

*TO
MY
BELOVED
PARENTS
And
My Guru*



**“RESPONSE OF FOLIAR SPRAY OF DIFFERENT CHEMICALS
ON FLOWERING AND FRUITING IN DASHEHARI MANGO
UNDER ULTRA HIGH DENSITY PLANTATION”**

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BY

PATOLIYA RAHULKUMAR MANSUKHBHAI

B. Sc. (Hons.) Horticulture

**DEPARTMENT OF FRUIT SCIENCE
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY**

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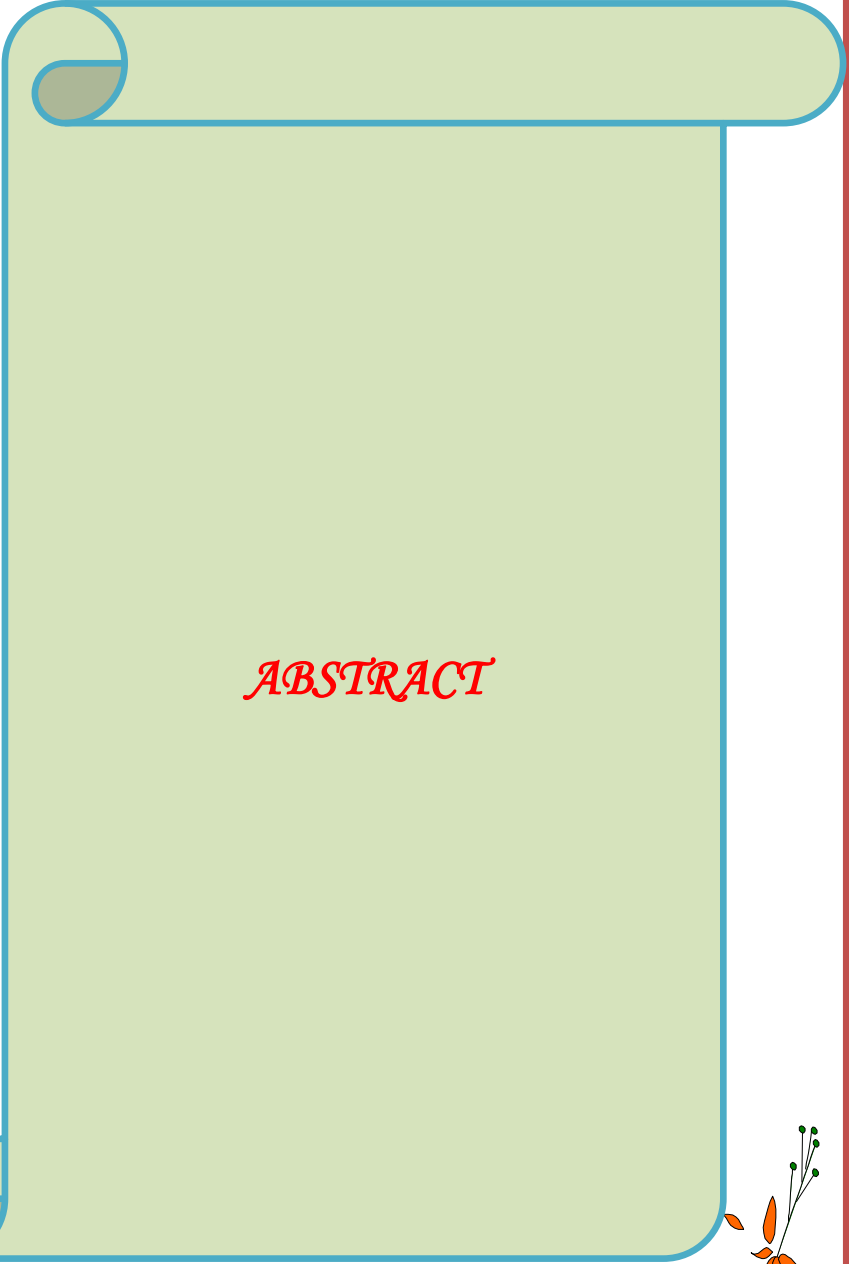
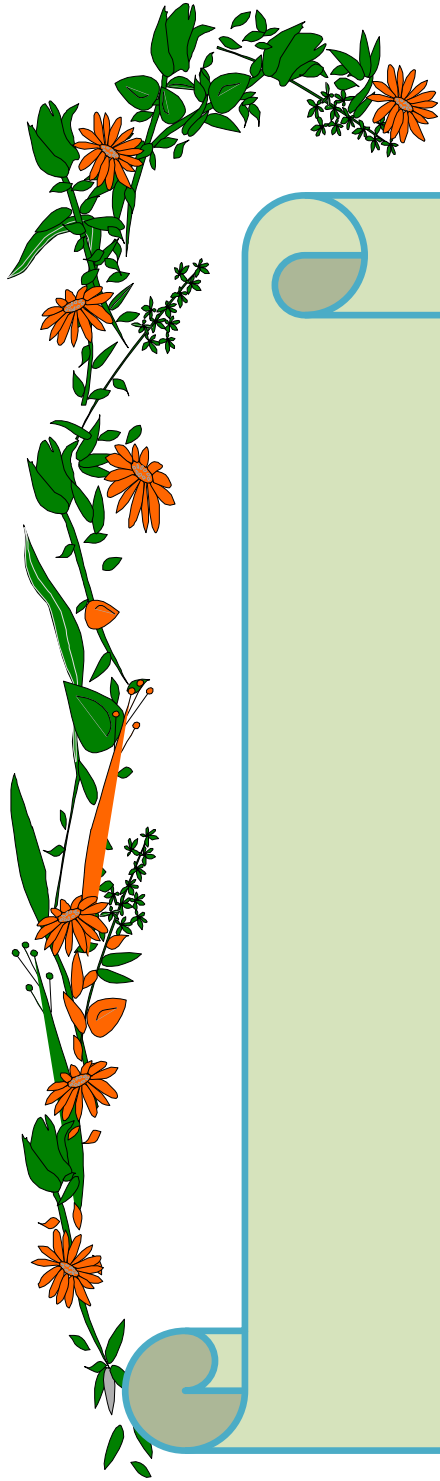
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❖ A. The Preliminary Pages ❖

1. Title Page
2. Abstract
3. Certificate
4. Declaration
5. Acknowledgements
6. Contents
7. List of Tables
8. List of Figures/graphs
9. List of Plates/photographs
10. List of Symbols and Abbreviations



ABSTRACT



**RESPONSE OF FOLIAR SPARY OF DIFFERENT
CHEMICALS ON FLOWERING AND FRUITING IN
DASHEHARI MANGO UNDER ULTRA HIGH DENSITY
PLANTATION**

Name of student:

Mr. Patoliya Rahulkumar M.

Major Guide:

Dr. B. M. Tandel

**DEPARTMENT OF FRUIT SCIENCE
ASPEE COLLEGE OF HORTICULTURE AND FORESTRY
NAVSARI AGRICULTURAL UNIVERSITY
NAVSARI - 396 450**

ABSTRACT

The present experiment entitled “Response of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation” was conducted during the year 2015-16 at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari.

The experiment was laid out in Randomized Block Design and replicated thrice. Nine treatments comprising urea (1, 1.5 and 2%), KNO_3 (1 and 2%), ethephon $200mg\ l^{-1}$ and novel organic liquid fertilizer (1 and 2%) along with one control and they were sprayed twice, first fortnight of October and November. The effect of these treatments on different parameters of flowering, fruiting, yield and quality were recorded and analyzed statistically.

Results of present investigation revealed that among all the treatments, foliar application of KNO_3 @ 2% treatment gave minimum vegetative shoot and maximum flowering shoot per terminal, minimum vegetative shoot (%), maximum flowering shoot (%), maximum length of panicle and minimum days for full bloom. Fruit setting percentage at pea, marble and maturity stage were significantly the maximum in same treatment.

The number of fruits, average fruit weight and yield (kg/tree) were significantly the maximum in KNO_3 @ 2% treatment. Untreated trees of mango produced minimum yield and its attributes as compared to other treatments. In case of quality parameters, foliar application of KNO_3 @ 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. For economic point of view, foliar application of KNO_3 @ 2% treatment at first fortnight of October and November were more remunerative in respect to net realization and benefit cost ratio.

On the basis of results obtained in present investigation, it can be summarized that foliar application of KNO_3 @ 2% at first fortnight of October and November, can be utilized for enhancing flowering, fruit retention, yield and quality in Dashehari mango under ultra high density plantation.



Dr. B. M. TANDEL
Associate Professor,
Department of Fruit Science,
ASPEE College of Horticulture and Forestry,
Navsari Agricultural University,
Navsari- 396 450

C E R T I F I C A T E

This is to certify that the thesis entitled
**“RESPONSE OF FOLIAR SPRAY OF DIFFERENT
CHEMICALS ON FLOWERING AND FRUITING IN
DASHEHARI MANGO UNDER ULTRA HIGH DENSITY
PLANTATION”** submitted by **PATOLIYA RAHULKUMAR
MANSUKHBHAI** in partial fulfilment of the requirements for
the award of the degree of **MASTER OF SCIENCE
(HORTICULTURE)** in the subject of **FRUIT SCIENCE** of
the Navsari Agricultural University, Navsari is a record of
bonafide research work carried out by him, under my guidance
and supervision and the thesis has not previously formed the
basis for the award of any degree, diploma or other similar
title.

Place : Navsari

(B. M. TANDEL)

Date : 03 /06 /2017

Major Guide

DECLARATION

This is to declare that the whole of the research work submitted in this thesis for the partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (HORTICULTURE)** in the subject of **FRUIT SCIENCE** is the result of investigation done by the undersigned under the direct guidance and supervision of **Dr. B. M. TANDEL**, Associate Professor, Department of Fruit Science, ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari and that no part of the work has been submitted for any other degree so far.

Place : Navsari

Date : 03 / 06/2017 (Patoliya Rahulkumar M.)

COUNTERSIGNED BY

(B. M. Tandel)

Associate Professor

Department of Fruit Science

ASPEE College of Horticulture and Forestry

Navsari Agricultural University

Navsari-396 450

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Place: Navsari

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(Patoliya Rahulkumar M.)

CONTENTS

CHAPTER	TITLE	PAGE
1	INTRODUCTION	1
2	REVIEW OF LITERATURE	6
2.1	Effect of KNO ₃	7
2.2	Effect of Urea	16
2.3	Effect of Ethephon	18
2.4	Effect of novel organic liquid Fertilizer	20
3	MATERIALS AND METHODS	23
3.1	General information	23
3.1.1	Experimental site	23
3.1.2	Climate and Weather conditions	23
3.2	Soil	24
3.3	Experimental material	25
3.4	Experimental details	26
3.5	Experimental design and layout	27
3.6	Salient features of variety	27
3.6.1	Dashehari	27
3.7	Preparation of solution	27
3.7.1	Urea	27
3.7.2	Potassium nitrate (KNO ₃)	28
3.7.3	Ethephon	28
3.7.4	Novel organic liquid fertilizer	28
3.7.5	Time and method of spray	29
3.8	Harvesting of fruits	29

CHAPTER	TITLE	PAGE
3.9	Methodology adopted in recording observation	29
3.9.1	Vegetative and reproductive growth parameters	29
3.9.1.1	Number of shoot – Vegetative shoot and flowering shoot per terminal	29
3.9.1.2	Vegetative shoot (%) and Flowering shoot (%)	29
3.9.1.3	Panicle length (cm)	30
3.9.1.4	Days require for full bloom	30
3.9.2	Yield parameters	30
3.9.2.1	No. of fruits set at pea size stage per panicle	30
3.9.2.2	No. of fruits set at marble stage per panicle	31
3.9.2.3	Number of fruits per panicle	31
3.9.2.4	Average Fruit weight (g)	31
3.9.2.5	Number of fruits per tree	31
3.9.2.6	Yield (kg/tree)	31
3.9.3	Quality parameters	
3.9.3.1	Shelf life (days)	31
3.9.3.2	Total soluble solids (°B)	32
3.9.3.3	Ascorbic acid (mg/100g pulp)	32
3.9.3.4	Reducing sugars (%)	33
3.9.3.5	Non- reducing sugars (%)	34
3.9.3.6	Total sugars (%)	34

CHAPTER	TITLE	PAGE
	3.9.3.7 Titrable acidity (%)	34
	3.9.3.8 Fruit firmness (kg/cm ²)	35
	3.9.4 Economics	35
	3.9.5 Statistical analysis	35
4	RESULTS	37
	4.1 Vegetative and reproductive growth parameters	37
	4.1.1 Number of shoot- vegetative shoot and flowering shoot per terminal and vegetative shoot (%) and flowering shoot (%)	38
	4.1.2 Panicle length (cm)	40
	4.1.3 Days require for full bloom	42
	4.2 Yield parameters	
	4.2.1 Number of fruit set at pea size and marble stage per panicle	42
	4.2.2 Fruit retention (%) at mature stage per panicle	44
	4.2.3 Number of fruits per tree	46
	4.2.4 Average fruit weight (gm)	47
	4.2.5 Yield (kg/tree)	47
	4.3 Quality parameters	
	4.3.1 Shelf life (days)	49
	4.3.2 Total soluble solids (⁰ Brix)	49
	4.3.3 Ascorbic acid (mg/100gm pulp)	50
	4.3.4 Total sugar (%)	51
	4.3.5 Reducing sugar (%)	54

CHAPTER	TITLE	PAGE
	4.3.6 Non reducing sugar (%)	54
	4.3.7 Titrable acidity (%)	55
	4.3.8 Fruit firmness (kg/cm ²)	55
	4.4 Economics of the treatments	57
5	DISCUSSION	58
	5.1 Effect of different chemicals on vegetative and reproductive growth parameters	59
	5.2 Effect of different chemicals on yield parameters	61
	5.3 Effect of different chemicals on quality parameters	64
	5.4 Economics	67
6	SUMMARY AND CONCLUSIONS	68
	6.1 Summary	68
	6.1.1 Vegetative and reproductive growth parameters	68
	6.1.2 Yield parameters	69
	6.1.3 Quality parameters	70
	6.1.4 Economics	70
	6.2 Conclusion	71
	REFERENCES	XIX
	APPENDICES	
	Appendices- I	XXXII
	Appendices- II	XXXIII

LIST OF TABLES

Table No.	Title	Page No.
3.1	Initial (chemical) properties of soil	25
4.1	Effect of different chemicals on number of vegetative shoot and flowering shoot per terminal in Dashehari mango under ultra high density plantation.	39
4.2	Effect of different chemicals on vegetative shoot (%) and flowering shoot (%) in Dashehari mango under ultra high density plantation.	40
4.3	Effect of different chemicals on panicle length (cm) in Dashehari mango under ultra high density plantation.	41
4.4	Effect of different chemicals on days require for full bloom (days) in Dashehari mango under ultra high density plantation.	43
4.5	Effect of different chemicals on number of fruits set at pea and marble stage per panicle in Dashehari mango under ultra high density plantation.	45
4.6	Effect of different chemicals on fruit retention (%) at mature stage per panicle in Dashehari mango under ultra high density plantation.	46
4.7	Effect of different chemicals on number of fruits per tree, average fruit weight and yield (kg per tree) in Dashehari mango under ultra high density plantation.	48
4.8	Effect of different chemicals on shelf life (days) in Dashehari mango under ultra high density plantation.	50
4.9	Effect of different chemicals on TSS (°Brix) and ascorbic acid (mg/100gm pulp) in Dashehari mango under ultra high density plantation.	52

4.10	Effect of different chemicals on total sugar, reducing sugar and non reducing sugar (%) in Dashehari mango under ultra high density plantation.	53
4.11	Effect of different chemicals on titrable acidity (%) and fruit firmness (kg/cm ²) in Dashehari mango under ultra high density plantation.	56
4.12	Effect of different chemicals on economics of Dashehari mango under ultra high density plantation.	58

LIST OF FIGURES

Fig. No.	Title	After page No.
1.	Layout of the mango orchard	27
2.	Effect of different chemicals on number of vegetative shoot and flowering shoot per terminal in Dashehari mango under ultra high density plantation	39
3.	Effect of different chemicals on vegetative shoot (%) and flowering shoot (%) in Dashehari mango under ultra high density plantation	40
4.	Effect of different chemicals on panicle length (cm) in Dashehari mango under ultra high density plantation	41
5.	Effect of different chemicals on days require for full bloom (days) in Dashehari mango under ultra high density plantation.	43
6.	Effect of different chemicals on number of fruit set at pea size and marble stage per panicle in Dashehari mango under ultra high density plantation	45
7.	Effect of different chemicals on fruit retention (%) at mature stage per panicle in Dashehari mango under ultra high density plantation	46
8.	Effect of different chemicals on number of fruits per tree in Dashehari mango under ultra high density plantation	48
9.	Effect of different chemicals on average fruit weight (gm) in Dashehari mango under ultra high density plantation.	48
10.	Effect of different chemicals on yield (kg/tree) in Dashehari mango under ultra high density plantation	48

11.	Effect of different chemicals on shelf life (days) in Dashehari mango under ultra high density plantation	50
12.	Effect of different chemicals on TSS (°Brix) and ascorbic acid (mg/100gm pulp) in Dashehari mango under ultra high density plantation	50
13.	Effect of different chemicals on total sugar, reducing sugar and non reducing sugar (%) in Dashehari mango under ultra high density plantation	53
14.	Effect of different chemicals on titrable acidity (%) and fruit firmness (kg/cm ²) in Dashehari mango under ultra high density plantation	56

LIST OF PLATE

Plate	Title	After Page No.
1	General view of experimental site	60
2	Pea size and marble stage per panicle in Dashehari mango under ultra high density plantation.	61
3	Fruiting in Dashehari mango under ultra high density plantation.	62
4	Measurement of quality parameters	65

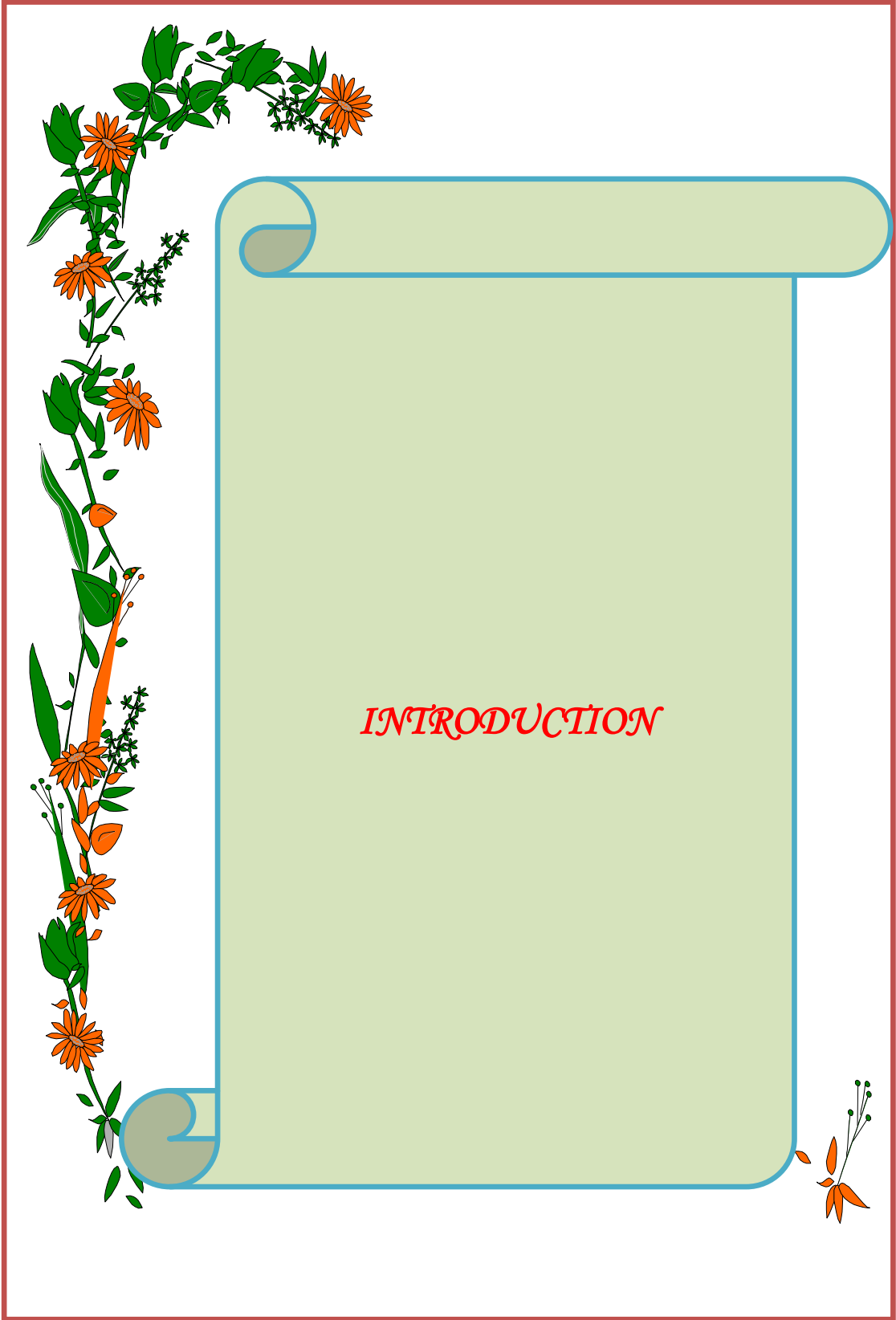
LIST OF ABBREVIATIONS AND SYMBOLS

Sr. no	Abbreviations/ symbols	Meaning
1	Anon.	Anonymous
2	C.D.	Critical difference
3	C.V.	Co-efficient of Variance
4	cm	Centimeter
5	Var.	Variety
6	<i>et al.</i>	<i>Et alii</i> (and others)
7	Fig.	Figure
8	RBD	Randomized Block Design
9	g	Gram
10	ha	hectare (s)
11	<i>i.e.</i>	That is
12	kg	Kilogram
13	ml	Milliliter
14	m	Meter
15	mg	Milligram
16	mm	Millimeter
17	mg l ⁻¹	Milligram per litre
18	m ²	Square meter
19	T ha ⁻¹	Tones per hector
20	Kg tree ⁻¹	Kilogram per tree
21	MT	Metric Tones
22	NAU	Navsari Agricultural University
23	no.	Number
24	NS	Non-significant

25	NOLF	Novel organic liquid fertilizer
26	ppm	Parts per million
27	S.Em.±	Standard error of mean
28	Eq. wt.	Equivalent weight
29	TSS	Total soluble solids
30	<i>viz.,</i>	Videlicet (Namely)
31	°C	degree Celsius or centigrade
32	±	plus or minus
33	@	at the rate of
34	%	per cent
35	=	is equal to
36	x	Multiply
37	-	Minus
38	()	Bracket parenthesis
39	/	Per
40	;	Semi colon
41	:	Hyphen
42	Max	Maximum
43	Min	Minimum
44	AES	Agriculture Experimental Station
45	RHRS	Regional Horticultural Research Station

❖ B. The Text ❖

1. Introduction
2. Review of Literature
3. Materials and Methods
4. Experimental Results
5. Discussion
6. Summary and Conclusions



I. INTRODUCTION

Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae is universally accepted as the finest tropical fruit of the world and has been called, in the orient, “King of fruits”. Mango is rightly known as ‘National Fruit of India’, owing to its nutritional richness, unique taste and flavour, religious and medicinal importance. It is third widely produced fruit crop of the tropics after banana and citrus.

