm was found to be the statistically superior treatment in increasing fruit set (97.75%). This might be due to application of Triacontanol, attributed to more efficient utilization of food for reproductive growth, flowering and fruit setting, higher photosynthetic efficiency and enhanced source to sink relationship in plants, increased uptake of nutrients and water, reduced transpiration and respiration, enhanced translocation and accumulation of sugar and other metabolites. Similar results found by Momin *et al.* (2016) in mango.

##### 5.2 Fruit retention stage (%)

The data revealed that, the treatment T<sub>13</sub>-Triacontanol at 500 ppm retain statistically more fruit per panicle pea stage (39.05%) and marble stage (13.66%), respectively than control. This might be due to application of

Triacntanol, attributed to more efficient utilization of food for reproductive growth, flowering and fruit setting, higher photosynthetic efficiency and enhanced source to sink relationship in plants, increased uptake of nutrients and water, reduced transpiration and respiration, enhanced translocation and accumulation of sugar and other metabolites. Similar results found by Konhar and singh (1988) in cashew and Bhamare *et al.* (2014) in mango.

### **5.3 Physical characters of fruit**

The effect of chemicals on fruit characters of mango *viz.*, Weight of fruit (g), Volume of fruit (ml), Mesocarp-pulp (g), Exocarp-skin (g) and Endocarp-stone (g) were found significant.

An appraisal of data indicated that, among all treatments, significantly highest average fruit weight (289.68 g), fruit volume (284.25 ml) and Mesocarp-pulp (192.23 g) was noted under the treatment T<sub>13</sub> (Triacntanol at 500 ppm) as compared to other treatments. This might be due to spraying of Triacntanol, attributed to more efficient utilization of food for reproductive growth, higher photosynthetic efficiency and enhanced source to sink relationship in plants, increased uptake of nutrients and water. Similar results found by Shinde *et al.* (2008) in mango.

In present investigation it was observed that, treatment T<sub>13</sub> Triacntanol at 500 ppm was found to be the statistically treatment in higher exocarp-skin (44.97 g) of fruit. The experiment revealed the beneficial role of chemicals tested on increasing the exocarp-skin in mango Cv. Kesar. However, the perusal of the literature available fails to throw light on these findings.

An appraisal of data indicated that, the treatment T<sub>13</sub> Triacntanol at 500 ppm was found to be the statistically treatment in higher endocarp-stone (52.48 g) of fruit. The experiment revealed the beneficial role of chemicals tested on

increasing the endocarp-stone (g) in mango Cv. Kesar. However, the perusal of the literature available fails to throw light on these findings.

#### **5.4 Yield characters**

The effect of different chemicals on yield characters of mango *viz.*, total number of fruits per tree, fruit yield per tree and average yield per ha were found significant.

As per the results from present investigation, statistically maximum number of fruit per tree (204.46) was noticed in treatment T<sub>13</sub> Triacantanol 500 ppm. This might be due to application of Triacantanol, increased photosynthetic activity in leaves and translocation of more photo assimilates. The experiment revealed the beneficial role of chemicals tested on increasing the number of fruit in mango Cv. Kesar. Similar results found by Momin *et al.* (2016) in mango.

An appraisal of data indicated that, the statistically maximum yield per tree (55.76 kg) was noticed in treatment T<sub>13</sub> Triacantanol 500 ppm. The experiment revealed the beneficial role of chemicals tested on increasing the yield per tree in mango Cv. Kesar. However, the perusal of the literature available fails to throw light on these findings.

As per the results from present investigation, statistically maximum yield per ha (22.30 t) was noticed in treatment T<sub>13</sub> Triacantanol 500 ppm. The experiment revealed that, the beneficial role of chemicals tested on increasing the yield per ha in mango Cv. Kesar. However, the perusal of the literature available fails to throw light on these findings.

#### **5.5 Quality characters**

The effect of different chemicals on quality characters of mango *viz.*, total soluble solid, reducing sugar and total sugar was found to be significant. While, titrable acidity and non-reducing sugar found non-significant.