It possesses good nutritive and medicinal values. It is internationally known as the fruit ambassador of India. It is because of its excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and high nutritive value.

The nutritional point of view, ripe mango is rich source of sugars, an excellent source of Vitamin - “A” and fair amount of Vitamin – “C”, apart from the usual content of minerals and other Vitamins. Mango fruits are put to various uses right from the initial stages of development to maturity and ripening. The ripe fruit, besides being used for dessert are also utilized for preparing several products and has a great potential as an item of export both as fresh and processed form.

All the cultivated Indian mangoes belong to the single species *Mangifera indica* L. that is the most important member of the family Anacardiaceae. The mango is indigenous to North East india and North Burma, in the foot hills of the

Himalayas, and is said to have originated in the Indo Burma region (Mukherji, 1953). Other well known relatives are Cashew (*Anacardium occidentale* L.), Pistachio nut (*Pistacia vera* L.), Hong plum (*Spondias cythera*) and Indian hog plum (*Spondias pinnata*).

Gujarat is one of the major mango growing states which mainly focus on export purpose. A larger area is being brought under mango cultivation, which needs technological backup for making Gujarat a strong mango growing state, for better income generation, employment opportunities and nutritional security.

In India, the area is about 2516.0 ('000 ha) and production 18431.3 ('000) MT with productivity 7.3 MT/ha. While in Gujarat, the area is about 142.69 ('000 ha) and production 1125.61 ('000) MT with productivity 7.9 MT/ha (Anon., 2014^a).

It is andromonoecious plant bearing male and hermaphrodite flowers separately on terminal panicles. There are two different types of flowers in succession on the same tree, but usually on different panicles or branches, hermaphrodite with abortive ovary (functional male), hermaphrodite female with non-dehiscent anthers (functional female) and male (Mustard and Lynch, 1945).

Mango is dicotyledonous, cross pollinated with entomophilous, allopolyploid in nature and having chromosome number is $2n = 40$. Mango inflorescence is

primarily terminal but axillary and multiple panicles may also arise from axillary buds quite frequently. The flowers are closely clustered towards the apices of each branch or main axis and are either male or hermaphrodite. The total number of flowers in a panicle may be varying from 1,000 to 6,000 depending upon the varieties (Mukherjee, 1953).

The flowering, fruit set and fruit yield of mango are the most critical events and it's depend upon many biotic and abiotic factors, amongst them foliar spray of growth regulators and growth retardants play very important role in regulating them in mango. These equally true for mango qualitative and quantitative production also.

In India productivity of mango is low as compared to Israel and Australia, it is due to the poor orchard management practices like inadequate or lack of nutrient management practices, training and pruning, water management and pest-diseases management. Out of that nutrient management in mango is one of the important practice for improving yield and quality of fruit. Use of imbalanced or inadequate use of fertilizer in some mango growing areas, leading to nutrient deficiencies especially potassium.

Potassium is major nutrient attributed to the stimulating effect of K on photosynthesis, phloem loading and translocation as well as synthesis of large molecular weight in the developing fruits (Rabeh and Sweelam, 1990). Further sulphur increase the absorption of potassium or it react with

nitrogen and potassium (Farrag *et al.*, 1990). It helps in energy transformation and activation of enzymes in carbohydrate metabolism which subsequently partitioning of photosynthates to the developing fruits.

Potassium nitrate (KNO_3), also known as saltpeter or nitric acid is considered a special fertilizer. It is a colorless transparent crystal or white powder with 14 % nitrogen (N) and 46 % potassium (K). KNO_3 is one of the chemical inducing substances that have shown some potential for inducing flowering in mango by increasing the activity of nitrate reductase and stimulating the production of ethylene. (Beevers and Hageman, 1969). The use of KNO_3 has been employed in various countries, like Mexico, United States (Hawaii) and Malaysia for off season flowering and quality improvement. (Afiqah *et al.*, 2014).

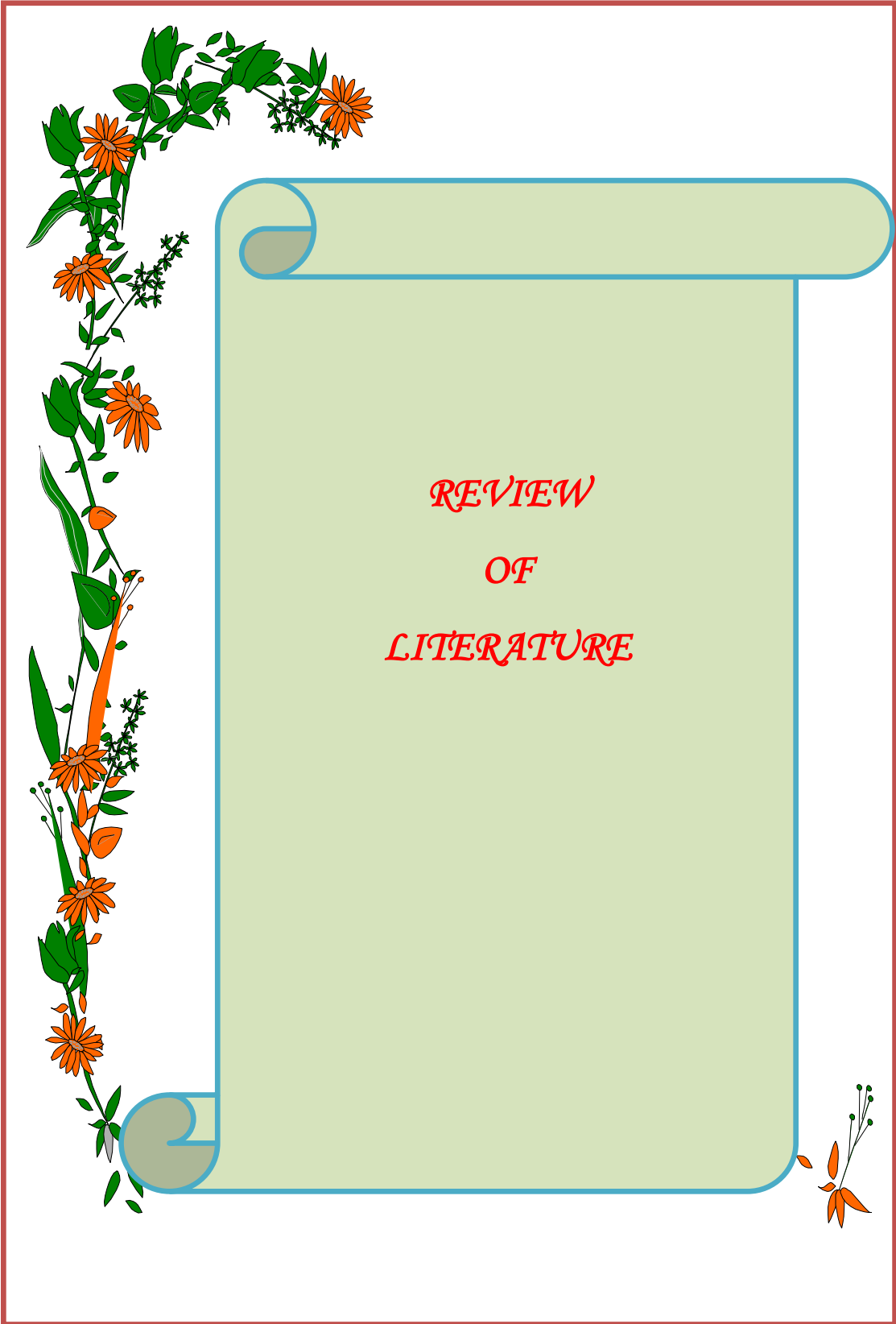
Urea is the richest source of nitrogen among the common dry fertilizers. Urea is the most important nitrogenous fertilizer. There are two main reason for urea fertilizer to be the king of fertilizers. Firstly. It has high nitrogen content about 46 percent. Secondly, it is a white crystalline organic chemical compound. It is neutral and can adapt to almost all the land. In case of mango, Pre-flowering foliar spray of urea have been found to increase the number of fruit retained per panicle. Pre-flowering urea spray application was reported to be effective increasing the number of leafy inflorescences produced by Washington navel orange trees (singh *et. al.* 2005).

Novel organic liquid fertilizer is pure organic product. It contains NPK as well as micro nutrients and it also contains naturally occurring growth promoters. It is reduce fruit drop and increase fruit size and setting. It is a growth promoter, it is very helpful in nursery plants. It enhance total plant growth, number of flower, maximum conversion of flowers into fruits and pods. It also enhance vigorous root development and growth.

In view of considering above facts, the present investigation is planned on effect of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation with the following objectives.

Objectives:

- i.** To study the effect of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation.
- ii.** To study the effect of foliar spray of different chemicals on yield and quality in Dashehari mango under ultra high density plantation.



*REVIEW
OF
LITERATURE*

II. REVIEW OF LITERATURE

India is one of the horticultural rich country in the world and it produces large number of fruits. Total area and production of fruit crops are 6982 ('000 ha) and 81285 ('000 MT), respectively with the 11.6 MT per ha productivity from which mango covered maximum area under cultivation with second highest production so mango is economically very important fruit crop (Anon., 2014^a).

The flowering, fruit set and fruit yield of mango are the most critical events and it's depend upon many factors, amongst them foliar spray of growth regulators and fertilizers play very important role. These are equally true for mango qualitative and quantitative production also, there for the available literature related to the effect of KNO₃ and Urea on mango as well as related crops are highlighted in this chapter.

Beevers and Hageman (1969) and Filner *et al.* (1969) reported ability of KNO₃ and other nitrate sources as inducing nitrate reductase in many species. Nitrate reductase is a key enzyme in nitrate assimilatory pathway for amino acids synthesis. Methionine has been reported to promote mango flowering and is a precursor of ethylene (Maity *et al.*, 1972). KNO₃ stimulated flowering of mango is mediated by increased levels of endogenous ethylene (Davenport and Nunez-Elisea, 1997). Potassium nitrate is a universal rest-breaking agent in deciduous fruit trees (Erez and Lavee, 1974) that may simply hasten flower emergence of a differentiated but dormant mango bud.

Foliar application of fertilizers effects on mango as well as other related fruit crops covered and highlighted in this chapter. Since last so many years, a considerable research work has been done in the country and abroad on such aspects. These reviews have been collected and systemically presented in respective sub-headings:

2.1 Effect of KNO_3

2.2 Effect of Urea

2.3 Effect of Ethephon

2.4 Effect of Novel organic liquid fertilizer

2.1 Effect of KNO_3

Mango:

Bhuyan and Irabagon (1993) observed the mango trees of Carabao cultivar, which was fertilizer applied, irrigated and sprayed with 2 per cent KNO_3 twelve week after full bloom which retained higher number of fruits per panicle (2.05) as compared to other treatments and control.

Oosthuysen (1997) studied the effect of KNO_3 spray @ 2 or 4% either once during the flowering period, i.e., when the inflorescences were in bloom or twice during this period, i.e., when the inflorescences were actively extending and subsequently when they were in bloom in mango. In 'Tommy Atkins', the highest fruit retention occurred due to single application of KNO_3 @ 4%. In 'Heidi', two applications @ 4% each gave rise to the greatest increased and in 'Kent', two applications @ 2% each increased

fruit retention. In every cultivar, slight reductions in average fruit weight (final fruit size) were associated with the increases in fruit retention found. KNO_3 increased tree yield in each cultivar. The greatest increased K in yield corresponded with the greatest increases in fruit retention found. There was no apparent effect of the KNO_3 sprays on fruit quality (ground skin colouration, total soluble solids content, pH, or taste on ripening).

Foliar application of PBZ 10 ml/tree produced highest yield (37.84 kg/tree) followed by 1 per cent KNO_3 (26.92 kg/tree), which was significantly higher than that of control (13.03 kg/tree) in mango *cv.* Alphonso (Vijayalakshmi and Srinivasn, 1998).

Anbu *et al.*, (2001) reported that the application of 2 per cent KNO_3 when fruit attain mustard size resulted in maximum yield of 17.67 kg per tree during off-season and 14.0 kg per tree during main season in 7 year old Neelum mango trees. Potassium nitrate sprayed at mustard size improved the fruit set and retention of fruits until maturity.

Burondkar *et al.*, (2002) studied the effect of different sources and doses of potassium on yield and quality of Alphonso mango and reported the trees, which received recommended dose of K through SOP as soil application when supplemented with 1 per cent KNO_3 foliar sprays at pea stage, registered maximum fruit yield (74.9kg/tree) over rest of the treatments including control (39.38 kg/tree).

Kumar *et al.*, (2003) reported that the foliar application of KNO₃ (2%) sprays gave maximum fruits per panicles, yield per tree (kg), and TSS (%) in mango *cv.* Baneshan.

Gupta and Brahmachari (2004) observed that foliar application of KNO₃ and urea (2, 4 and 6%) increased the fruit retention in mango *cv.* Bombay. The maximum fruit retention (2.27%) was noticed with application of 4 per cent KNO₃ as compared to 2 per cent (2.01%), 6 per cent (1.75%) and control (1.50%).

Yeshitela (2004) studied the effect of potassium nitrate concentrations especially in combination with urea at different concentrations on flowering, fruit set and fruit quality of 'Tommy Atkins' mango grown in the rift valley of Ethiopia. Potassium nitrate concentrations in combination with urea (5 litre solution of KNO₃ @ 4% + 0.5 g urea/tree and 5 litres of KNO₃ @ 4% +1 g urea per tree) produced best results for most of the flowering and yield parameters. The trees were sprayed at full bloom stage and another spray was given two and half month after first spray.

Dalal *et al.*, (2005) recorded the maximum fruit set (2.08%) and number of fruit (305.77 fruits/tree) with treatment 1.5 per cent KNO₃ foliar spray on 12th October in mango *cv.* Pairi.

Shinde *et al.*, (2006) recorded significant increase in fruit retention (34.28%), fruit yield (28.93%), fruit weight (5.15%) and ascorbic acid (26.99%) with three foliar sprays of

1% KNO_3 at peanut, marble and egg stage over control in Alphonso mango.

Burondkar *et al.*, (2009) conducted an experiment on post flowering morpho- physiological behavior of Alphonso mangoes as influenced by plant growth regulators, polyamine and nutrients under rainfed conditions. They noted that application of KNO_3 (1%) at pea and marble stage significantly increased the size of individual fruits, number of fruits and maximum fruit retention.

Nahar *et al.* (2010) studied the effect of different chemicals on the flowering and fruiting of nine years old mango cv. Amrapali and six years old Longan (*Dimocarpous longan*) at the BAU Germplasm Centre, FTIP, Bangladesh Agricultural University, Mymensingh in one fruiting season from November 2008 to July 2009. Amrapali variety of mango and Malaysian Longan were taken under study. The different chemicals potassium chlorate (KClO_3) (0.93g per ft^2 canopy ground area), potassium nitrate (KNO_3) @ 4% and urea at 4% were used. The experiment was laid out in randomized complete block design (RCBD) with three replications. In mango 4% KNO_3 was considered to be the best among the three treatments in terms of earlier emergence of panicle, number of panicles plant-1, fruit set, number of fruits retained, number of fresh fruits plant-1 and yield. Foliar application of 4% KNO_3 produced the highest number of panicles, highest number of fruits (581.00) and yield (78.18 Kg) plant-1.

Singh and Verma (2011) observed that the application of ZnSO_4 3% + KNO_3 2% significantly increased the number of fruits per tree, fruit yield per hectare, TSS, reducing sugar, non reducing sugar and total sugar in mango *cv.* Kesar.

Stino and Kelani (2011) carried out an experiment during 2008 and 2009 at El-Kassasien Horticulture Research Station, Ismailia Governorate, Egypt. Langara, Ewais, on 18 year old Alphonso. They sprayed at bud emergence, full bloom and pea stages with calcium nitrate at 2%, zinc sulfate at 0.4%, boric acid at 0.2% or potassium nitrate at 2%. As calcium nitrate at 2% and potassium nitrate at 2% sprayed were the most effective treatments for enhancing the yield.

Reddy and Kurian (2012) recorded that the best treatment was T_3 (Pruning + 1% KH_2PO_4 + 1% KNO_3 spray at the time of bud break in December) for mean fruit yield of 63.9 kg / plant, as compared to a fruit yield of 33.0 kg / plant in control of mango *cv.* Alphonso.

Sudha *et al.* (2012) investigated on effect of foliar application of various nitrogenous chemicals on flowering, fruit set and yield of mango *cv.* Alphonso was studied in the orchard of Horticultural College and Research Institute, Coimbatore, during 2010-11. Maximum fruit yield (43.8 kg/tree) was obtained with foliar spray of 2% KNO_3 at 15 days interval from 15th November to 30th December. Higher content of chlorophyll (1.7g mg⁻¹), carbohydrate (14.5g100g⁻¹) and nitrogen (1.43%) and higher C/N ratio (10.18) were also

recorded in plants sprayed with 2% KNO₃, followed by 1% KNO₃.

Garad *et al.*, (2013) studied the effect of chemicals on flowering and fruiting in mango *cv.* Kesar at Rahuri, Maharashtra. They found that the maximum panicle length (34.41 cm) was observed with the spray of K₂HPO₄ 1% + KNO₃ 1%. The treatment KH₂PO₄ 1% + KNO₃ 1% increased percentage of hermaphrodite flowers (18.53), the number of fruits per panicle at marble stage (6.53) and final fruit retention per panicle (2.53). The treatment KH₂PO₄ 1% + KNO₃ 1% also increased the fruit length (11.50 cm), diameter (7.80 cm) and average weight of fruit (280.36 g). The overall results indicated that the foliar spray of KH₂PO₄ 1% + KNO₃ 1% seems to be beneficial for increasing the flowering, fruit set, fruit size and fruit weight.

Sarker and Rahim (2013) investigated yield and quality of mango as influenced by foliar application of potassium nitrate. They applied foliar spray of KNO₃ @ 4%, 6%, 8%, and control (water spray) on mango *cv.* Amrapali plants which was carried at the BAU Germplasm Centre, Department of Horticulture, Bangladesh Agricultural University, Mymensingh. Foliar spraying of potassium nitrate @ 4% gave superior results with respect to length and breadth of panicle and number of secondary branches per panicle compared to control. The plants sprayed with KNO₃ @ 4% expressed earlier panicle appearance by 17 days as compared to delayed appearance of panicle in untreated control plants. The plants received KNO₃ @ 4% produced the maximum number of

panicles per plant, more number of fruits per plant and maximum yield as compared to control.

Nulit *et al.* (2014) showed that earlier flowering with 2 % KNO_3 followed by 1 % KNO_3 ; produced longer panicle lengths with 2 % KNO_3 while, only 1 % KNO_3 initiated flowering on young mango trees cv. “Chok Anon”.

Nur, A. *et al.* (2014) studied that the effects of chemical inducing substance, potassium nitrate (KNO_3) on enhancement of flowering on the mango cv. ‘Chok Anan’ at Department of Biology, Faculty of Science, university Putra Malaysia, Serdang, Selangor, Malaysia. Initially 12 month old and 5 year old mango trees were sprayed with 1 %, 2%, and 5 % KNO_3 . Results showed that 5 year old mango trees gave earlier flowering and higher fruit set with 2% KNO_3 followed by 5% and 1% KNO_3 .

Maloba *et al.* (2014) observed that foliar application of potassium @ 4% increased flowering percentage (% of tagged shoots) in both ‘Ngowe’ and ‘Apple’ varieties at two different agro- ecological zone (AEZs) of Kenya. In Embu, KNO_3 @ 4% resulted in 46% flowering in ‘Ngowe’ compared to 4% in ‘Apple’. On the contrary, in Makueni, the response was greater in ‘Apple’ (60%) compared to ‘Ngowe’ (28%). Response to ethephon increased with concentration with the 1000 ppm giving the best response; 22 and 28% flowering (% of tagged shoots) for Embu and Makueni, respectively, in ‘Ngowe’. In both AEZs and varieties, flowering was 3% in untreated

controls. Significant treatment effect was observed on fruit set with KNO_3 @ 4% and 1000 ppm ethephon resulting in the highest percentage.

Baiea *et al.*, (2015) reported that four foliar spray of 2% potassium nitrate (at full bloom, after fruit set and two spray at one month interval after fruit set) were very effective in improving fruit retention, number of fruits, fruit weight (kg/tree) and pulp weight of mango *cv.* Hindi. However, In chemical parameters enhanced total soluble solids (TSS) percentage, total sugar and ascorbic acid content.

Amarcholi *et. al.* (2016) studied the influence of chemicals on flowering and fruiting characteristics of ‘Kesar’ mango. The foliar application of chemicals applied twice during the investigation, once at flower bud differentiation followed by another spray during the full bloom stage in eight year old ‘Kesar’ mango orchard. Flowering and fruiting characteristics were significantly influenced by various chemicals treatment during the investigation as compare to control. The foliar application of KNO_3 @ 1.0% recorded the maximum flowering percentage (26.12%), fruit set percentage (0.21%), Fruit retention percentage (20.45), number of fruit per panicle (2.10), number of fruit per tree (276.33) and fruit yield (11.30 ton/ha) followed by KH_2PO_4 @ 0.5 % and ethrel 200 ppm in mango *cv.* Kesar.

Cashew nut :

Palsande *et al.* (2013) studied the foliar application of 3% urea and KNO_3 with insecticides had significant effect on growth,

yield contributing characters, fruit set and fruit retention. The maximum average weight of nut and highest protein content in the nuts was observed with 2 per cent KNO_3 foliar spray at new vegetative growth, flowering stage and at seed setting stage.

Ber :

Srivastava *et al.* (2013) investigated that among different sources of potassium, KNO_3 (2%) was found superior for retaining the maximum number of fruits (41.54%) per branch with minimum fruit drop as compare to control in ber *cv.* Banarasi Karaka.

Citrus :

Singh and Chohan (1978) reported that the foliar spray of 0.25% ZnSO_4 + 0.25% CuSO_4 + 0.25% KNO_3 increasing the total soluble solids and decreasing the acidity resulting in the increasing in TSS/acid ratio in *cv.* Wilking Mandarin.

Debaje *et al.* (2011) revealed that two foliar spray of KNO_3 2% + GA_3 100 ppm increased fruit weight (43.87 g), fruit volume (44.52) and improved fruit quality as compare to control in acid lime.

Sarrwy *et al.*, (2012) reported that significant difference with foliar sprays of all the forms of potassium over control. However, 1.5% KNO_3 found significantly higher in fruit length, fruit diameter and fruit weight in 'Balady' mandarin.

Olive

Sarrwy *et al.*, (2010) reported that the foliar application of KNO_3 at 3% was found superior to improve nutritional

status, flowering, fruit set, yield and fruit quality in olive cv. Picual.

Hegazi *et al.*, (2011) reported that the foliar application of potassium nitrate at 4% after final set or pit hardening improve the vegetative growth, nutritional status, especially in the second season and the productivity in both the seasons. While spray of potassium nitrate at 4% after pit hardening gave the best fruit quality and flesh oil content of Picual olive fruit in both the seasons.

Peach :

Arvind *et al.*, (2012) recorded highest TSS content (10.81 %) and TSS: acid ratio (15.01) with 2 % KNO₃, while minimum acidity (0.71 %) which closely followed by 1 % KNO₃ in sub-tropical peach.

2.2 Effect of Urea

Mango:

Sharma *et al.*, (1990) measured the effect of urea (0, 2 and 4%), potassium nitrate 0, 1.5 and 3% (KNO₃) and NAA (400 mg l⁻¹), alone and in combination applied as foliar spray at the time of flowering (20 February) in 10 year old mango trees cv. Langra. They found significantly increase in fruits set percentage, fruit retention, yield and significantly reduced percentage of fruit drop when foliar application of 4 per cent urea + 3 per cent KNO₃ at flowering stage.

Singh *et al.*, (2005) carried-out an experiment at Fruit Research Station; Gangian situated in sub-montane zone of

Punjab, to ascertain the positive effects of chemicals on vegetative, floral and physico-chemical characteristics in Dashehari mango. Chemicals like Urea (2 and 4%), H₃PO₄ (1 and 2%) and KNO₃ (2 and 3%) were sprayed at the time of panicle emergence during the years 1999 and 2000. They found that the foliar spray of 2% urea and 2% KNO₃ could be exploited for improving fruit yield and quality attributes of mango grown in sandy loam soils of Punjab, which are low to medium in organic matter and available K.

Bansode *et al.*, (2014) studied effect of foliar spray of different nutrients on fruit yield of mango cv. Alphonso. They found that the application of 2% urea at pea stage significantly increased fruit retention, number of fruits and yield per plant. It was at par with the treatment KNO₃ @ 1% applied at pea stage. Most of fruit quality parameters at ripe stage were observed to be non significant among all the treatments under study.

Zaeneldeen, E.M.A. (2014) studied the effect of spraying of urea @ 1 and 2%, GA₃ @ 25 and 50 ppm and pinching early emerged panicles at ½ and 1 cm in mango. The results showed that various transactions of spray urea, GA₃ and pinching early emerged panicles separately or combination with each other led to delay flowering, also led to flowering, increase fruit set and reduce fruit drop in mango tree. He concluded that maximum number of fruit, yield and improved the quality of fruit with three foliar spray of urea @ 2% + GA₃ 50 ppm during November, December and January + pinching early removed panicles in mango cv. Succary Abiad.

Banana :

Kumar and Kumar (2010) reported that the foliar application of potassium di hydrogen phosphate (0.5%) + urea (1%) + 2,4-D (20 ppm) and SOP at 1.5 per cent resulted to obtain higher yield with good quality fruits and relatively higher cost benefit ratio. Thus, the overall study clearly indicates that the benefit of giving post shoot application in banana cv. Ney-Poovan (AB).

A field experiment was conducted at farmer field to determine the effect of Urea and SOP on bunch spray of tissue culture banana cv. Grand Naine (AAA). Foliar applications of urea (1%, 2% and 3%) and combination of urea and SOP were sprayed thrice after emergence of flag leaf. The results revealed that, bunch sprayed with combination of SOP (2%) and urea (1%) appeared to be increased cost benefit ratio (3.04), whereas, the minimum benefit cost ratio (2.37) was obtained in control. (Shetty *et al.*, 2014).

2.3 Effect of ethephon:

Mango :

Chaudhari (2014) studied that foliar application of cycocel (3000 ppm) and ethylene (200 ppm) induced early flowering and maturity in Kesar mango trees.

Plum :

Gupta and Kaur (2007) noted that fruit retention; fruit yield and fruit weight were significantly higher with foliar

application of ethrel (100 ppm) during March in plum cv. Satluj Purple.

Cashew :

Gawankar *et al.* (2010) showed that ethrel @ 100 ppm significantly increased fruit-set m⁻² (28.8), number of nuts per panicle (2.9) and yield tree⁻¹ (1.51 kg tree⁻¹) than control. Thus, lower concentration of ethrel had a beneficial effect on cashew.

Date Palm:

Meena *et al.* (2009) recorded that maximum fruit weight (7.88 g), fruit length (3.31 cm) and fruit breadth (2.47 cm) with ethephon (1500 ppm) followed by ethephon (1000 ppm) in date palm under hot arid region.

Guava:

Brar and Bal (2011) concluded that maximum fruit length (6.46), fruit breadth (6.57 cm), fruit weight (196.00 g) and pulp content (96.0 %) through ethephon 500 ppm during winter season in “L-49” guava fruits.

Papaya:

Pusdekar and Pusdekar (2009) reported that maximum fruit length (25.03 cm), fruit breadth (14.86 cm) and pulp thickness with foliar application of CCC- 1000ppm as compare to control in papaya cv. CO-2.

Grape :

Kaur *et al.* (2013) indicated that highest yield (25.37 kg/vine) was obtained in the treatment 100 % crop load + 500 ppm ethephon followed by 75% crop load + 500 ppm ethephon as compare to control in Flame Seedless grape.

Phalsa:

Debnath *et al.* (2011) noted that maximum TSS (25.72 °B), reducing sugar (18.91 %), TSS: acid ratio (10.98) and pulp: stone ratio (5.85 g) with ethrel (500 ppm) in phalsa.

Kacha *et al.* (2012) recorded that the quality of fruits in terms of total soluble solids (25.23 °B), reducing sugar (2.01 %) and total sugar (5.74 %) were significantly higher in foliar application of ethrel 1000 ppm followed by ethrel 750 ppm.

Cape Gooseberry:

Yadava *et al.* (2008) indicated that 400 ppm ethephon, significantly increased the TSS, total sugar, reducing sugar, ascorbic acid while decreased acidity and non-reducing sugar with highly significant increase yield in cape gooseberry.

2.4 Effect of Novel Organic Liquid Fertilizer :

Mango

A field experiment was conducted to study the effect of pseudostem sap and vermiwash on fruit setting in mango at NAU, Navsari and observed that four sprays of banana

pseudostem sap and vermiwash in 1:1 ratio with 5 % concentration during flowering increased fruit retention, fruit yield and net income in mango (Anon., 2012).

Banana

A field experiment was conducted at NAU, Navsari to study the effect of banana pseudostem sap on production of banana and they found that 3 litres banana pseudostem sap (in 10 equal splits at an interval of 10 days starting from 60 days after planting) per plant along with 80 % of RDF gave higher yield and net profit in banana cv. 'Grand Nain' (Anon., 2011).

An experiment was conducted on injection of enriched banana pseudostem sap or novel organic liquid fertilizer at pre-flowering stage on banana cv. 'Grand Nain' at NAU, Navsari and they observed that application of enriched banana pseudostem sap (120 ml and 240 ml) at pre flowering stage significantly increased length of bunch, number of hands per bunch, length, girth of fingers/ bunch, bunch weight and fruit yield of banana cv. Grand Nain (Anon., 2014^b).

Papaya

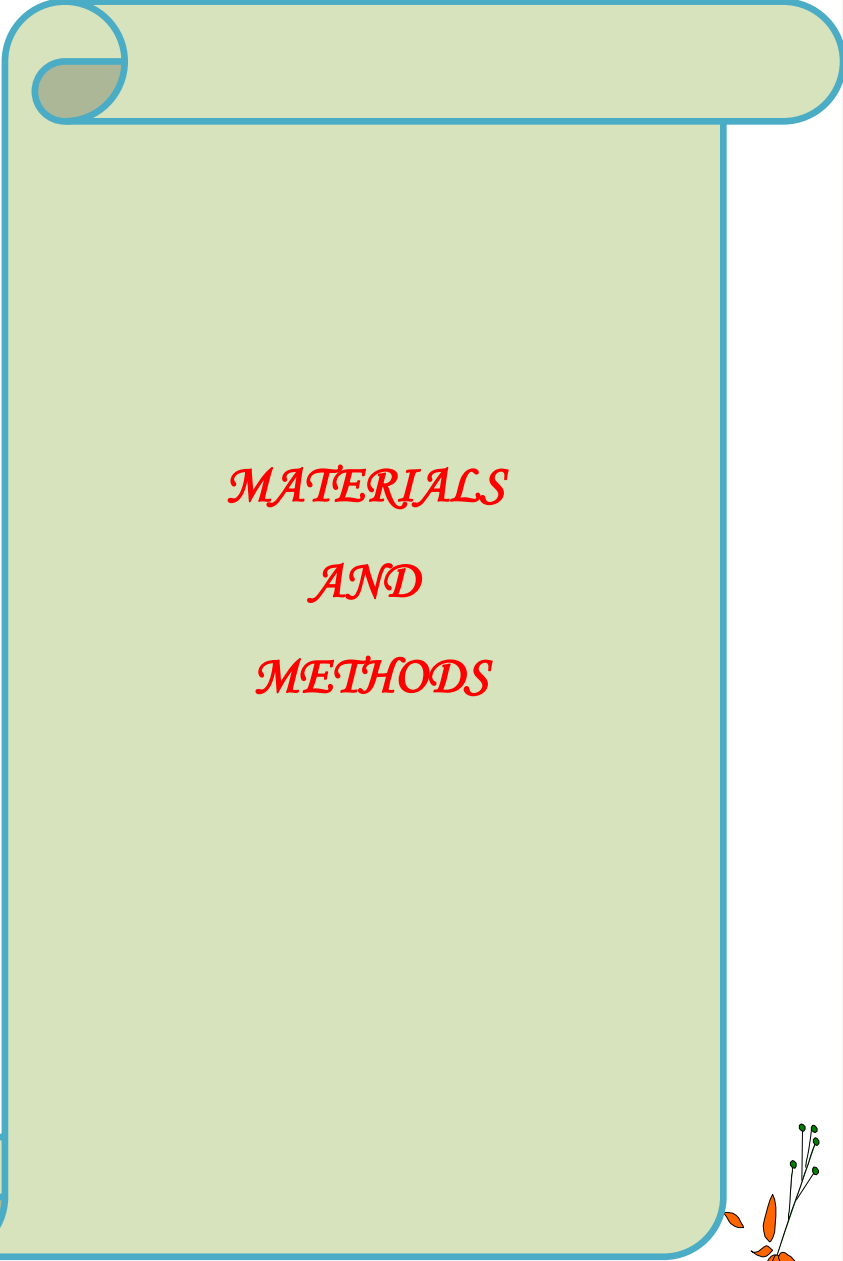
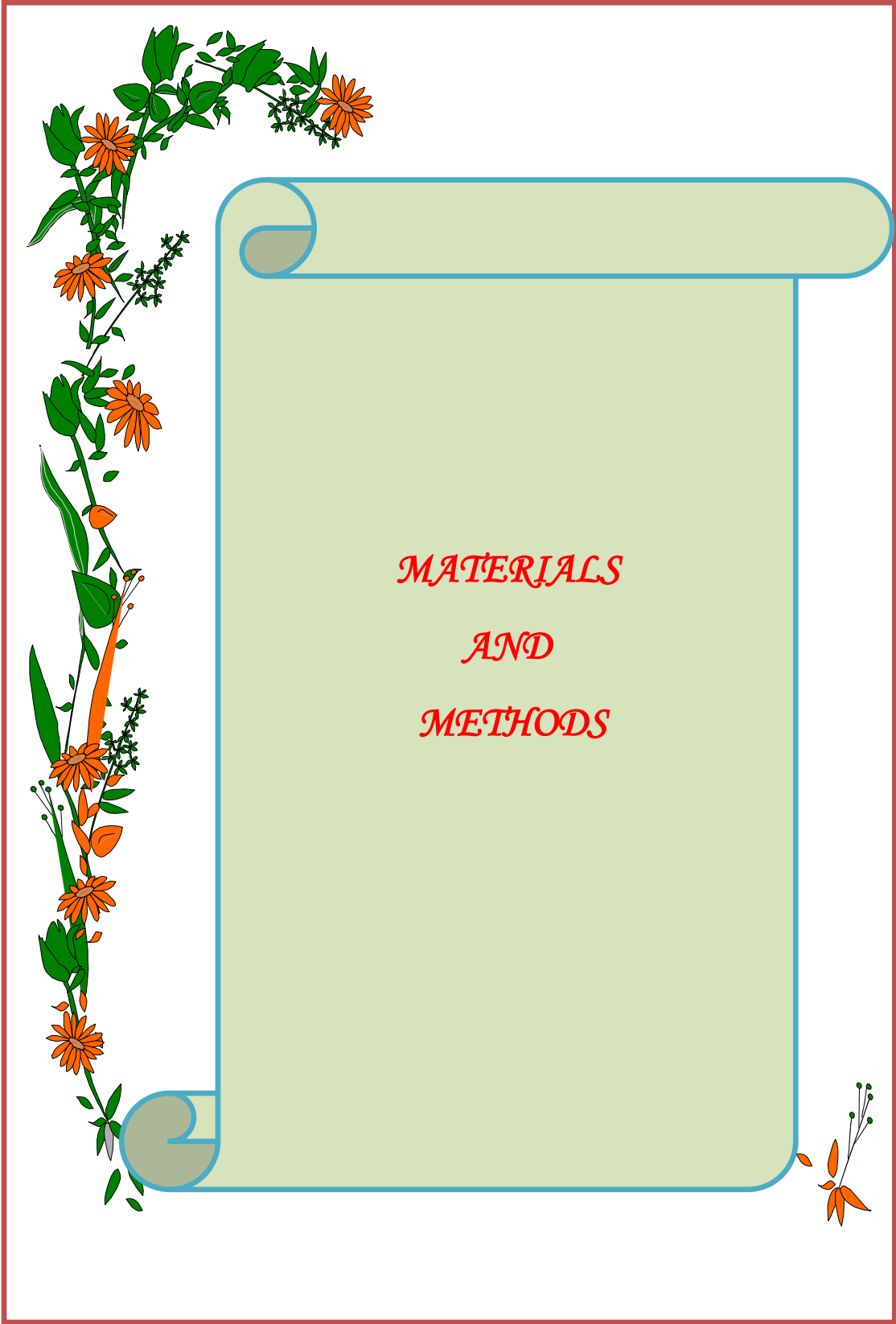
An experiment was conducted to observe the effect of banana pseudostem sap on papaya at NAU, Navsari and noted that banana pseudostem sap at 8 l/plant in 8 equal splits at an interval of one month, starting from two months after planting gave higher and better quality of papaya fruit (Anon., 2013).

Chili

Deore *et al.* (2010) at Pune conducted trial on effect of novel organic liquid fertilizer on growth and yield in chilli and revealed that application of 3 % novel organic liquid fertilizer gave maximum plant height, number of branches per plant, leaf number, leaf area, number of fruits per plant and total yield.

Onion

Salunkhe *et al.* (2013) studied the effect of banana pseudostem sap as liquid fertilizer in onion at NAU, Navsari and observed that higher bulb yield of onion produced from 80 % RDF along with banana pseudostem sap @ 2000 l/ha under drip irrigation.



*MATERIALS
AND
METHODS*

III. MATERIALS AND METHODS

The present investigation entitled “Response of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation” was conducted during the year of 2015-16. The details of the materials used, methods followed, observations recorded and techniques adopted during the course of the present investigation are being presented in this chapter.

3.1 General information

3.1.1 Experimental site

The experiment was carried out at Regional Horticultural Research Station, ASPEE College of Horticulture and Forestry, Navsari Agricultural University.

Geographically Navsari is situated on the coast of Arabian Sea at 20⁰-57’N latitude and 72⁰-54’E longitude with an altitude of about 10 meters above the mean sea level. The campus is about 12 km away from the historical place Dandi, near the Arabian seashore. The quality analysis was carried out at laboratory of Centre of Excellence on Post-Harvest Technology, ASPEE College of Horticulture and Forestry, Navsari Agricultural University.

3.1.2 Climate and Weather conditions

Navsari Campus is located in South Gujarat Heavy Rainfall Zone-I and Agro Ecological Situation III. Climatically

Navsari is typically tropical characterized by fairly hot summer, moderate cold winter, more humid and warm monsoon with heavy rains. The maximum temperature of 38⁰C in month of April and minimum temperature of 10⁰C in month of January were recorded. Annual rainfall is about 1500 to 1800 mm. Monsoon generally starts from second week of June and lasts up to the third week of September. Most of the rainfall is received from South - West monsoon concentrating in the months of July and August.

3.2 Soil

As per the seventh approximation, the soil of Navsari has been placed under the great group of vertic ustocherpts, sub order chrepts and order inceptisols with Jalalpore series, which include deep, moderately drained clayey soil, which was classified earlier as “deep black soil”.

The soil of experimental site is black, deep and rich in organic matter and potash, having good water holding capacity with good drainage. The soil was considered quite suitable for mango crop under South Gujarat condition.

The soil samples were taken randomly from five different places covering the complete experimental block with the help of auger up to 30 cm depth. The soil analysis was done as of the soil of experimental block have been presented.

Table 3.1 Initial (chemical) properties of soil

Sr. No.	Particulars	Initial value	Method employed	References
1.	Soil pH (1:2.5 soil: water ratio)	7.24	Potentiometric	Jackson (1973)
2.	Electrical Conductivity (1:2.5 soil: water ratio) dsm^{-1} at 20°C	0.52	Conductometric	Jackson (1973)
3.	Organic carbon (%)	0.42	Walkley and Black's rapid titration method	Jackson (1973)
4.	Available N (kg ha^{-1})	238.0	Alkaline permagnate oxidation	Subbiah and Asija (1956)
5.	Available P_2O_5 (kg ha^{-1})	44.0	Spectrophotometric	Olsen <i>et al.</i> (1954)
6.	Available K_2O (kg ha^{-1})	557.0	Flamephotometric	Jackson (1973)

3.3 Experimental material

Field experiment was conducted on Ultra High Density plantation. About eight year old mango trees planted at 3m x 1.5m spacing. All the trees under the experiment was given uniform cultural practices during the course of investigations. The experiment was laid out in Randomised

Block Design (RBD). All the treatments were replicated thrice and a double tree served as a unit.

3.4 Experimental details

- a). Crop & Variety** : Mango var. Dashehari
- b). Year** : 2015-16
- c). Design** : Randomized Block Design (RBD)
- d). Replications** : 3
- e). Treatments** : 9
- f). Number of trees per treatment:** 2
- g). Total no. of trees** : 54
- h). Spacing** : 3m × 1.5m
- i). Age of tree** : 8 Years
- j). Time of spray** : 1) 15th Oct. 2015
2) 15th Nov. 2015
- k). Treatment details** :
 - T₁: Urea @ 1%
 - T₂: Urea @ 1.5%
 - T₃: Urea @ 2%
 - T₄: KNO₃ @ 1%
 - T₅: KNO₃ @ 2%
 - T₆: Ethephon @ 200mg l⁻¹
 - T₇: Novel organic liquid fertilizer @ 1%
 - T₈: Novel organic liquid fertilizer @ 2%
 - T₉: Control

3.5 Experimental design and layout

The experiment was laid out in a Randomized Block Design and is depicted in Fig. 1

3.6 Salient features of variety

3.6.1 Dashehari

‘Dashehari’ is one of the most popular varieties of North India. It is a mid season mango. Fruits are medium sized with pleasant flavour. Sweet, firm and fibreless pulp. Stone is thin & keeping quality is good with TSS 20.04%. Its pulp is sweet and succulent. It gets its name from the dashehari village near Malihabad region of Uttar Pradesh. In September 2009 the area was registered with Geographical Indication No. 125 in the name of “Mango Malihabad Dussehari” by India’s Geographical Indication registry.

The fruit of dashehari tree are oblong, elliptical and medium size (13cm long and 8cm breadth) weighing 130 to 260 g. It has attractive yellow pulp, firm and non-fibrous, with very sweet taste. The Dashehari mango is exported internationally to various countries including Singapore, Hong Kong, The Philippines, Malaysia and other countries in South-East Asia.

3.7 Preparation of solution

3.7.1 Urea

The required quantity of Urea was weighted, dissolved in water and then the final volume was made up.

LAYOUT

Fig. 1 : Mango Orchard at Regional Horticultural Research Station, A.C.H.F., N.A.U., Navsari.