As per the results from present investigation, statistically maximum TSS (17.95 %) was noticed in treatment T<sub>3</sub>-NAA 40 ppm. The experiment revealed the beneficial role of chemicals tested on increasing the TSS % in mango Cv. Kesar. Similar results found by Ghosh *et al.* (2009) in aonla.

The data revealed that, the maximum reducing sugar (3.80 %) and total sugar (12.37 %) was noticed in treatment T<sub>5</sub>-KNO<sub>3</sub> 2 %. This might be due to potassium reduces respiration, preventing energy losses through maintaining turgor pressure and reduces water loss in fruits which helps in improving the shelf life of fruits. The experiment revealed the beneficial role of chemicals tested on increasing the reducing sugar in mango Cv. Kesar. Similar results found by Patoliya *et al.* (2017) in mango.

The titrable acidity and non-reducing sugar were not influenced by the different treatment. The remarkable difference was not observed among all the treatments included under this investigation for this attribute. Hence, the treatments were statistically non-significant at this stage. Similar results found by Saha *et al.* (2017) in mango.



# **SUMMARY AND CONCLUSION**

## CHAPTER - VI

### SUMMARY AND CONCLUSION

The present investigation entitled “Effect of chemicals on fruit retention and quality of mango Cv. Kesar” were undertaken at mango orchard located at Fruit Research Station Aurangabad during 2016-2017. An experiment was laid out in Randomised Block Design along with thirteen treatments of chemicals at flowering, pea stage and at marble stage of fruit growth with three replications. The chemical treatments consistent NAA 20 ppm, NAA 40 ppm, NAA 60 ppm, KNO<sub>3</sub> 2%, KNO<sub>3</sub> 4%, KNO<sub>3</sub> 6%, Urea 1%, Urea 1.5%, Urea 2%, Triacntanol 100 ppm, Triacntanol 300 ppm, Triacntanol 500 ppm and control (water spray). The observation on fruit set, fruit retention at pea, marble, stages, fruit weight, volume of fruit, mesocarp-pulp (g), exocarp-skin (g), endocarp-stone(g), yield per tree (kg), yield per ha(t), number of fruits per tree, TSS (%), acidity (%), reducing sugar(%), non-reducing sugar (%) and toal sugar (%) were recorded.

All the chemicals treatments increased the fruit set than untreated control. The maximum fruit set (97.75%) was found in treatment Triacntanol 500 ppm followed by NAA 40 ppm, KNO<sub>3</sub> Urea with their different levels of treatments. The chemicals treatments decreased the fruit drop and there by increased the fruit retention at all the two stages of fruit development as compared to control. Treatment of Triacntanol at 500 ppm gives highest fruit retention at pea stage (39.05%) followed by NAA 40 ppm, NAA 60 ppm, KNO<sub>3</sub>, Urea treatment. The treatment of Triacntanol 500 ppm gave more retention of fruit at the marble stage (13.66%) and next better treatment was NAA 40 ppm, NAA 60 ppm followed by KNO<sub>3</sub> which shows better results than that of Urea and control.

All the chemical treatments gave maximum desirable physical characters like weight of fruit and volume of fruit treatment of Triacntanol at 500

ppm shows highest weight of fruit (289.68 g) and volume of fruit (284.25 ml) followed by treatment NAA 40 ppm. In case of mesocarp-pulp, Triacantanol 500 ppm shows greater mesocarp-pulp (192.23 g) than rest of the treatment. Maximum exocarp-skin (44.97 g) was observed in treatment T<sub>13</sub> Triacantanol 500 ppm followed by NAA 40 ppm and control. The maximum endocarp-stone (52.48 g) was observed in treatment Triacantanol 500 ppm.

Triacantanol 500 ppm gave more number of fruit per tree (204.46) and next better treatment was NAA 40 ppm, NAA 60 ppm followed by KNO<sub>3</sub>, which shows better results than that of Urea and control. Highest yield per tree (55.76 kg) was observed Triacantanol 500 ppm and next better treatment was NAA 40 ppm, which shows better results than that of KNO<sub>3</sub>, Urea and control. Maximum yield per ha (22.30 t) was observed Triacantanol 500 ppm and next better treatment was NAA 40 ppm, which shows better results than that of KNO<sub>3</sub>, Urea and control.