R₁	1	(T ₆)	●	(T ₃)	●	(T ₅)	●	(T ₂)	●	(T ₄)	●	(T ₉)	●	(T ₇)	●	(T ₈)	●	(T ₁)	●	●
	2	(T ₆)	●	(T ₃)	●	(T ₅)	●	(T ₂)	●	(T ₄)	●	(T ₉)	●	(T ₇)	●	(T ₈)	●	(T ₁)	●	●
R₂	3	●	(T ₂)	●	(T ₅)	●	(T ₈)	●	(T ₉)	●	(T ₆)	●	(T ₇)	●	(T ₃)	●	(T ₄)	●	(T ₁)	●
	4	●	(T ₂)	●	(T ₅)	●	(T ₈)	●	(T ₉)	●	(T ₆)	●	(T ₇)	●	(T ₃)	●	(T ₄)	●	(T ₁)	●
R₃	5	(T ₅)	●	(T ₉)	●	(T ₈)	●	(T ₄)	●	(T ₆)	●	(T ₇)	●	(T ₁)	●	(T ₃)	●	(T ₂)	●	●
	6	(T ₅)	●	(T ₉)	●	(T ₈)	●	(T ₄)	●	(T ₆)	●	(T ₇)	●	(T ₁)	●	(T ₃)	●	(T ₂)	●	●
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

Indications: Plant Not Selected Plant Selected	Number Indications: R & T, Where, R= Replication no. T= Treatment no.	Treatments under experimentation		
	Spacing = 3 × 1.5 m	T₁ : Urea @ 1%	T₄ : KNO₃ @ 1%	T₇ : Novel organic liquid fertilizer @ 1%
		T₂ : Urea @ 1.5%	T₅ : KNO₃ @ 2%	T₈ : Novel organic liquid fertilizer @ 2%
T₃ : Urea @ 2%	T₆ : Ethephon @ 200mg/l	T₉ : Control		

For example, 1% Urea solution, 100 g Urea dissolved in 10 litre of water.

3.7.2 Potassium nitrate (KNO₃)

For preparation of KNO₃ @ 1 % solution, 100 g KNO₃ dissolved in 10 lit of water.

3.7.3 Ethephon

The required quantity of Ethephon was measured, dissolved in water and then the final volume was made up.

For example, 200 mg l⁻¹ solution 2g Ethephon dissolved in 10 litre of water.

3.7.4 Novel organic liquid fertilizer

The required quantity of Novel organic liquid fertilizer was weighted, dissolved in water and then the final volume was made up.

For example, 1% solution 100 g Novel organic liquid fertilizer dissolved in 10 litre of water.

S.N.	Name of fertilizer	Content			
1	Urea	N: 46 %			
2	Potassium Nitrate	N: 13% K : 45%			
3	Novel organic liquid fertilizer	Content	Mg/lit	Content	Mg/lit
		N	7900-10700	S	131-170
		P	270-274	Mn	13.45
		K	1600-1900	Cu	0.83
		Ca	330-450	Zn	4.44
		Mg	970-1070	Fe	44.85
		Total Phenol: 4.80-4.91			
GA: 0.18					

3.7.5 Time and method of spray

Foliar spray of prepared solution of chemicals were done at first fortnight of October and November as per the treatments. The spray was done by using tractor operated sprayer. According to the treatments, the freshly prepared solutions were sprayed on the trees till they were thoroughly wet.

3.8 Harvesting of fruits

Fully mature fruits of Dashehari mango were harvested from the treated trees and immediately brought to the laboratory and arranged as per the treatments.

3.9 Methodology adopted in recording observation

In this investigation, observations were recorded on the there parameters viz. Flowering and fruit set, quality and yield parameters.

3.9.1 Vegetative and reproductive growth parameters

3.9.1.1 Number of shoot – Vegetative shoot and flowering shoot per terminal

Total 16 terminal shoots were tagged for recording observations on vegetative and reproductive shoots. Among these shoots, four shoots were earmarked in each direction for recording observations on number of shoots per terminal and counting was done at end of January after flowering and average value was worked out.

3.9.1.2 Vegetative shoot (%) and Flowering shoot (%)

For calculating shoots in percentage, 16 tagged terminals were considered as 100 per cent for both vegetative as well as

flowering shoots and number of emerged terminal either vegetative or reproductive were counted.

$$\text{Vegetative shoot (\%)} = \frac{\text{No. of vegetative emerging shoots}}{\text{Total no. of shoots}} \times 100$$

However, Total number of shoots per tree were counted and out off that how many bears panicles also counted and then worked out percent flowering shoot with following formula.

$$\text{Flowering shoot (\%)} = \frac{\text{No. of panicles emerging shoots}}{\text{Total no. of shoots}} \times 100$$

3.9.1.3 Panicle length (cm)

Sixteen panicles per tree were chosen for measuring the length of panicle (cm) with the help of scale at full bloom stage. Length was measured from the point of emergence to the apex of panicle.

3.9.1.3 Days require for full bloom

The date on which overall 100 per cent of the panicle emergence was considered as the date of full bloom.

3.9.2 Yield parameters

3.9.2.1 No. of fruits set at pea size stage per panicle

Four panicles per each direction were randomly tagged for counting the fruit set at pea stage per panicle. When the fruits attained pea size, they were counted and average values were worked out for recording number of fruit set per panicle.

3.9.2.2 No. of fruits set at marble stage per panicle

The panicles which were tagged for recording the fruit set at pea stage, these fruits were subsequently counted at marble stage and their average values were worked out.

3.9.2.3 Number of fruits per panicle

The number of fruits were counted from labelled panicle at harvest. The result was expressed as number of fruits per panicle.

3.9.2.4 Average Fruit weight (g)

Five fruits were taken as sample from each treatment, their weight was recorded at harvest and the average fruit weight was worked out.

3.9.2.5 Number of fruits per tree

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

3.9.2.6 Yield (kg/tree)

For recording yield, total produce per tree was weighted and expressed in kilograms.

3.9.3 Quality parameters

3.9.3.1 Shelf life (days)

The shelf life of fruit was noted by keeping the fruits at room temperature and noted the days taken from harvesting to optimum eating stage and expressed in days.

3.9.3.2 Total soluble solids (°B)

The total soluble solid of the pulp was recorded using digital hand refractometer (0 – 32° Brix). In each treatment, the readings were taken and their average was considered as results. The results were directly recorded as °Brix and corrected at 20 °C.

3.9.3.3 Ascorbic acid (mg/100g pulp)

The titrimetric method described by Ranganna (1986) was adopted for estimation of ascorbic acid content in pulp. Ten gram of pulp was taken to a 100 ml volumetric flask and volume made up with 3% metaphosphoric acid solution. After 30 minutes, the suspension was filtered through Whatman No.1 filter paper. The 2, 6-dichlorophenolindophenol dye solution was standardized by titrating against standard ascorbic acid solution and the dye factor was calculated before actual titration. Five ml of the aliquot was taken from the filtrate and titrated against standardized dye solution through a burette. Titration was continued till the light pink colour persisted for 15 seconds. Ascorbic acid content was calculated adopting the following formula:

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

3.9.3.4 Reducing sugars (%)

The titrimetric method of Lane and Eynon described by Ranganna (1986) was adopted for estimation of reducing sugars. The method is based on the principle that invert sugars or reducing sugars reduces copper in the Fehling's solution to red insoluble cuprous oxide. Sugars in a sample were estimated by determining the volume of unknown sugar solution required to completely reduce a measured volume of Fehling's solution. Before using, the mixture (1:1) of Fehling's solution A and B (5 ml of each) was standardized against standard glucose for obtaining glucose equivalent and to arrive at a conversion factor.

Procedure:

25g of the pulp was taken in a volumetric flask and two millilitres of 45 % basic lead acetate solution was added for clarification. After 10 minutes, the solution was de-leaded by adding potassium oxalate crystals in excess and the volume was made upto 250 ml with distilled water and filtered through Whatman No. 1 filter paper. The filtrate was taken in a burette and titrated against boiling Fehling's mixture (5 ml of Fehling's solution A + 5 ml of Fehling's solution B) till the blue colour faded. Then few drops of methylene blue indicator (1 %) were added and the titration was continued till the contents attained a brick red colour and titrate value was noted. The percentage of reducing sugars was calculated according to the following formula:

$$\text{Reducing sugars (\%)} = \frac{\text{Glucose Eq. (0.05)} \times \text{Total volume made up}}{\text{Titre value} \times \text{Weight of the pulp}} \times 100$$

3.9.3.5 Non- reducing sugars (%)

The value of non-reducing sugars was recorded by subtracting the value of reducing sugars from total sugars.

3.9.3.6 Total sugars (%)

For estimation of total sugars, the filtrate obtained in the above estimation was used. An aliquot from the filtrate was taken and the one fifth of its volume of hydrochloric acid (1:1) was added and the inversion was carried out at room temperature for 24 hours. Subsequently, the contents were cooled and neutralized with 40 per cent sodium hydroxide using phenolphthalein as an indicator and the final volume was made up to 100 ml. The solution was filtered and titration was carried out using filtrate as described for reducing sugars. The total sugars content was expressed as percentage in terms of invert sugars according to the following formula:

$$\text{Total sugars (\%)} = \frac{\text{Glucose Eq. of Fehling's solution (0.05)} \times \text{Total volume made up} \times \text{Volume made up after inversion}}{\text{Titre value} \times \text{Weight of pulp taken} \times \text{Aliquot taken for inversion}} \times 100$$

3.9.3.7 Titrable acidity (%)

Method described by Ranganna (1986) was adopted for estimation of titrable acidity. To obtain acidity (per cent), 10 g of homogenized pulp was taken in a 100 ml volumetric flask and the volume was made. The suspension was filtered through

Whatman No. 1 filter paper. 10 ml of the filtrate was taken by pipetting and titrated against 0.1 N NaOH. Phenolphthalein was used as an indicator. Appearance of colourless to pink colour denotes the end point. The reading of burette was noted. The acidity % was calculated by using following formula:

$$\text{Acidity \%} = \frac{\text{Titre of Normality of alkali} \times \text{Volume made up} \times \text{Eq. Wt. of citric acid} \times 100}{\text{Volume of sample taken for estimation} \times \text{Weight of the sample} \times 1000}$$

3.9.3.8 Fruit firmness (kg/cm²)

Fruit firmness was measured by penetrometer in terms of Magness-Taylor pressure tester.

3.9.4 Economics

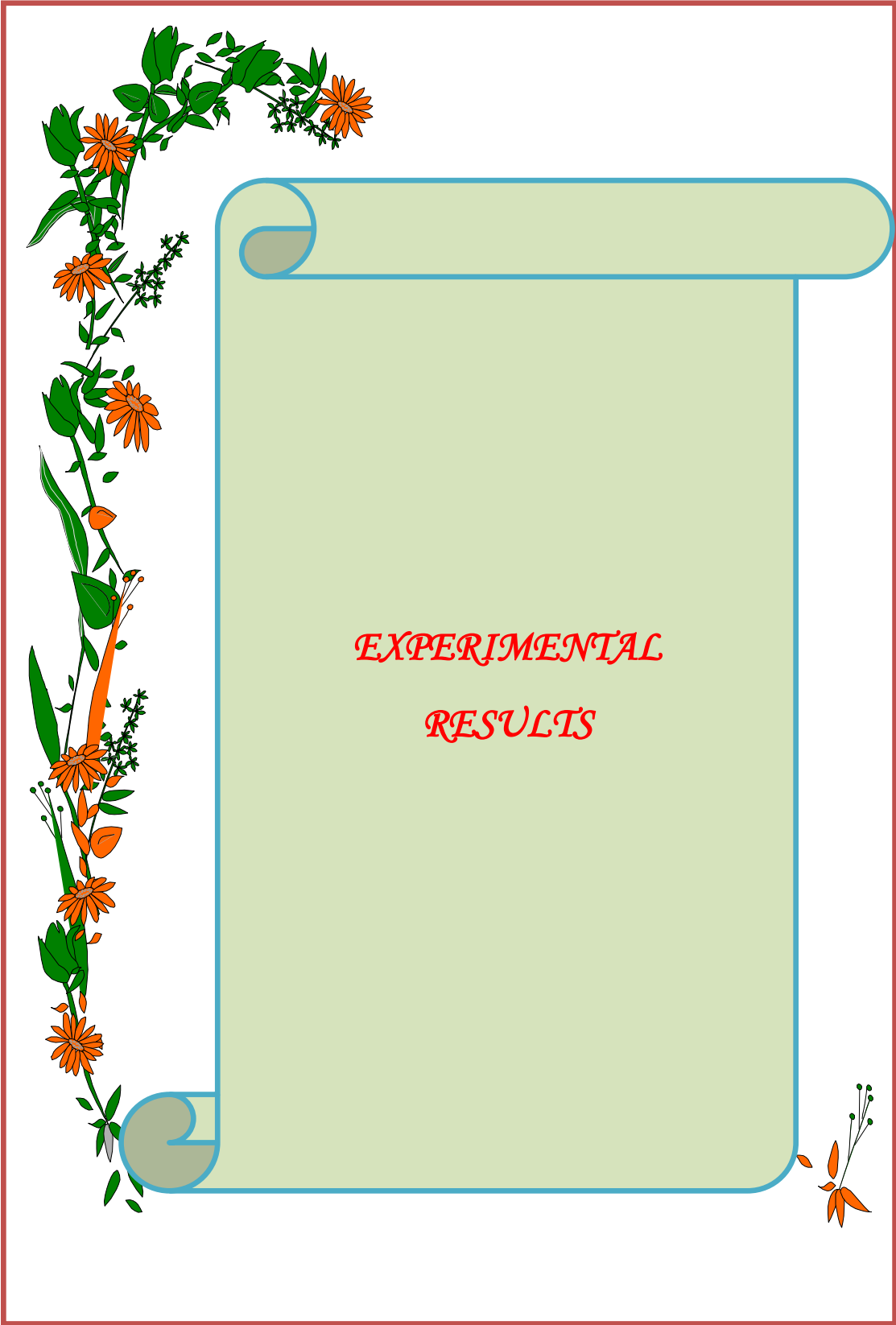
The gross income in terms of rupee per hectare was worked out on the basis of mean yield for each treatment and the market price of mango fruits. The cost of different treatments was worked out by considering prices of labour employed for treatments, treatments cost and cultivation cost. The net income was worked out by deducting cultivation cost and the cost required for different treatments from the gross income per hectare for respective treatment and recorded accordingly.

Benefit Cost Ratio (BCR):	$\frac{\text{Net Income}}{\text{Cost of Cultivation}}$
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3.9.5 Statistical analysis

The data of all characters were studied subjected to statistical analysis of variance technique as described by

Panse and Sukhatme (1985). The method of analysis of variance for randomized block design was used. The treatment differences were tested by “F” test of significance on the basis of null hypothesis. The appropriate Standard Error of mean (S. Em.) was calculated in each case and the Critical Difference (C.D.) at five per cent level of probability was worked out to compare the two treatments means where the treatment effects were significant.



EXPERIMENTAL

RESULTS

IV. EXPERIMENTAL RESULTS

The results of the present investigation on “Response of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation” has been presented in this chapter. The results pertaining to various characters on vegetative growth, flowering and quality of fruit have been presented in this chapter which recorded during the course of investigation and were subjected to statistical analysis. The research results pertaining to each aspect have been presented and described along with statistical inferences under the following heads.

4.1 Vegetative and reproductive growth parameters

4.2 Yield parameters

4.3 Quality parameters

4.1 Vegetative and reproductive growth parameters

The mean data on Vegetative and reproductive growth parameters *viz.*, Number of shoot- vegetative shoot and flowering shoot per terminal, vegetative shoot and flowering shoot (%), panicle length(cm), days require for full bloom as influenced by different treatments of Urea, KNO₃, Ethephon and Novel organic liquid fertilizer were recorded during the experimentation.

4.1.1 Number of shoot- vegetative shoot and flowering shoot per terminal and vegetative shoot (%) and flowering shoot (%)

The data on number of vegetative shoot and flowering shoot per terminal and vegetative shoot (%) and flowering shoot (%) as influenced by different treatments of urea, KNO₃, ethephon and novel organic liquid fertilizer are presented in Table 4.1 and Table 4.2 and graphically represented in Fig 2 and Fig. 3.

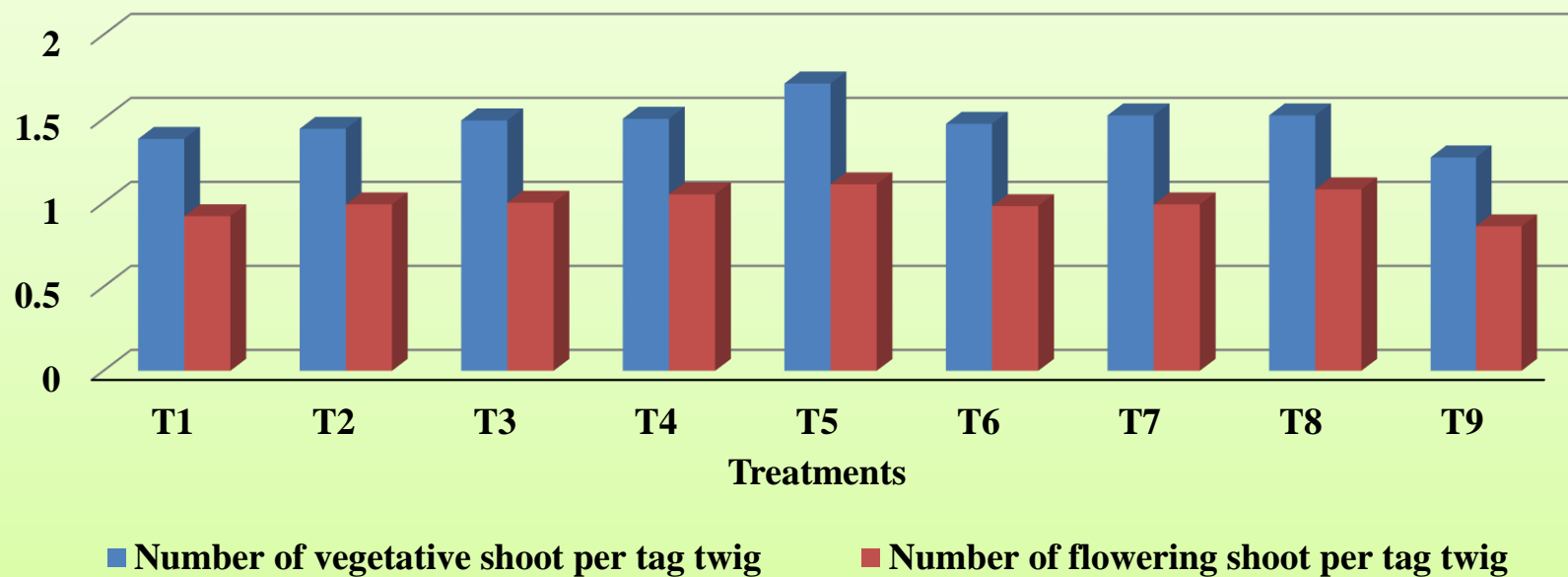
The minimum number of vegetative shoots (0.70) and per cent vegetative shoots (6.67 %) were recorded in treatment T₅ (KNO₃ @ 2%) which was statistically at par with treatment T₁, T₂, T₃, T₆ and T₇ treatment. While the maximum number of vegetative shoots (1.26) and per cent vegetative shoots (22.42 %) were observed in treatment T₃ (Urea @ 2%).

Similarly, the maximum number of flowering shoots (0.86) and per cent flowering shoots (93.38 %) were recorded in treatment T₅ (KNO₃ @ 2%) which was statistically at par with treatment T₈ (Novel organic liquid fertilizer @ 2%). While the minimum number of flowering shoots (0.41) and per cent flowering shoots (61.66 %) were observed in treatment T₉ (control).

Table 4.1: Effect of different chemicals on vegetative shoot and flowering shoot per terminal in Dashehari mango under ultra high density plantation.

Treatments	Number of vegetative shoot per terminal	Number of flowering shoot per terminal
T ₁ : Urea @ 1%	0.99	0.54
T ₂ : Urea @ 1.5%	1.02	0.58
T ₃ : Urea @ 2%	1.26	0.60
T ₄ :KNO ₃ @ 1%	0.80	0.64
T ₅ : KNO ₃ @ 2%	0.70	0.86
T ₆ :Ethephon @ 200 ppm	0.89	0.66
T ₇ :Novel organic liquid fertilizer@ 1%	0.98	0.58
T ₈ :Novel organic liquid fertilizer@ 2%	0.72	0.81
T ₉ : Control	0.81	0.41
S. Em. ±	0.06	0.04
C. D. at 5 %	0.18	0.12
C.V. %	11.38	11.10

Fig. 2 : Effect of different chemicals on number of vegetative shoot and flowering shoot per terminal in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

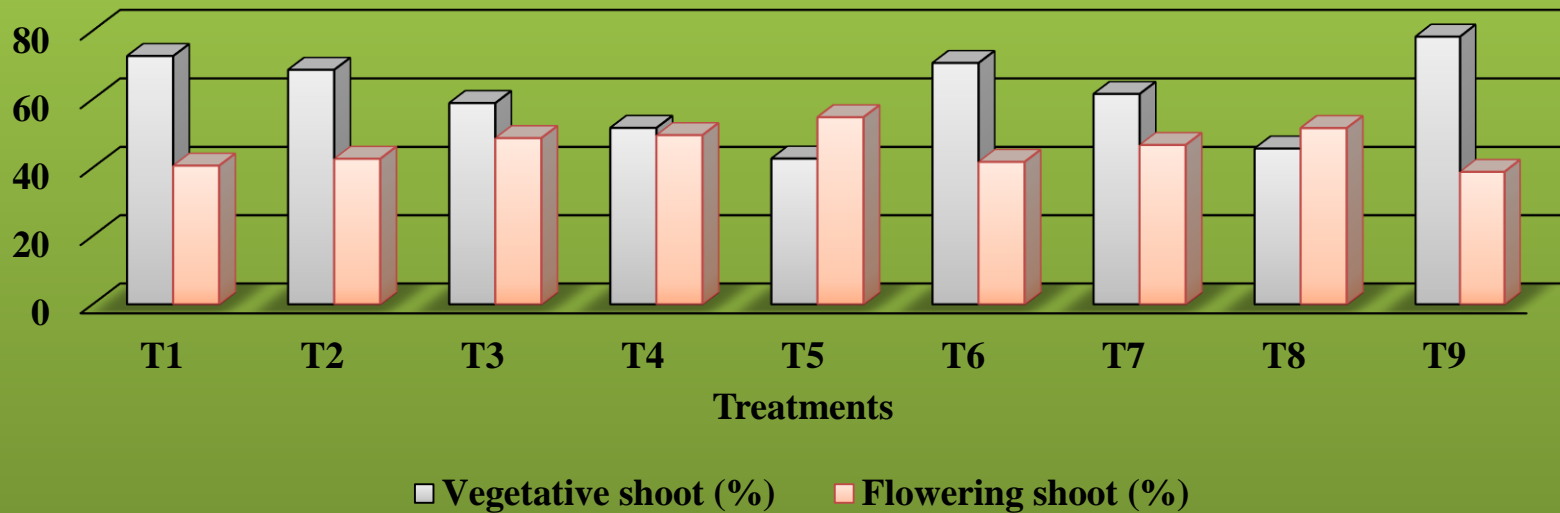
Table 4.2: Effect of different chemicals on vegetative shoot (%) and flowering shoot (%) in Dashehari mango under ultra high density plantation.

Treatments	Vegetative shoot (%)	Flowering shoot (%)
T ₁ : Urea @ 1%	21.99	69.41
T ₂ : Urea @ 1.5%	20.30	76.42
T ₃ : Urea @ 2%	22.42	79.52
T ₄ :KNO ₃ @ 1%	12.48	79.24
T ₅ : KNO ₃ @ 2%	6.67	93.38
T ₆ :Ethephon @ 200 ppm	15.05	71.38
T ₇ :Novel organic liquid fertilizer@1%	13.48	77.64
T ₈ :Novel organic liquid fertilizer@2%	8.45	87.57
T ₉ : Control	9.12	61.66
S. Em. ±	0.93	4.24
C. D. at 5 %	2.79	12.71
C.V. %	11.17	9.49

4.1.2 Panicle length (cm)

Length of flowering shoot measured from the point of emergence to the apex of panicle is presented in table 4.3 and graphically depicted in Fig. 4. The results on length of panicle indicated that there were differences in panicle length due to the

Fig. 3 :Effect of different chemicals on vegetative shoot (%) and flowering shoot (%) in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

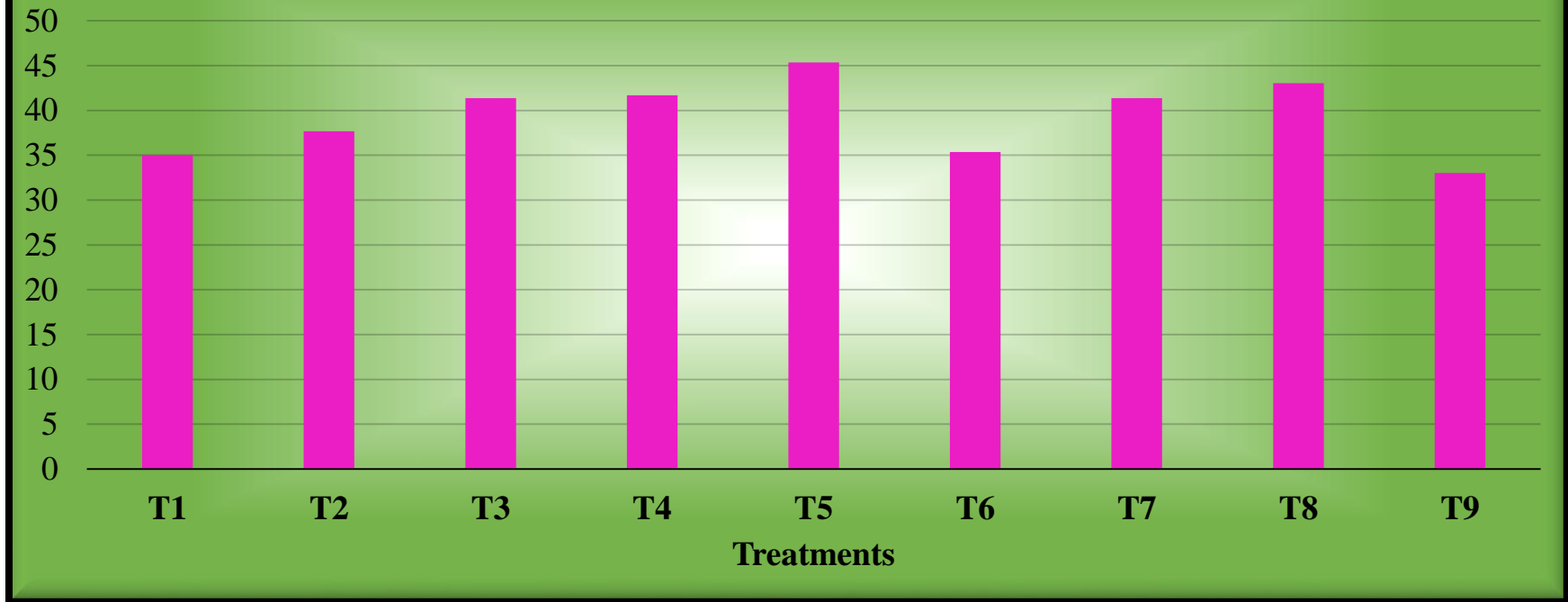
T₆: Ethephon @ 200 ppm
T₇: Novel organic liquid fertilizer @ 1%
T₈: Novel organic liquid fertilizer @ 2%
T₉: Control

use of different foliar application chemicals. The longest panicle length (45.36 cm) was recorded in treatment T₅ (KNO₃ @ 2%) which was statistically at par with treatment T₈, T₄, T₃, T₇ and T₂. While the shortest panicle length (33.01) was recorded in control (T₉).

Table 4.3: Effect of different chemicals on panicle length (cm) in Dashehari mango under ultra high density plantation.

Treatments	Panicle length (cm)
T ₁ : Urea @ 1%	35.04
T ₂ : Urea @ 1.5%	37.69
T ₃ : Urea @ 2%	41.38
T ₄ :KNO ₃ @ 1%	41.68
T ₅ : KNO ₃ @ 2%	45.36
T ₆ :Ethephon @ 200 ppm	35.37
T ₇ :Novel organic liquid fertilizer@1%	41.38
T ₈ :Novel organic liquid fertilizer@2%	43.03
T ₉ : Control	33.01
S. Em. \pm	2.60
C. D. at 5 %	7.80
C.V. %	11.47

Fig. 4 : Effect of different chemicals on panicle length (cm) in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

4.1.3 Days require for full bloom

The data on days require for full bloom as affected by different treatments of foliar spray application of chemicals are presented in Table 4.4 and graphically depicted in Fig. 5.

The data show that days require to full bloom significantly affected by various foliar chemical application during the year. Among them, foliar application of KNO_3 @ 2% (T_5) treatment was found early full bloom (20 days) which was statically at par with all other treatments except T_9 .

4.2 Yield parameters

The mean data on number of fruit set at pea size stage and marble stage per panicle, fruit retention (%) at mature stage per panicle, number of fruits per panicle, average fruit weight, number of fruits per tree and yield (kg/tree) as influenced by different treatments of Urea, KNO_3 , Ethephon and Novel organic liquid fertilizer were recorded during the experimentation and are presented in Table 4.5 to Table 4.7 and graphically represented in Fig. 6 to Fig. 10.

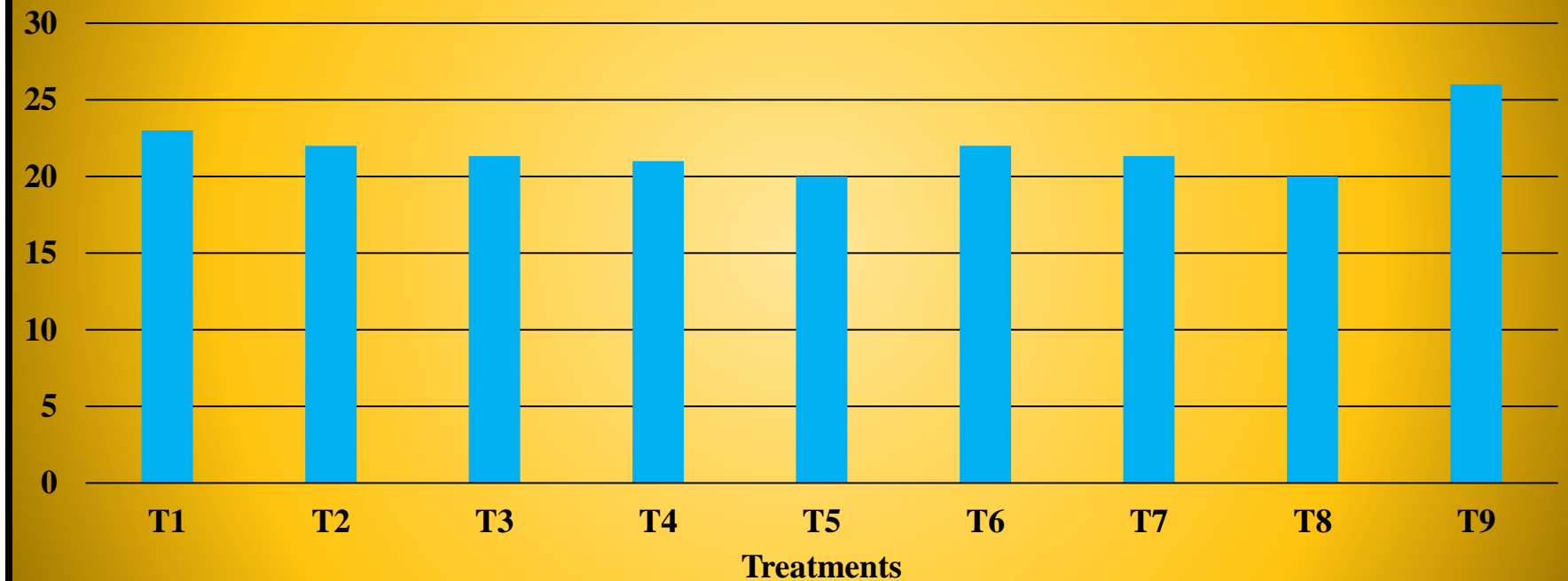
4.2.1 Number of fruit set at pea size and marble stage per panicle

The data regarding the number of fruit set at pea and marble stage per panicle as influenced by different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer did exert significant difference are presented in Table 4.5 and depicted in Fig. 6.

Table 4.4 : Effect of different chemicals on days require for full bloom (days) in Dashehari mango under ultra high density plantation.

Treatments	Days require for full bloom (days)
T ₁ : Urea @ 1%	23.00
T ₂ : Urea @ 1.5%	22.00
T ₃ : Urea @ 2%	21.33
T ₄ :KNO ₃ @ 1%	21.00
T ₅ : KNO ₃ @ 2%	20.00
T ₆ :Ethephon @ 200 ppm	22.00
T ₇ :Novel organic liquid fertilizer@ 1%	21.33
T ₈ :Novel organic liquid fertilizer@ 2%	20.00
T ₉ : Control	26.00
S. Em. \pm	1.12
C. D. at 5 %	3.34
C.V. %	8.84

Fig. 5 : Effect of different chemicals on days require for full bloom (days) in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

The maximum number fruit set (19.00) at pea size stage per panicle was recorded in KNO_3 @ 2% (T_5) treatment which was statistically at par with urea @ 2% (T_3), KNO_3 @ 1% (T_4) and novel organic liquid fertilizer @ 2% (T_8) treatments. While, minimum number of fruit set (13.67) at pea stage per panicle was recorded in control (T_9) treatment.

At marble stage of fruit, the maximum number (4.47) was recorded with KNO_3 @ 2% (T_5) which was statistically at par with T_3 , T_4 , T_8 treatments while, the minimum number (2.93) of fruit set at marble stage per panicle was recorded in control (T_9) treatment.

4.2.2 Fruit retention (%) at mature stage per panicle

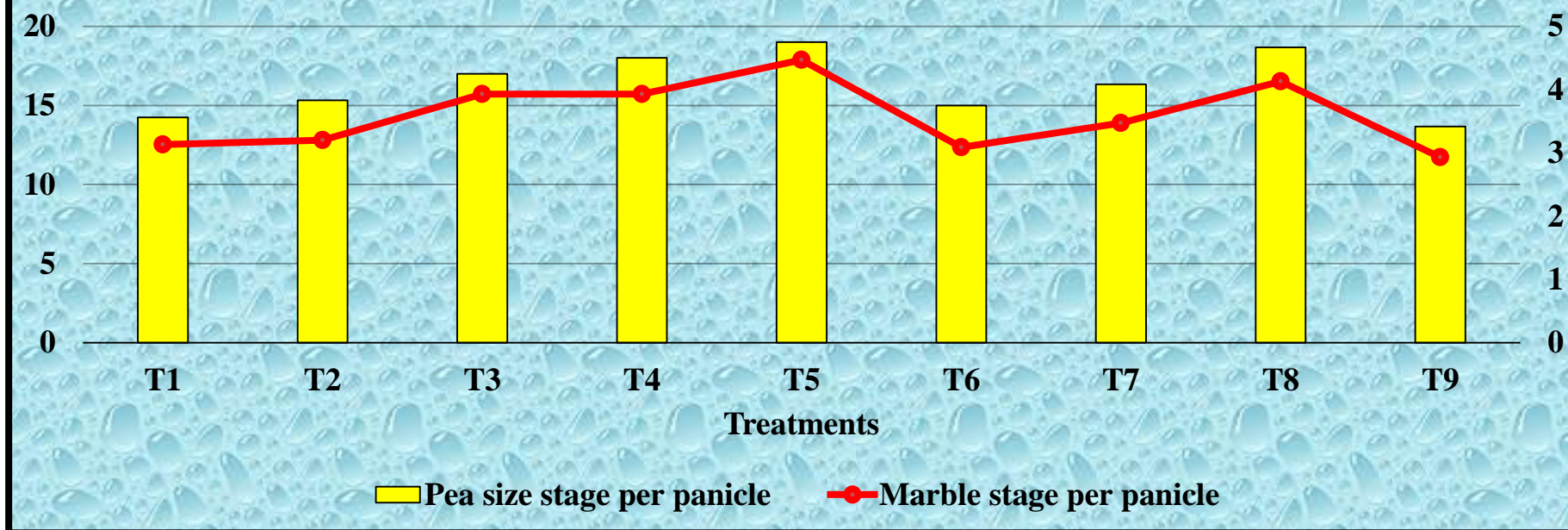
The mean data on number of fruit retention (%) at mature stage per panicle as influenced by different treatments are presented in Table 4.6 and graphically presented in Fig. 7.

A perusal of the data revealed that different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer did exert significant difference. The higher fruit retention (23.76%) at mature stage per panicle was recorded in KNO_3 @ 2% (T_5) treatment. Whereas, lower fruit retention (19.49 %) at mature stage per panicle was recorded in treatment T_9 (control).

Table 4.5 : Effect of different chemicals on number of fruits set at pea and marble stage per panicle in Dashehari mango under ultra high density plantation.

Treatments	Number of fruits set at pea size stage per panicle	Number of fruits set at marble stage per panicle
T ₁ : Urea @ 1%	14.25	3.13
T ₂ : Urea @ 1.5%	15.33	3.20
T ₃ : Urea @ 2%	17.00	3.93
T ₄ :KNO ₃ @ 1%	18.00	3.93
T ₅ : KNO ₃ @ 2%	19.00	4.47
T ₆ :Ethephon @ 200 ppm	15.00	3.09
T ₇ :Novel organic liquid fertilizer@ 1%	16.33	3.47
T ₈ :Novel organic liquid fertilizer@ 2%	18.67	4.13
T ₉ : Control	13.67	2.93
S. Em. \pm	1.01	0.22
C. D. at 5 %	3.02	0.67
C.V. %	10.67	10.73

Fig. 6. : Effect of different chemicals on number of fruit set at pea size and marble stage per panicle in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆: Ethephon @ 200 ppm
T₇: Novel organic liquid fertilizer @ 1%
T₈: Novel organic liquid fertilizer @ 2%
T₉: Control

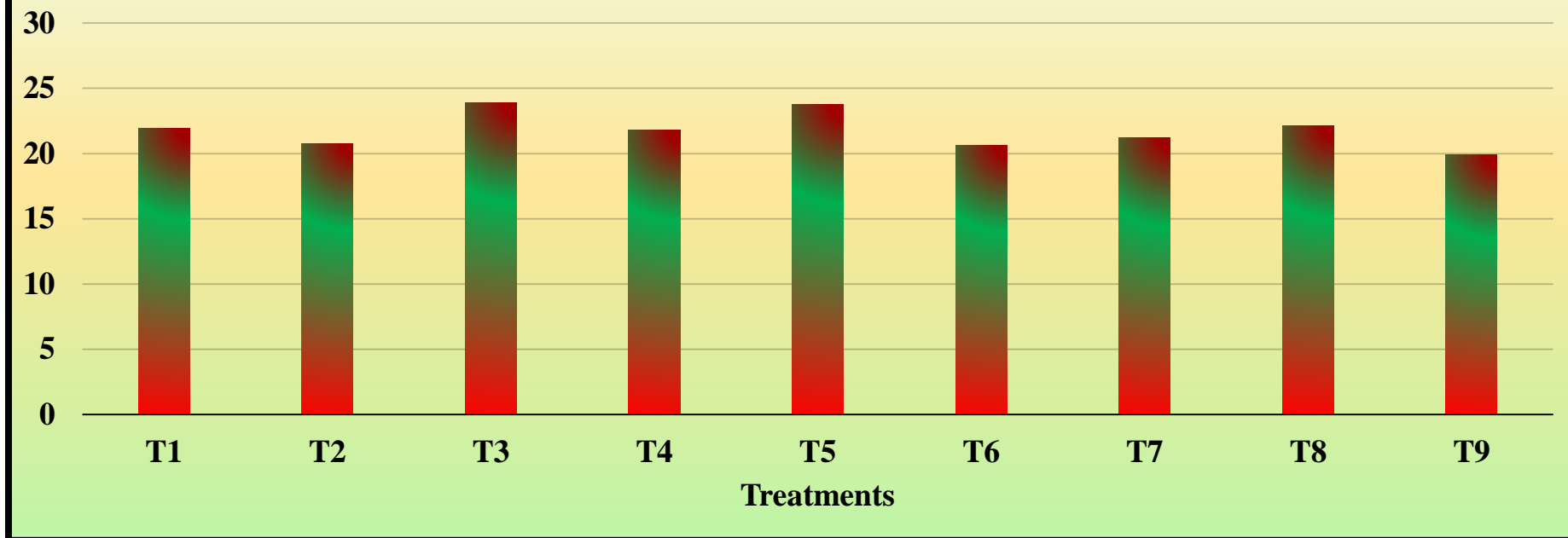
Table 4.6: Effect of different chemicals on fruit retention (%) at mature stage per panicle in Dashehari mango under ultra high density plantation.

Treatments	Fruit retention (%) at mature stage per panicle
T ₁ : Urea @ 1%	21.91
T ₂ : Urea @ 1.5%	19.75
T ₃ : Urea @ 2%	23.70
T ₄ :KNO ₃ @ 1%	21.83
T ₅ : KNO ₃ @ 2%	23.59
T ₆ :Ethephon @ 200 ppm	20.72
T ₇ :Novel organic liquid fertilizer@ 1%	21.59
T ₈ :Novel organic liquid fertilizer@ 2%	22.35
T ₉ : Control	19.49
S. Em. ±	0.75
C. D. at 5 %	2.25
C.V. %	6.00

4.2.3. Number of fruits per tree

The data pertaining to the number of fruits per tree were as influenced by different chemical treatments in mango cv.

Fig. 7. :Effect of different chemicals on fruit retention (%) at mature stage per panicle in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

Dashehari, are presented in table 4.7 and graphically depicted in Fig. 8.

The highest number of fruits per tree (191.34) was harvested in KNO_3 @ 2 % (T_5) treatment which was statistically at par with novel organic liquid fertilizer @ 2% (T_8) treatment. While, the lowest number of fruits per tree (157.33) was recorded in control (T_9) treatment.

4.2.4 Average fruit weight (g)

The mean data pertaining on average weight of fruit as influenced by different treatments are given in Table 4.7 and graphically presented in Fig. 9. The maximum average weight of fruit (170.19 g) were recorded in foliar application of KNO_3 @ 2% (T_5) treatment which was statistically at par with T_8 (novel organic liquid fertilizer @ 2%) and T_4 (KNO_3 @ 1%). While, the minimum average fruit weight (118.66 g) was recorded in control (T_9) treatment.

4.2.5 Yield (kg/tree)

The data pertaining to the yield (kg/tree) of mango was influenced by different chemical application have been presented in table 4.7 and graphically presented in Fig. 10.

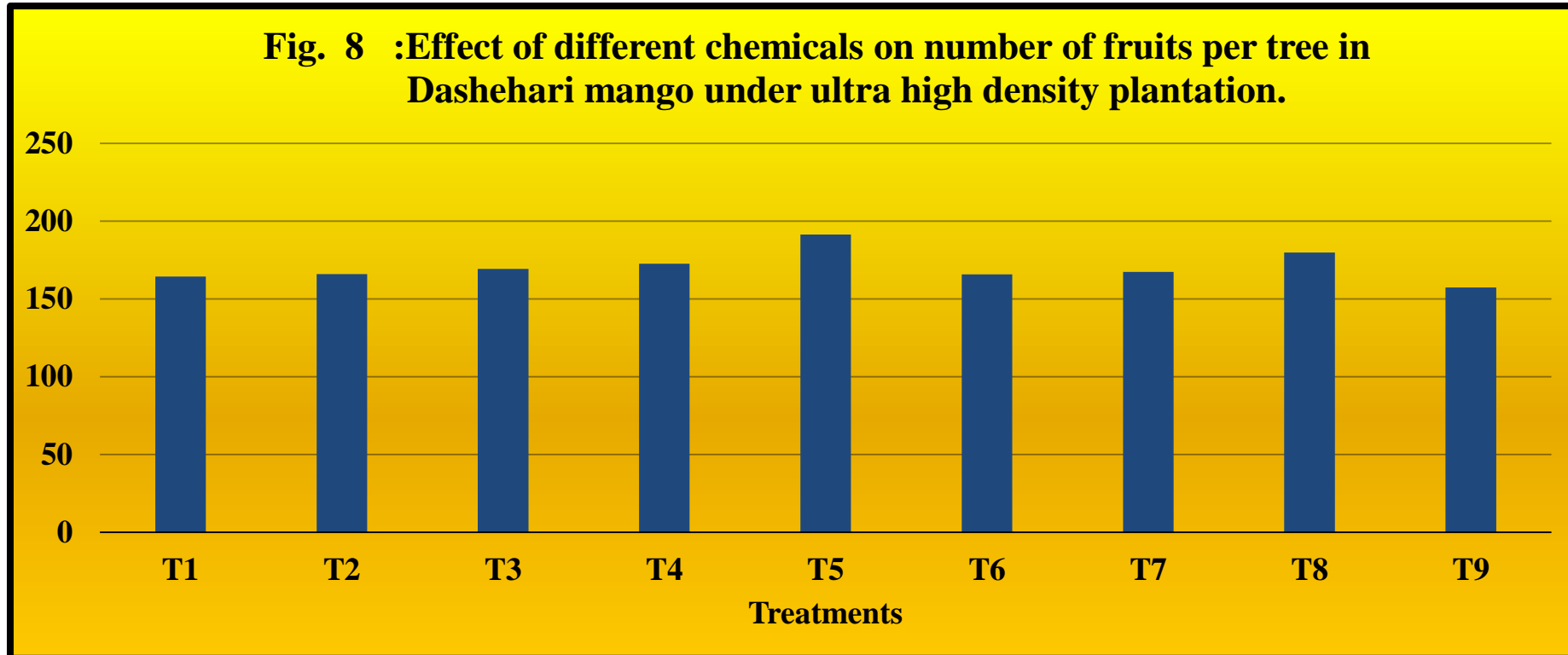
The application of different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer exerted significant differences on yield (kg/tree) in mango var. Dashehari. Significantly the maximum fruit yield (32.49 kg/tree) was recorded in treatment T_5 (KNO_3 @ 2%) which was statistically at par with treatment T_8 (novel organic liquid fertilizer @ 2%)

followed by T₅ (KNO₃ @ 1%). While, minimum fruit yield (18.96 kg/tree) kg per tree was noted in control (T₉) treatment.