The highest TSS (17.95%) was observed NAA 40 ppm and next better treatment was NAA 20 ppm, which shows better results than that of KNO<sub>3</sub>, Urea, Triacantanol and control. The minimum acidity (0.23%) was observed NAA 60 ppm, which shows better results than that of NAA 40 ppm, Triacantanol 100 ppm, Triacantanol 500 ppm and control. Maximum reducing sugar (3.80%) was observed KNO<sub>3</sub> 2%, which shows better results than that of NAA, Urea, Triacantanol and control. Highest non-reducing sugar (8.65%) was observed KNO<sub>3</sub> 4%, which shows better results than that of NAA, Urea, Triacantanol and control. The maximum total sugar (12.37%) was observed KNO<sub>3</sub> 2%, which shows better results than that of NAA, Urea, Triacantanol and control.

## CONCLUSION

Thus from the result obtained on various aspects during the present investigations on effect of chemical on fruit retention and quality of mango can be concluded that:

- Spraying Triacontanol 500 ppm at flowering stage, pea stage and marble stage increased fruit retention and reduced the extent of fruit drop.
- The Triacontanol 500 ppm can increase the fruit weight, volume of fruit mesocarp-pulp, exocarp-skin and endocarp-stone.
- It helps to increase fruit yield and quality of the mango.

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



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## LITERATURE CITED

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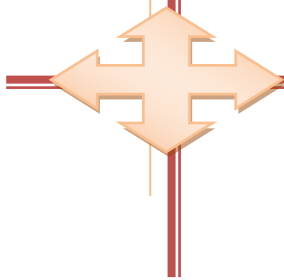
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# APPENDIX