Table 4.7 : Effect of different chemicals on number of fruits per tree, average fruit weight and yield (kg/tree) in Dashehari mango under ultra high density plantation.

Treatments	Number of fruits per tree	Average fruit weight (g)	Yield (kg / tree)
T ₁ : Urea @ 1%	164.32	125.12	20.69
T ₂ : Urea @ 1.5%	165.88	141.98	23.53
T ₃ : Urea @ 2%	169.26	144.45	24.48
T ₄ :KNO ₃ @ 1%	172.55	160.05	27.59
T ₅ : KNO ₃ @ 2%	191.34	170.19	32.49
T ₆ :Ethephon @ 200ppm	165.72	145.37	24.09
T ₇ :Novel organic liquid fertilizer@ 1%	167.33	143.90	24.12
T ₈ :Novel organic liquid fertilizer@ 2%	179.72	166.76	29.89
T ₉ : Control	157.33	118.66	18.96
S. Em. ±	6.07	8.18	1.15
C. D. at 5 %	18.19	24.51	3.44
C.V. %	6.17	9.68	7.92

Fig. 8 :Effect of different chemicals on number of fruits per tree in Dashehari mango under ultra high density plantation.

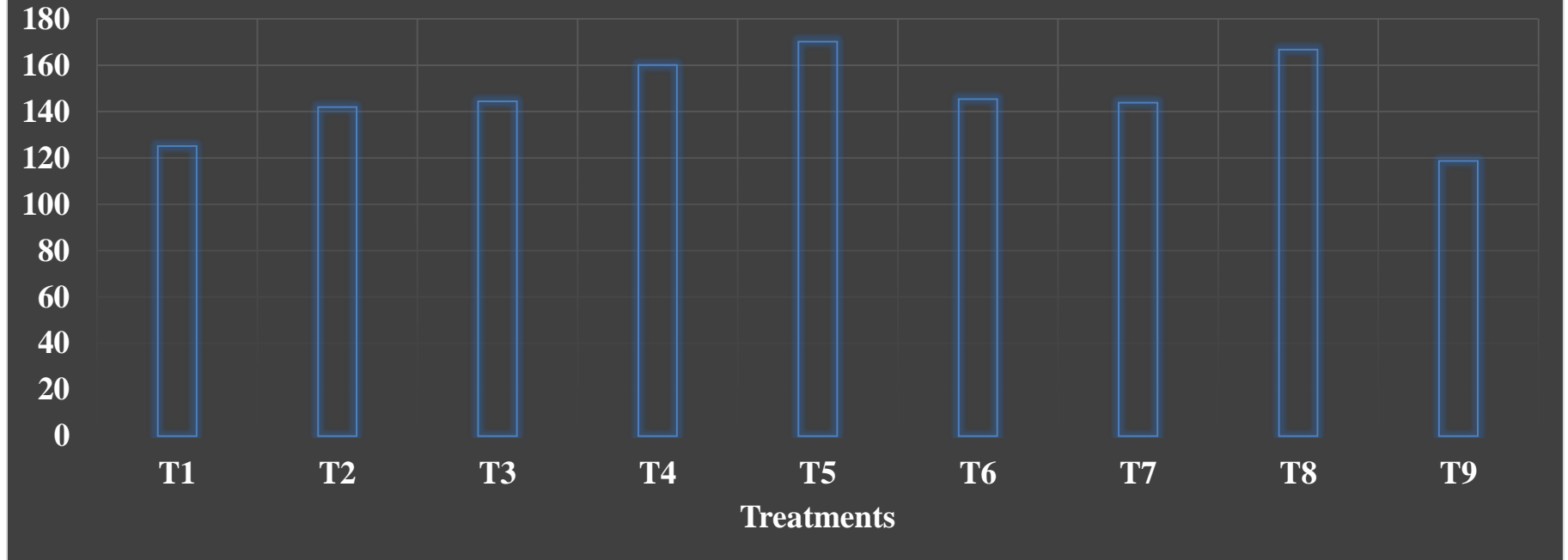


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T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

Fig. 9 :Effect of different chemicals on average fruit weight (gm) in Dashehari mango under ultra high density plantation.

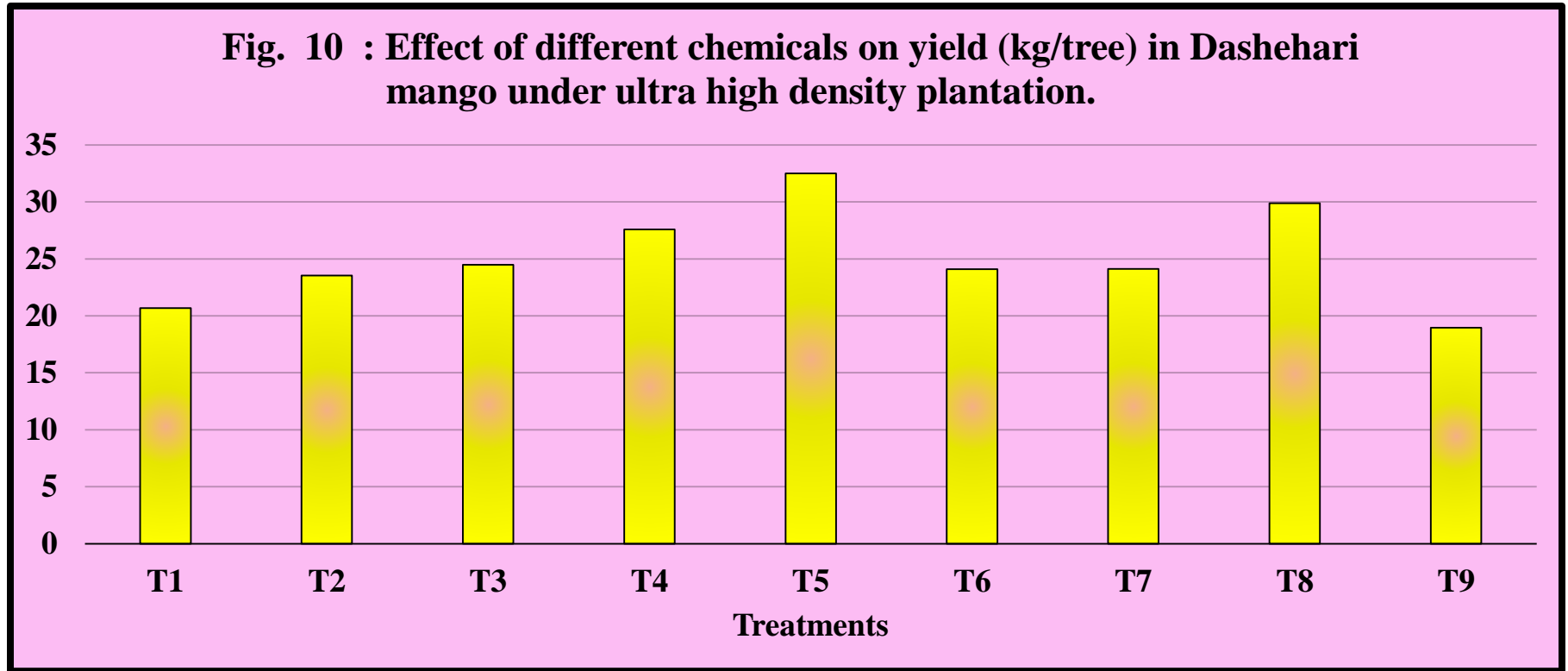


6
7

T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

Fig. 10 : Effect of different chemicals on yield (kg/tree) in Dashehari mango under ultra high density plantation.



8
9

T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

9.3 Quality parameters

9.3.1 Shelf life (days)

The data pertaining to shelf life of fruits (days) as influenced by different treatments of urea, KNO₃, ethephon and novel organic liquid fertilizer are presented in Table 4.8 and graphically depicted in Fig. 11.

The maximum (18.33 days) shelf life was noted in treatment T₂ (urea @ 1.5 %) which was statistically at par with treatment T₃ (urea @ 2 %), T₄ (KNO₃ @ 1%), T₅ (KNO₃ @ 2%). Whereas, the minimum (14.80 days) shelf life was noted in control (T₉) treatment.

4.3.2 Total soluble solids (⁰Brix)

The data on total soluble solids as influenced by different treatments are presented in Table 4.9 and graphically depicted in Fig.12.

Significantly the maximum (19.79 ⁰Brix) total soluble solids was noted in treatment T₅ (KNO₃ @ 2%) which was statistically at par with treatment T₅ (KNO₃ @ 1%), T₆ (ethephon @ 200 ppm) and T₈ (Novel organic liquid fertilizer @ 2%). While, minimum (15.90⁰ Brix) total soluble solids was recorded in control (T₉) treatment.

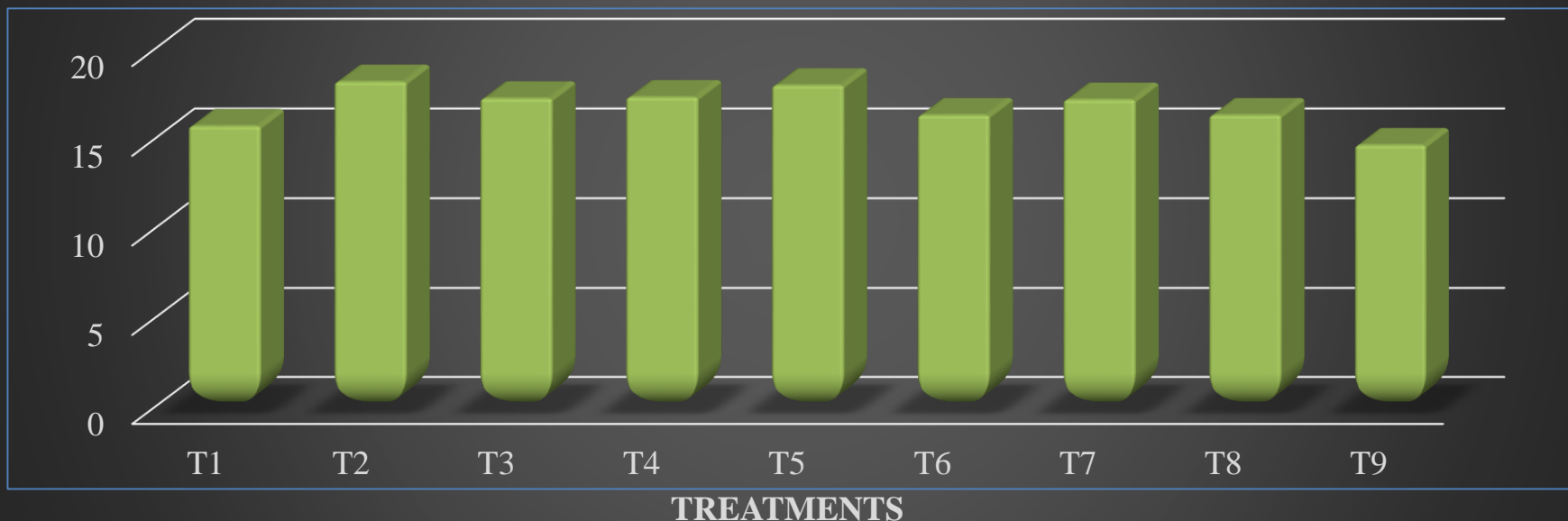
Table 4.8 : Effect of different chemicals on shelf life (days) in Dashehari mango under ultra high density plantation.

Treatments	Shelf life (days)
T ₁ : Urea @ 1%	15.86
T ₂ : Urea @ 1.5%	18.33
T ₃ : Urea @ 2%	17.40
T ₄ :KNO ₃ @ 1%	17.47
T ₅ : KNO ₃ @ 2%	18.13
T ₆ :Ethephon @ 200 ppm	16.47
T ₇ :Novel organic liquid fertilizer@ 1%	17.33
T ₈ :Novel organic liquid fertilizer@ 2%	16.47
T ₉ : Control	14.80
S. Em. \pm	0.39
C. D. at 5 %	1.18
C.V. %	4.02

4.3.3 Ascorbic acid (mg/100gm pulp)

The ascorbic acid (mg/100g pulp) content of fruits as affected by different treatments of urea, KNO₃, ethephon and novel organic liquid fertilizer are presented in Table 4.9 and graphically depicted in Fig.12.

Fig. 11 : Effect of different chemicals on shelf life (days) in Dashehari mango under ultra high density plantation.



T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
T₇:Novel organic liquid fertilizer@1%
T₈:Novel organic liquid fertilizer@2%
T₉: Control

The ascorbic acid was significantly differ by different treatment of urea, KNO_3 , ethephon and novel organic liquid fertilizer. Significantly the higher (20.44 mg/100g) ascorbic acid content of fruit was recorded in treatment T_5 ($\text{KNO}_3 @ 2\%$) followed by treatment T_8 (novel organic liquid fertilizer @ 2%). While, lower ascorbic acid content (17.15 mg/100g) was recorded in control (T_9) treatment.

4.3.4 Total sugar (%)

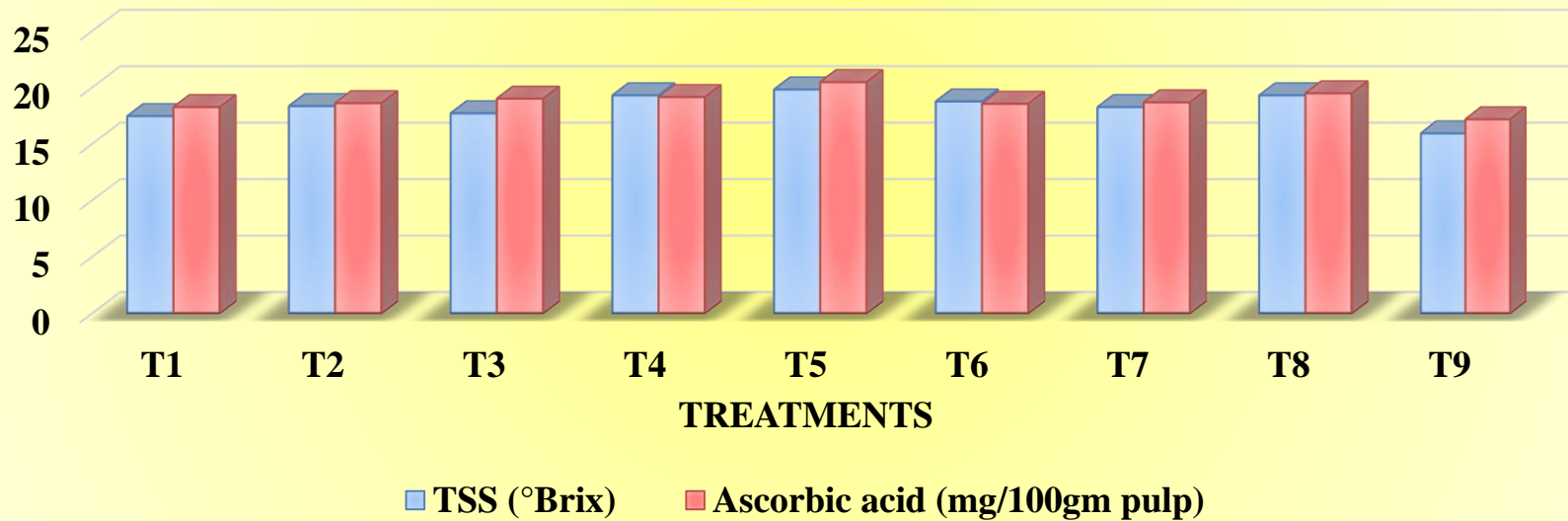
The changes in total sugar content in fruit as influenced by different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer were studied and the details are furnished in the Table 4.10 and graphically depicted in Fig.13.

The total sugar content of fruit was significantly differ by different treatments. The maximum (13.70 %) total sugar content in fruit was recorded in $\text{KNO}_3 @ 2\%$ (T_5) treatment. While, the minimum (9.37 %) total sugar content was noted in control (T_9) treatment.

Table 4.9 : Effect of different chemicals on TSS (°Brix) and ascorbic acid (mg/100gm pulp) in Dashehari mango under ultra high density plantation.

Treatments	TSS (°Brix)	Ascorbic acid (mg/100g m pulp)
T ₁ : Urea @ 1%	17.43	18.23
T ₂ : Urea @ 1.5%	18.32	18.58
T ₃ : Urea @ 2%	17.68	18.98
T ₄ :KNO ₃ @ 1%	19.27	19.12
T ₅ : KNO ₃ @ 2%	19.79	20.44
T ₆ :Ethephon @ 200 ppm	18.73	18.52
T ₇ :Novel organic liquid fertilizer@ 1%	18.23	18.65
T ₈ :Novel organic liquid fertilizer@ 2%	19.27	19.45
T ₉ : Control	15.90	17.15
S. Em. ±	0.45	0.50
C. D. at 5 %	1.34	1.51
C.V. %	4.24	4.65

Fig. 12 :Effect of different chemicals on TSS (°Brix) and ascorbic acid (mg/100gm pulp) in Dashehari mango under ultra high density plantation



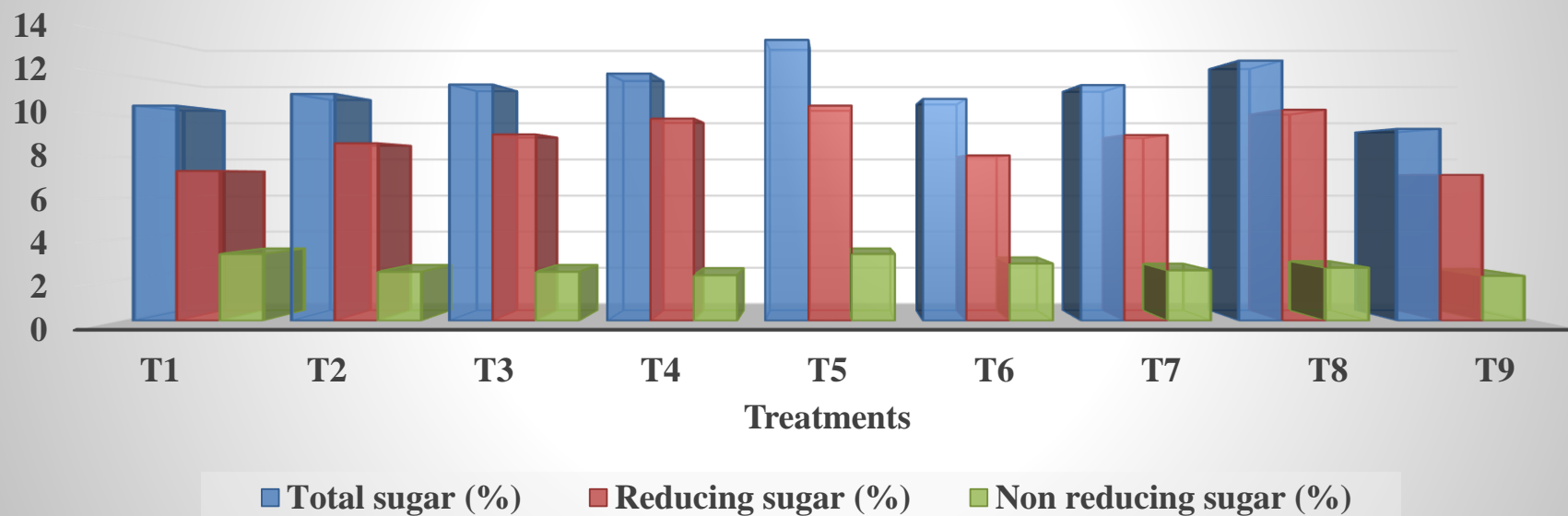
T₁: Urea @ 1%
T₂: Urea @ 1.5%
T₃: Urea @ 2%
T₄: KNO₃ @ 1%
T₅: KNO₃ @ 2%

T₆: Ethephon @ 200 ppm
T₇: Novel organic liquid fertilizer @ 1%
T₈: Novel organic liquid fertilizer @ 2%
T₉: Control

Table 4.10: Effect of different chemicals on total sugar, reducing sugar and non reducing sugar (%) in Dashehari mango under ultra high density plantation.

Treatments	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)
T ₁ : Urea @ 1%	10.50	7.32	3.27
T ₂ : Urea @ 1.5%	11.07	8.67	2.40
T ₃ : Urea @ 2%	11.53	9.10	2.40
T ₄ :KNO ₃ @ 1%	12.06	9.87	2.23
T ₅ : KNO ₃ @ 2%	13.70	10.50	3.27
T ₆ :Ethephon @ 200 ppm	10.83	8.08	2.80
T ₇ :Novel organic liquid fertilizer@ 1%	11.50	9.07	2.47
T ₈ :Novel organic liquid fertilizer@ 2%	12.69	10.30	2.60
T ₉ : Control	9.37	7.13	2.20
S. Em. \pm	0.16	0.14	0.07
C. D. at 5 %	0.49	0.41	0.21
C.V. %	2.45	2.68	4.68

Fig. 13 :Effect of different chemicals on total sugar, reducing sugar and non reducing sugar (%) in Dashehari mango under ultra high density plantation



T₁: Urea @ 1%
 T₂: Urea @ 1.5%
 T₃: Urea @ 2%
 T₄: KNO₃ @ 1%
 T₅: KNO₃ @ 2%

T₆:Ethephon @ 200 ppm
 T₇:Novel organic liquid fertilizer@1%
 T₈:Novel organic liquid fertilizer@2%
 T₉: Control

4.3.5 Reducing sugar (%)

A perusal of data presented in Table 4.10 and graphically depicted in Fig.13 clearly indicated that foliar application of different chemical treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer had significant effect on reducing sugar. However, the higher (10.50 %) reducing sugar content of fruit was observed in treatment T_5 (KNO_3 @ 2%) which was statically at par with treatment T_8 . While, the lower (7.13 %) reducing sugar was recorded in control (T_9) treatment.