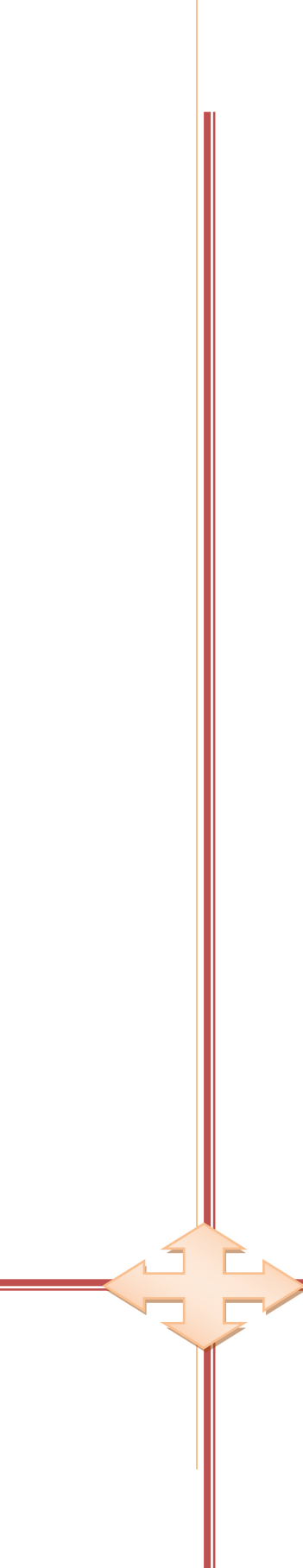
## APPENDIX - I

### NATIONAL AGRICULTURE RESEARCH PROJECT, AURANGABAD WEEKLY METEOROLOGICAL DATA FOR THE YEAR 2017

MW	Period	Rainfall (mm)	R.D.	Temperature °C		Humidity	
				Max.	Min.	RH <sub>1</sub>	RH <sub>2</sub>
1	01-07 Jan.	0.0	0.0	30.3	11.5	0.0	0.0
2	08-14 Jan.	0.0	0.0	29.0	10.0	0.0	0.0
3	15-21 Jan.	0.0	0.0	28.3	13.9	0.0	0.0
4	22-28 Jan.	0.0	0.0	30.2	15.3	0.0	0.0
5	29-04 Feb.	0.0	0.0	32.4	13.6	0.0	0.0
6	05-11 Feb.	0.0	0.0	32.7	15.0	0.0	0.0
7	12-18 Feb.	0.0	0.0	32.2	16.7	0.0	0.0
8	19-25 Feb.	0.0	0.0	35.1	17.3	0.0	0.0
9	26-04 Mar.	0.0	0.0	35.4	17.1	0.0	0.0
10	05-11 Mar.	0.0	0.0	34.2	17.6	0.0	0.0
11	12-18 Mar.	0.0	0.0	33.9	18.0	0.0	0.0
12	19-25 Mar.	0.0	0.0	36.1	20.4	0.0	0.0
13	26-01 Apr.	0.0	0.0	40.5	25.1	0.0	0.0
14	02-08 Apr.	0.0	0.0	38.7	23.4	0.0	0.0
15	09-15 Apr.	0.0	0.0	40.5	22.6	0.0	0.0
16	16-22 Apr.	0.0	0.0	41.6	25.1	0.0	0.0
17	23-29 Apr.	0.0	0.0	37.1	23.0	0.0	0.0
18	30-06 May.	0.0	0.0	39.7	24.5	0.0	0.0
19	07-13 May.	0.0	0.0	41.4	25.6	0.0	0.0
20	14-20 May.	0.0	0.0	40.9	25.9	0.0	0.0
21	21-27 May.	0.0	0.0	40.8	25.8	0.0	0.0
22	28-03 June.	0.0	0.0	36.3	25.4	0.0	0.0
23	04-10 June.	76.5	5.0	34.3	23.1	84	53
24	11-17 June.	109.0	3.0	32.7	22.0	89	59

Cont...

25	18-24 June.	0.0	0.0	33.9	22.7	85	59
26	25-01 July.	7.5	1.0	30.8	26.2	86	65
27	02-08 July.	20.5	2.0	31.4	21.4	85	70
28	09-15 July.	18.5	1.0	29.8	21.1	86	64
29	16-22 July.	23.0	0.0	28.2	21.0	92	79
30	23-29 July.	17.0	2.0	28.2	21.1	91	74
31	30-05 Aug.	3.0	1.0	30.6	21.1	90	64
32	06-12 Aug.	0.0	0.0	31.2	22.0	89	62
33	13-19 Aug.	7.0	1.0	31.4	22.3	86	69
34	20-26 Aug.	63.0	3.0	27.8	20.9	88	77
35	27-02 Sept.	30.0	2.0	20.4	14.4	89	77
36	03-09 Sept.	45.5	2.0	22.1	15.4	88	63
37	10-16 Sept.	62.5	3.0	30.5	21.3	91	75
38	17-23 Sept.	128.0	4.0	29.0	21.0	88	68
39	24-30 Sept.	0.0	0.0	31.4	21.7	87	58
40	01-07 Oct.	7.5	1.0	34.2	19.9	70	56
41	08-14 Oct.	33.0	3.0	29.8	21.1	92	65
42	15-21 Oct.	10.5	2.0	31.7	20.0	74	35
43	22-28 Oct.	0.0	0.0	33.6	19.1	70	33
44	29-04 Nov.	0.0	0.0	33.0	16.4	59	29
45	05-11 Nov.	0.0	0.0	31.3	15.1	59	36
46	12-18 Nov.	0.0	0.0	30.4	14.2	58	33
47	19-25 Nov.	0.0	0.0	30.4	18.3	64	40
48	26-02 Dec.	0.0	0.0	30.6	12.8	58	35
49	03-09 Dec.	0.0	0.0	28.6	16.3	65	52
50	10-16 Dec.	0.0	0.0	30.1	15.0	66	59
51	17-23 Dec.	0.0	0.0	29.9	13.8	59	31
52	24-31 Dec.	0.0	0.0	25.1	10.8	48	22
	<b>From Jan</b>	<b>662.0</b>	<b>35.0</b>				



**VITA**

## VITA

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