4.3.6 Non reducing sugar (%)

The data concerning the non reducing sugar percentage of fruits as influenced by different treatments are presented in Table 4.10 and graphically depicted in Fig.13.

The non reducing sugar percentage of mango fruits was significantly influenced by different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer. Significantly the maximum (3.27 %) non reducing sugar was recorded in treatment T_5 (KNO_3 @ 2%) which was statically at par with treatment T_1 (Urea @ 1%). While, the minimum (2.20%) non reducing was recorded in T_1 (control) treatment.

4.3.7 Titrable acidity (%)

The data pertaining to titrable acidity (%) as influenced by different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer are presented in Table 4.11 and graphically depicted in Fig.14.

The titrable acidity was significantly differs by different treatments and the minimum (0.19%) titrable acidity was found in treatment T_5 (KNO_3 @ 2%) which was statically at par with treatment T_8 treatment. While, the maximum (0.24 %) titrable acidity was noted in control (T_1) treatment which was statistically at par with urea @ 1% (T_1) treatment.

4.3.8 Fruit firmness (kg/cm^2)

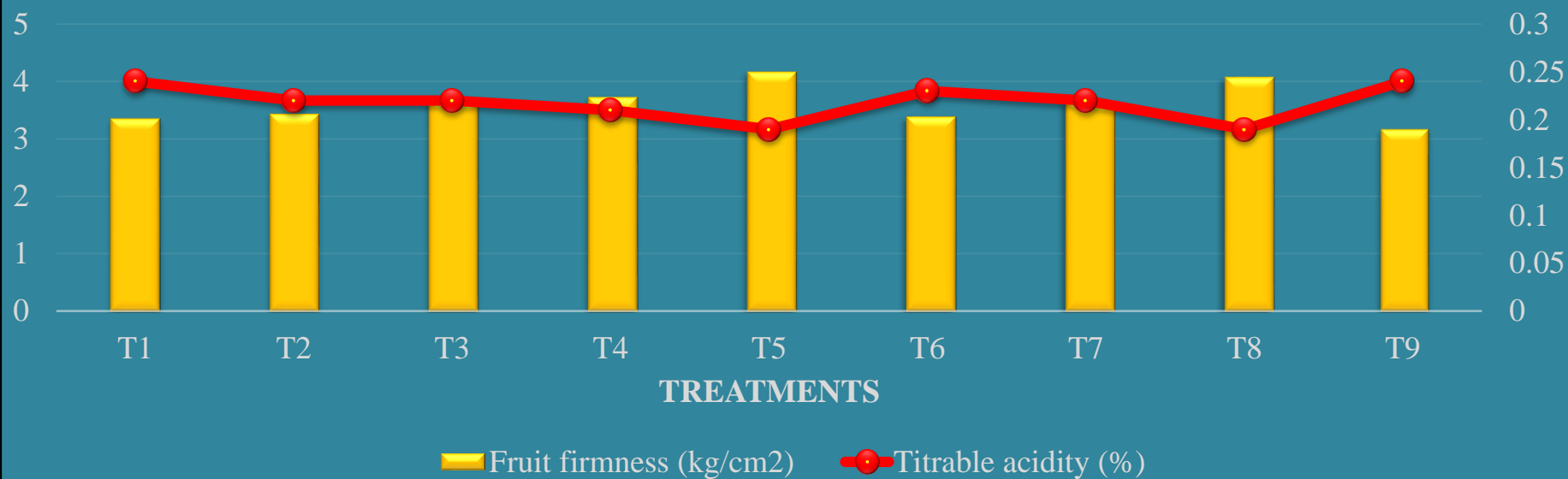
The data pertaining to Fruit firmness (kg/cm^2) as influenced by different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer are presented in Table 4.11 and graphically depicted in Fig.14.

The fruit firmness was significantly differs by different treatments and the maximum ($4.17 \text{ kg}/\text{cm}^2$) fruit firmness was found in T_5 treatment (KNO_3 @ 2%) which was statistically at par with novel organic liquid fertilizer @ 2% (T_1) treatment. While, the minimum (3.17 %) fruit firmness was noted in control (T_9) treatment.

Table 4.11: Effect of different chemicals on titrable acidity (%) and fruit firmness (kg/cm²) in Dashehari mango under ultra high density plantation.

Treatments	Titrable acidity (%)	Fruit firmness (kg/cm²)
T ₁ : Urea @ 1%	0.24	3.36
T ₂ : Urea @ 1.5%	0.22	3.44
T ₃ : Urea @ 2%	0.22	3.68
T ₄ :KNO ₃ @ 1%	0.21	3.73
T ₅ : KNO ₃ @ 2%	0.19	4.17
T ₆ :Ethephon @ 200 ppm	0.23	3.39
T ₇ :Novel organic liquid fertilizer@ 1%	0.22	3.67
T ₈ :Novel organic liquid fertilizer@ 2%	0.19	4.08
T ₉ : Control	0.24	3.17
S. Em. \pm	0.005	0.06
C. D. at 5 %	0.15	0.19
C.V. %	3.68	3.09

Fig. 14 : Effect of different chemicals on titrable acidity (%) and fruit firmness (kg/cm²) in Dashehari mango under ultra high density plantation



T₁: Urea @ 1%
 T₂: Urea @ 1.5%
 T₃: Urea @ 2%
 T₄: KNO₃ @ 1%
 T₅: KNO₃ @ 2%

T₆: Ethephon @ 200 ppm
 T₇: Novel organic liquid fertilizer @ 1%
 T₈: Novel organic liquid fertilizer @ 2%
 T₉: Control

4.4. Economics of the treatments

The data pertaining to the effect of different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer on net realization and B: C ratio are presented in Table 4.12.

The data existing in Table 4.12 clearly indicated that the foliar application of KNO_3 @ 2% (T_5) treatment gave the maximum net realization (8, 07, 220 Rs./ha) and benefit cost ratio (3.11) which was followed by treatment T_4 (KNO_3 @ 1%) (6, 72, 680 Rs/ha, 2.96, respectively).

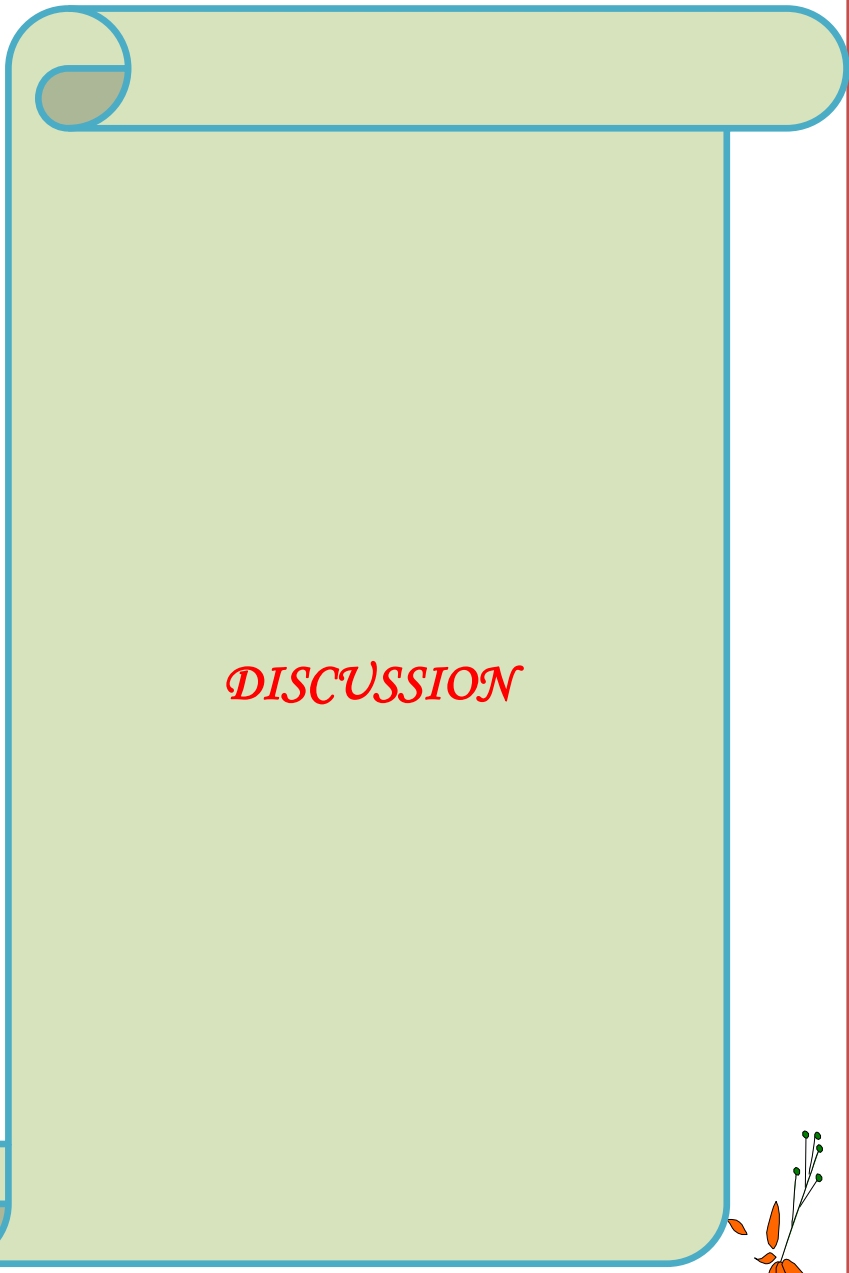
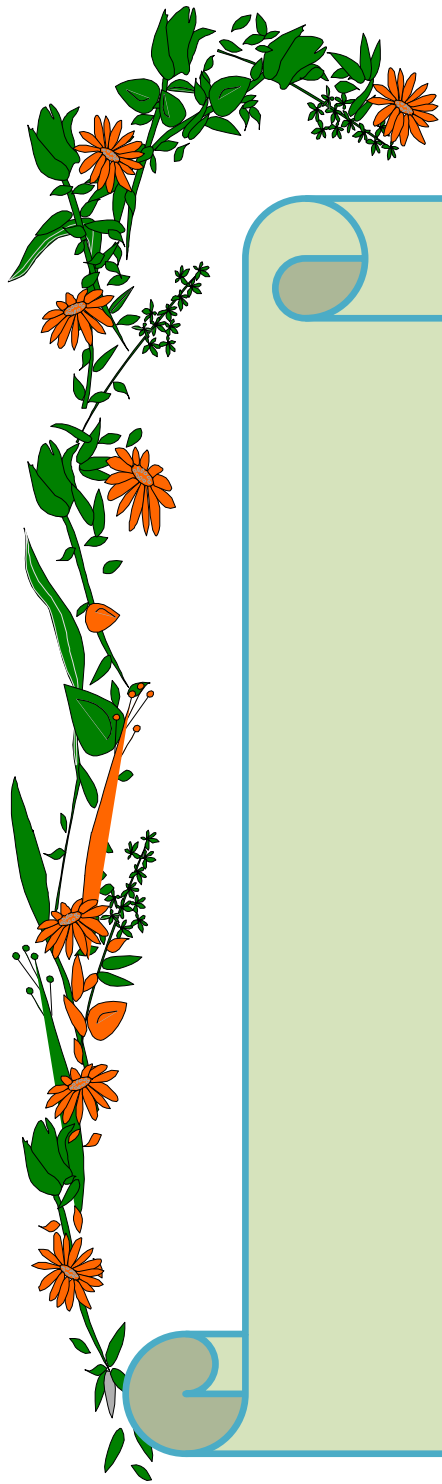
Table 4.12 : Response of foliar spray of different chemicals on economics of Dashehari mango under ultra high density plantation.

Treatments	Yield (Kg/ha)	Treatment Cost (Rs./ha)	Harvesting Cost (Rs./ha)	Fixed Cost (Rs./ha)	Total Cost (Rs./ha)	Total Return (Rs./ha)	Net Return (Rs./ha)	B: C Ratio
T ₁	44440	2352	44440	145136	191928	666600	474672	2.47
T ₂	51106	2978	51106	145136	199220	766590	567370	2.85
T ₃	53328	3604	53328	145136	202068	799920	597852	2.96
T ₄	59994	22100	59994	145136	227230	899910	672680	2.96
T ₅	71104	43100	71104	145136	259340	1066560	807220	3.11
T ₆	53328	4584	53328	145136	203048	799920	596872	2.94
T ₇	53328	27100	53328	145136	225564	799920	574356	2.55
T ₈	64438	53100	64438	145136	262674	966570	703896	2.68
T ₉	39996	00	39996	145136	185132	599940	414808	2.24

Note : Retail price of Dashehari mangoes were Rs. 15/kg.

❖ **Input and selling cost :**

Input	Cost
Urea	Rs. 6.26/kg
KNO ₃	Rs. 105 /kg
Novel organic liquid fertilizer	Rs. 130/l
Ethephon	Rs. 871/l



DISCUSSION



V. DISCUSSION

The investigation “Response of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation” was carried out at Regional Horticultural Research Station, Navsari Agricultural University, Navsari, by different chemical concentrations of urea, KNO_3 , ethephon and novel organic liquid fertilizers as a foliar spray. In this chapter, it is contemplated to discuss the variations observed in vegetative and reproductive growth parameters with respect to number of shoot- vegetative shoot and flowering shoot per terminal, vegetative shoot and flowering shoot (%), panicle length (cm) and days require for full bloom also, yield parameters with respect to number of fruit set at pea size stage per panicle, number of fruit set at marble stage per panicle, fruit retention (%) at mature stage per panicle, number of fruits per panicle, average fruit weight, number of fruits per tree, and yield (kg/tree) and quality parameters like, TSS, acidity, ascorbic acid, reducing sugar, non reducing sugar, total sugar, shelf life (days) of fruits, fruit firmness and economics to the treatments. It has been attempted to establish ‘effect and cause relationship’. The results of the present investigation duly supported by appropriate reasoning with available evidences of the earlier research workers.

The entire discussion has been divided into following sub-heads:

- 5.1 Effect of different chemicals on vegetative and reproductive growth parameters**
- 5.2 Effect of different chemicals on yield parameters**
- 5.3 Effect of different chemicals on quality parameters**
- 5.4 Economics**

5.1 Effect of different chemicals on vegetative and reproductive growth parameters

Different chemical treatments of Urea, KNO_3 , Ethephon and Novel organic liquid fertilizer exert significant effects on various growth parameters viz., vegetative shoot and flowering shoot per terminal, vegetative shoot and flowering shoot (%), panicle length (cm) and days require for full bloom.

Foliar application of different chemicals treatment at first fortnight of October and November, among them foliar application of KNO_3 @ 2% (T5) treatment gave lower vegetative shoot and vegetative shoot (%) but higher number of flowering shoot and flowering shoot percentage. It might be due to the KNO_3 induced flowering. The mechanism of action of KNO_3 involves a biochemical process where the reduction of nitrate to ammonia takes place. Ammonia got metabolised to different amino acids that also includes methionine. Methionine is further converted to S-adenosylmethionine (SAM) and then to 1-aminocyclo-propane-1-carboxylic acid (ACC) and is finally converted to ethylene. Ethylene might be an important second messenger in plant development and is also capable of promoting



Plate- 01: General view of experimental site.

flowering (Burg and Burg, 1966) and (Maloba *et al.* 2014). Some previous studies suggested that KNO_3 may be a stimulus for flower initiation. KNO_3 does not induce flowering, but helped in sensitizing buds to the floral stimulus when KNO_3 is sprayed on the terminal bud of mango shoots. (Kulkarni, 1988) stated that the floral stimulus was already present in the shoots at the time the buds responded to KNO_3 .

Spraying of chemicals and nutrient (Urea and KNO_3 , KH_2PO_4) could induced early vegetative growth but into a lesser degree in Alphonso mango (Srihari and Rao, 1998). However, Sergent *et al.* (2000) indicated that urea treatment (July) followed by KNO_3 (at first fortnight of October and November) induced better vegetative growth in Haden mango. It could be attributed to the nitrogen effect on plants during rainy season. This is in conformity with (Reddy and Kurian, 2012) pruning along with chemical sprays reduced percentage of vegetative shoots and increased percentage of flowering shoot in mango cv. Alphonso. The controversial results were also reported by Palsande *et al.* (2013) in cashew with urea and KNO_3 ; Ramirez *et al.* (2010) in mango cvs. Keitt and Tommy Atkins with KNO_3 ; Shaban and Haseeb (2009) in guava with pruning and KNO_3 .

All the treatment showed remarkable improvement in flowering and length of panicle in mango over control. The highest percentage as well as length of panicle was recorded in treatment spray application of KNO_3 and novel organic liquid fertilizer (T_5 and T_8). The reason behind it was the foliar application of KNO_3 promotes ethylene biosynthesis which

encourage floral induction and the favorable effect novel organic liquid fertilizer on plant growth and yield might be due to its bio regulatory effect chiefly through mobilization of dry matter and translocation of photosynthesis to sink. (Mishra *et al.*, 2011)

5.2 Effect of different chemicals on yield parameters

Different treatments of urea, KNO_3 , ethephon and novel organic liquid fertilizer exert significant effects on various parameters viz., number of fruits set at pea size stage per panicle, number of fruits set at marble stage per panicle, fruit retention (%) at mature stage per panicle, number of fruits per panicle, average fruit weight, number of fruits per tree, and yield (kg/tree).

Significantly maximum number of fruit set at pea and marble stage per panicle and fruit retention (%) at mature stage were noted in KNO_3 @ 2 % (T_5) treatment followed by novel organic liquid fertilizer @ 2% (T_8) and KNO_3 @ 1% (T_5). While minimum number of fruit set at pea size and marble stage per panicle and fruit retention (%) at mature stage were noted in control (T_9) treatment. It might be due to potassium lowers osmotic potential thus reducing water stress and it essential constituent of carbohydrate synthesis. On the other hand, nitrogen in the experimental plants as a consequence of KNO_3 application enhanced carbohydrate reserves, which ensured better fruit set. All these reduce metabolites and water stress caused by competition among fruit lets, fruit setting and further development. It has been reported by different workers that nitrogen increases auxin content (Addicot, 1970) and auxin plays



Pea size Stage



Marble Stage

Plate- 02: Pea size and marble stage per penicle in Dashehari mango under ultra high density plantation.



T₉: control



T₅ : KNO₃ @ 2%

Plate- 03: Fruiting in Dashehari mango under ultra high density plantation.

a decisive role in enhancing fruit set and fruit retention by checking the abscission layer formation in fruit stalk. Nitrogen and potash promote the growth of settled fruit and boost up their retention on the tree till harvesting. Potassium nitrate and potassium di-hydrogen phosphate interacted positively with fruits, encouraged their favourable characters and their active implications increased fruit set and fruit retention (Barun, 2006).

Foliar application of KNO_3 at different critical fruit development stages of mango, which content 14 % nitrogen and 46 % potassium had positive effect on fruit set and fruit development. This is might be due to foliar application of K enhanced carbohydrate reserves, which ensured better fruit set. All these reduce metabolites and water stress caused by competition among fruitlets and fruit setting which leads to increased fruit set percentages and reduced fruit drop percentage. (Beevers and Hageman, 1969)

Application of KNO_3 increased fruit retention because it contain nitrogen which increases auxin content which ultimately prevent abscission (Addicot, 1970).

Significantly, the maximum number of fruit per panicle was recorded in KNO_3 @ 2% (T_5) treatment followed by novel organic liquid fertilizer @ 2% (T_8), KNO_3 @ 1% (T_4) and urea @ 2% (T_3). While minimum (1.53) number of fruit per panicle was recorded in control (T_9) treatment.

Significantly, the maximum average fruit weight was recorded in KNO_3 @ 2% (T_5) treatment followed by novel organic liquid fertilizer @ 2% (T_8), KNO_3 @ 1% (T_4) and

ethephon @ 200ppm (T6). While minimum (118.66 gm) average fruit weight was recorded in control (T₉) treatment. This might be due to increased efficiency on fruit which caused more food material in treated trees and ultimately gave higher fruit weight. The findings are supported by results of (Desai, 1994). These results are very close to be the finding of Sharma *et al.* (1989), and (Singh and Ranganath 2006).

Treatment T5, Foliar application of KNO₃ @ 2 % at first fortnight of October and November gave maximum fruit yield. This might be due to KNO₃ induced flowering, the beneficial effect of nutrients in increasing the fruit yield seems to be the increased of fruit retention per panicle, fruit length and fruit girth. Moreover, the applied nutrients (N and K) might have stimulated the functioning of a number of enzymes which in turn increased the translocation and mobilization of metabolites and photosynthetic towards the developing fruits, resulted in highest number of fruits and fruit yield (Barun and Kumar 2008) and (Sudha *et al.*,2012).

The increased in the fruit yield in KNO₃ might be due to increased in fruit set and due to that synthesis of proteins from amino acids for which potassium is essential. The findings are confirmed with Sarker and Rahim (2013), Reddy and Kurian (2012), Sarker and Rahim (2013), Nahar *et al.* (2010) and Kumar and Reddy (2008) in mango.

According to Nijjar (2000) potassium might have acted as an activator for a number of complex enzyme systems and these enzymes catalyze metabolic reactions related to the carbohydrate, amino acid, protein and folic acid. Besides, potassium improves the condition of photosynthesis in general. The first and important step in photosynthesis i.e., conversion of solar energy into chemical energy (photo-phosphorylation) is promoted by potassium. This energy is utilized for the reduction of CO₂ to carbohydrates and then sugars. Which ultimately leads to increased yield and yield attributing characters. These results show parallelism to the findings of Nahar *et al.* (2010), Oosthuyse (1997) and Reddy (2006) in mango.

5.3 Effect of different chemicals on quality parameters

Different treatments of urea, KNO₃, ethephon and novel organic liquid fertilizer exert significant effects on shelf life of fruits (days), ascorbic acid (mg/100 ml), TSS (°Brix), total sugar (%), reducing sugar (%), non reducing sugar, titrable acidity (%) and fruit firmness (kg/cm²) were observed.

The maximum TSS, total sugar, non reducing and minimum acidity was recorded in KNO₃ @ 2% (T₅) treatment. Similar results are in agreement with the results of Sharma *et al.* (1989).

Maximization of TSS might be due to increased level in sugar content which is dependent mostly upon the conversion of starch on hydrolysis to the invert sugars (Yadava *et al.*, 2008).

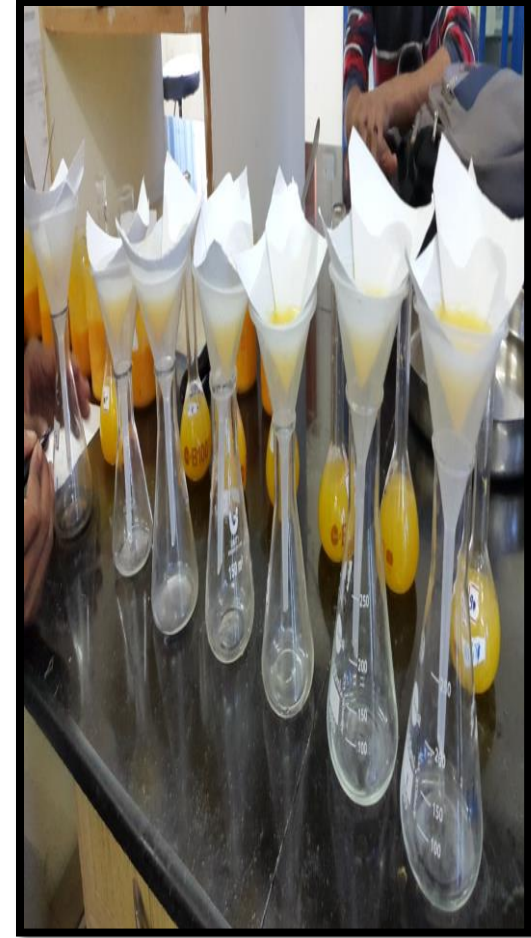


Plate- 04: Measurement of quality parameters

The present results on total soluble solid are in conformity with the results achieved by Singh and Singh(2003), Singh et al. (2005) and Reddy and Kurian (2008) in mango. Also K favours the conservation of starch into sugar during ripening by activating sucrose synthesis enzyme, resulting higher sugar content in fruits.

Acidity was minimum in KNO_3 @ 2% (T_5) treatment. This might be due to neutralization of organic acids due to high K level in tissues could have also resulted in a reduction in acidity (Tisdale and Nelson, 1966).

KNO_3 @ 2% (T_5) and urea @ 1% (T_1) treatment recorded significantly the maximum non-reducing sugar content. This might be due to the non-reducing sugars under the influence of chemicals might have either been fastly converted into sugar by the reaction involving the reversal of glycolytic path way or might be used in respiration or both (Ruffiner *et al.* 1975). Similar results were also reported by Hoda *et al.* (2001) in mango. Also when plants well supplied with K, the osmotic potential of the phloem sap and the volume flow rate are higher than in the plants supplied with low K level and as a result, sucrose concentration in the phloem sap was increased. Such results were also supported by Singh and Varma (2011) in mango cv. Kesar.

The total sugars were significantly increased with KNO_3 @ 2% (T_5) treatment. This might be due to hydrolytic

changes during ripening usually leads to the formation of sugar (Burondkar *et al.* 2000). Hydrolytic activities can give rise to rise in sugar content not only from starch but also from fat (Kulkarni, 1988) that further adds the content and this might be due to synthesis of protein depending on availability of balance nutrition which will have synergistic effect on metabolic activities of plant leading to break down of complex carbohydrate into sugar and thus resulted in higher sugar content in treated fruits by Sharma *et al.* (1989). Similar result on total sugars is in conformity with the results achieved by Singh and Singh (2003) and (Singh *et al.* 2005) in mango.

The maximum total sugar was noted in KNO_3 @ 2% (T_5) treatment this might be due to potassium is involved in carbohydrate synthesis, breakdown and translocation and synthesis of protein and neutralization of physiologically important organic acids (Tisdale and Nelson, 1966). Besides K is involved in phloem loading and unloading of sucrose, amino acid and storage in form of starch in developing fruits by activating the enzymes starch synthesis (Narhar, *et al.* 2010). Similar results were also recorded by (Singh and Varma 2011) and Singh *et al.* (2005).

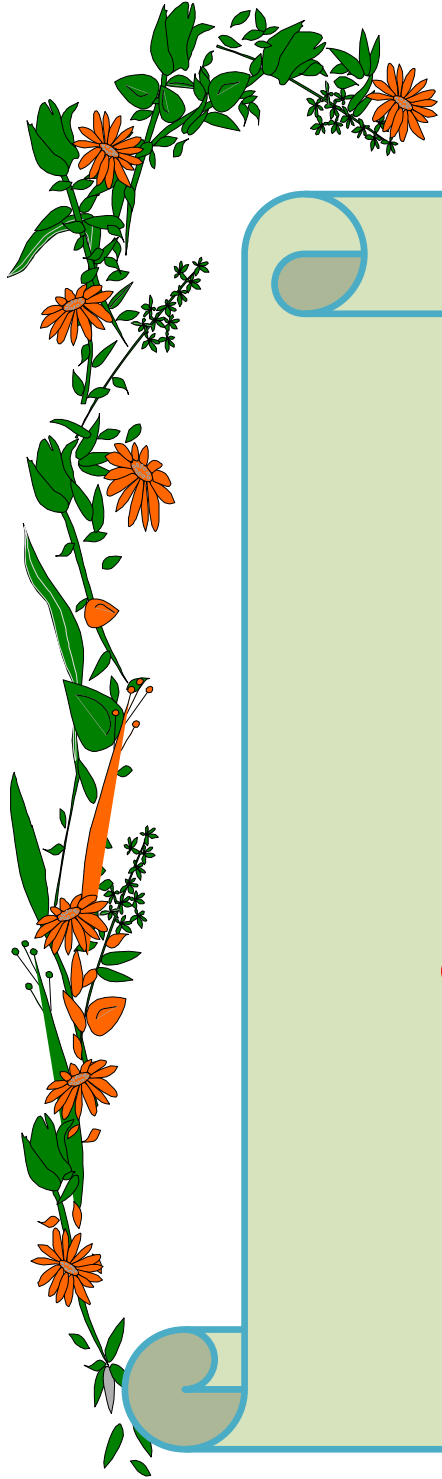
The results of present experiment indicated that the significantly maximum shelf life of the fruits was recorded in urea @ 1.5% (T_2) treatment followed by KNO_3 @ 2%. This might be due to potassium reduces respiration, preventing energy losses through maintaining turgor pressure and reduces water

loss in fruits which helps in improving the shelf life of fruits (Srivastava, *et al.*, 2013).

5.4 Economics

The mean data on economics were worked out for net realization and B:C ratio as influenced by different treatments of urea, KNO₃, ethephon and novel organic liquid fertilizer.

Among the different treatments, maximum net realization and higher benefit cost ratio were obtained in treatment T5 (KNO₃ @ 2 %). In present investigation same treatment, foliar application KNO₃ @ 2 % at first fortnight of October and November gave maximum fruit retention, yield and yield attributing characters which leads to higher net returns and benefit cost ratio.



*SUMMARY
AND
CONCLUSIONS*



VI. SUMMARY AND CONCLUSION

6.1 Summary

The present investigation on “Response of foliar spray of different chemicals on flowering and fruiting in Dashehari mango under ultra high density plantation” was carried out during the year 2015-16 at Regional Horticultural Research Station, Navsari Agricultural University, Navsari. The experiment was laid out in Randomized Block Design with nine treatments and replicated thrice. Different chemicals were spray during the October and November month. Nine treatments comprising urea (1, 1.5 and 2%), KNO_3 (1 and 2%), ethephon (200ppm) and novel organic liquid fertilizer (1 and 2%) along with one control. Different chemicals spray was done during first fortnight of October and November. The effect of these treatments on vegetative and reproductive growth parameters, yield and quality parameters were studied. The salient features of the experimental findings are summarised and concluded in this chapter.

6.1.1 Vegetative and reproductive growth parameters

6.1.1.1 Foliar application of KNO_3 @ 2% (T_5) in first fortnight of October and November had significantly highering number of flowering shoot per terminal and lowering the vegetative shoot per terminal.

- 6.1.1.2 Significantly the minimum vegetative shoot (%) was observed in KNO_3 @ 2% (T_5 treatment) and maximum vegetative shoot (%) was noted in urea @ 2 % treatment (T_3). Whereas, maximum flowering shoot (%) was observed in treatment T_5 and minimum flowering shoot (%) was noted in control treatment.
- 6.1.1.3 Foliar application of KNO_3 @ 2% treatment (T_5) gave maximum panicle length (%) while, minimum was noted in control (T_9).
- 6.1.1.4 Significantly the minimum days require for full bloom were observed in KNO_3 @ 2% (T_5) treatment. while, maximum was noted in control (T_9).

6.1.2 Yield parameters

- 6.1.2.1 Significantly the maximum number of fruits set at pea size and marble stage per panicle were observed in KNO_3 @ 2 % treatment (T_5). While, minimum fruit set was noted in control (T_9).
- 6.1.2.2 Fruit retention (%) at mature stage per panicle was significantly maximum with foliar application of KNO_3 @ 2% treatment (T_5).
- 6.1.2.3 Foliar application of KNO_3 @ 2% treatment (T_5) gave significantly maximum number of fruits per tree, average weight of fruit (g) and yield (kg per tree) while, minimum number of fruits per tree, average

fruit weight of fruit (g) and yield (kg per tree) were recorded in control (T₉).

6.1.3 Quality parameters

6.1.3.1 Significantly the maximum shelf life (days) was noted in KNO₃ @ 2% treatment (T₅). Whereas, the minimum shelf life (days) was observed in control.

6.1.3.2 Significantly the maximum TSS (°Brix) and ascorbic acid (mg/100pulp) were recorded in KNO₃ @ 2% (T₅) treatment.

6.1.3.3 Significantly the maximum total sugar, reducing sugar and non reducing sugar (%) were recorded in KNO₃ @ 2% treatment (T₅).

6.1.3.4 Significantly the minimum acidity (%) and maximum fruit firmness (kg/cm²) were recorded in KNO₃ @ 2% treatment.

6.1.4 Economics

The satisfactory outcome in higher yield of mango fruits per hectare with higher total return, net realization (Rs.807220) and higher benefit cost ratio (3.11) were obtained by foliar application of KNO₃ @ 2% in first fortnight of October and November i.e. treatment T₅.

6.2 Conclusion

From the overall experiment it can be concluded that the experiment was laid out in Randomized Block Design with nine treatments and replicated thrice. Nine treatments comprising urea (1, 1.5 and 2 %), KNO_3 (1 and 2 %), ethephon 200mg l^{-1} and novel organic liquid fertilizer (1 and 2 %) along with one control and they were spray twice, at first fortnight of October and November. The effect of these treatments on different parameter of flowering, fruiting, yield and quality were recorded and analyzed statistically.

Results of present investigation revealed that among all the treatments, foliar application of KNO_3 @ 2% treatment gave minimum vegetative shoot and maximum flowering shoot per terminal, minimum vegetative shoot (%), maximum flowering shoot (%), maximum length of panicle and minimum days for full bloom. Fruit setting percentage at pea, marble and maturity stage were significantly the maximum in same treatment.

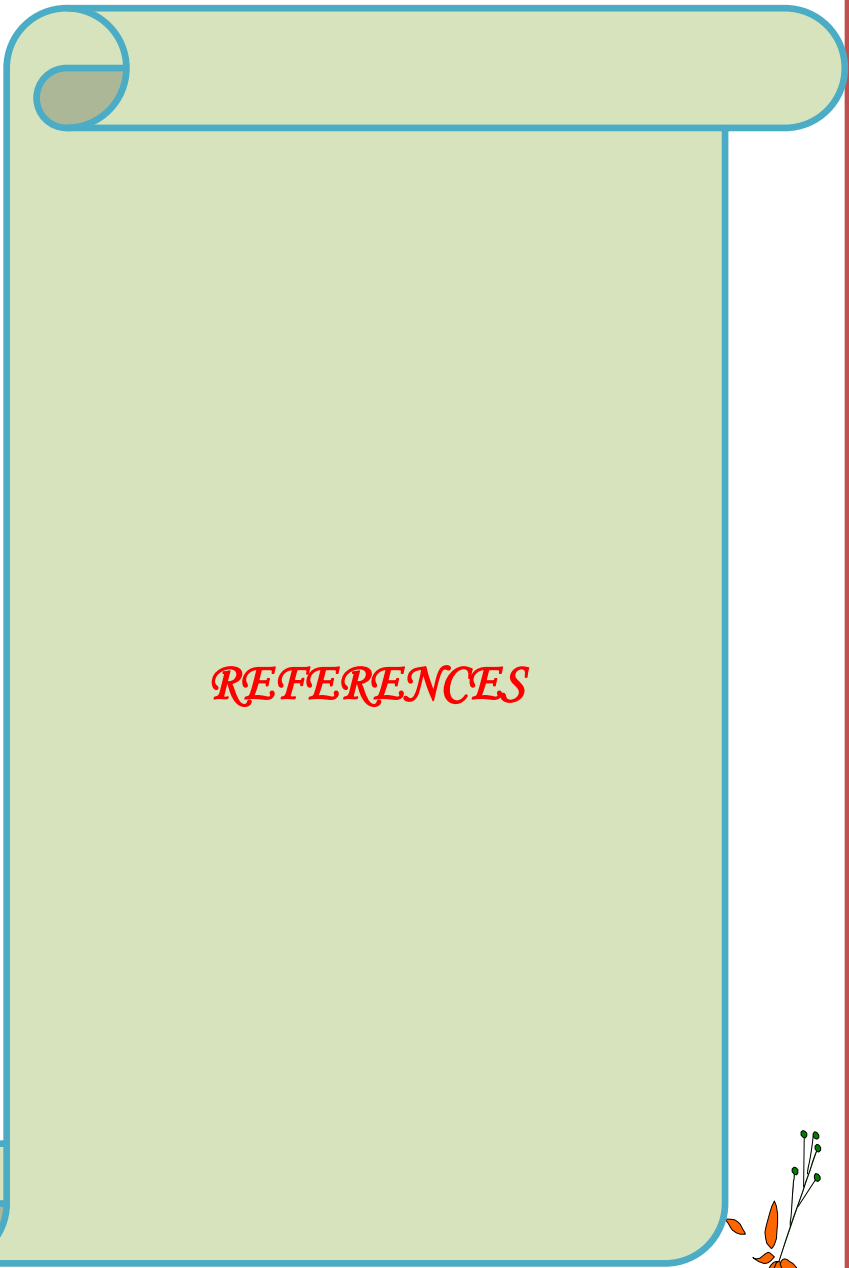
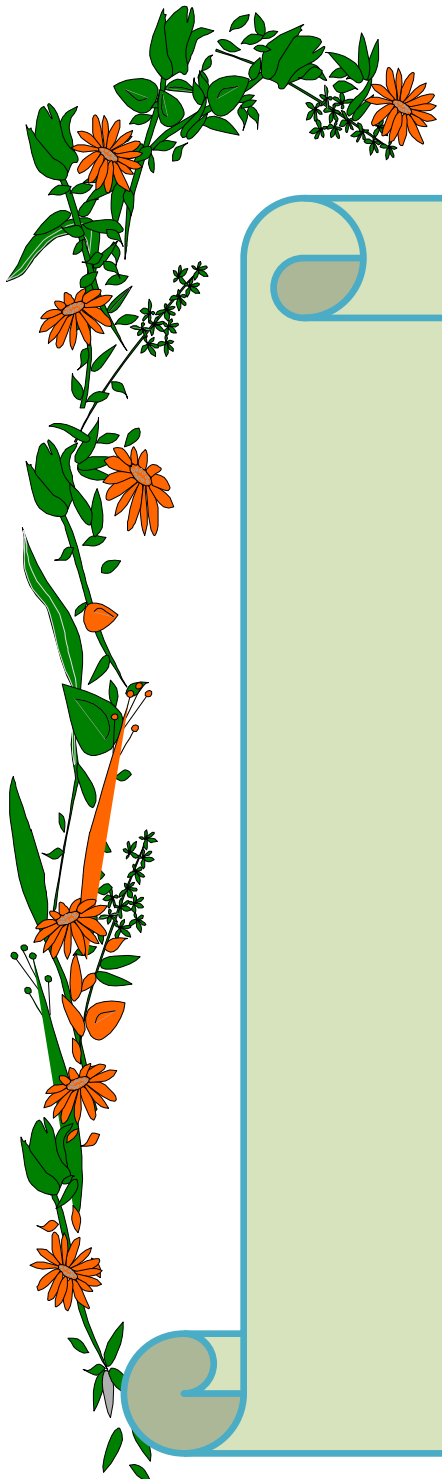
The number of fruits, average fruit weight and yield (kg/tree) were significantly the maximum in KNO_3 @ 2% treatment. Untreated trees of mango produced minimum yield and its attributes as compared to other treatments. In case of quality parameters, foliar application of KNO_3 @ 2% treatment improved 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. For economic point of view, foliar

application of KNO_3 @ 2% treatment at first fortnight of October and November were more remunerative in respect to net realization and benefit cost ratio.

On the basis of results obtained in present investigation, it can be summarized that foliar application of KNO_3 @ 2% at first fortnight of October and November, can be utilized for enhancing flowering, fruit retention, yield and quality in Dashehari mango under ultra high density plantation.

❖ C. The References and Appendices ❖

1. References
2. Appendices



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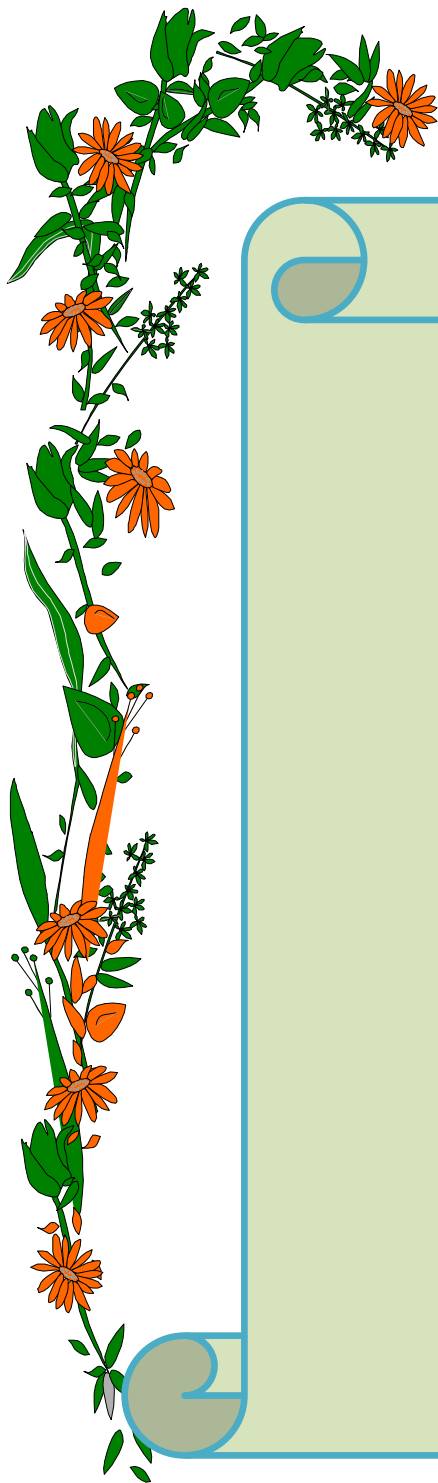
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* Original data not seen



APPENDICES



APPENDIX-I

Standard month wise meteorological data of Navsari during 2015-16

Month	Temperature		Relative Humidity (%)		Rain fall (mm)	Wind Speed (km/hrs)	Evapo (mm/day)
	Max.	Min.	Morning	Evening			
Sept.- 15	31.0	23.4	91.9	68.7	440.0	4.7	3.3
Octo.-15	35.5	23.1	86.4	45.0	3.0	3.1	4.2
Nov.-15	34.1	20.3	77.7	40.9	0.0	2.9	4.4
Dece.-15	31.3	13.1	72.2	29.2	0.0	3.2	3.6
Janu.-16	30.6	15.1	81.1	31.4	0.0	2.7	3.2
Feb.-16	30.2	14.0	80.7	33.2	0.0	3.0	3.7
March-16	35.5	18.7	85.7	29.5	0.1	3.6	4.9
April-16	35.6	22.1	82.4	39.9	0.0	4.9	6.6
May-16	34.4	26.7	82.8	58.2	0.0	8.9	6.6
June-16	33.8	27.3	84.7	71.5	3.0	9.6	6.2

Source : Agricultural Meteorological Observatory,
Agricultural Experimental Station,
Navsari Agricultural University, Navsari

Appendix - II
Expenditure details of mango cultivation

	Particulars	Quantity	Rate	Cost (Rs/ha)
A) Fixed cost expenditure				
1.	Land preparation			
	I. Ploughing	9 hrs	Rs. 350 /hrs.	3150
	II. Harrowing	9 hrs	Rs. 250 /hrs.	2250
2.	Irrigation	2 times	Rs. 1500 /hrs	3000
3.	Fertilizer			
	I. Organic fertilizer			
	1. FYM	44 tons	Rs. 490 /tons	21560
	2.Labour for application	2222 tree	Rs. 7 /tree	15554
	II. Inorganic fertilizer (600-128-600 g NPK/tree) for 8 year old.			
	1.Urea	28977 kg	Rs. 6.26 /kg	181355
	2.SSP	1706 kg	Rs. 7 /kg	11942
	3.MOP	2133 kg	Rs. 17 /kg	36261
	4. Labour for application	2222 trees	Rs. 7 /tree	15554
4.	Plant protection measures			
	Imidacloprid (2.7 ml/10 lit.water)	2 .7 lit.	Rs. 1400 /lit.	3780
	Sulphur wt. (25 g/10 lit.water)	25 kg	Rs. 90 /kg	2250
	Carbendazim (5 g/10 lit water)	5 kg	Rs. 350/kg	1750
	Acephate (15 g/ 10 lit.water)	15 kg	Rs. 590 /kg	8850
	Labour charge for spraying	4 Spray	Rs. 275 /Spray	1100
		Total		145136

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