STUDIES ON FOLIAR APPLICATION OF CHEMICALS ON FLOWERING, YIELD AND QUALITY OF POMEGRANATE (*Punica granatum* L.) IN *HASTA* BAHAR

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IN
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(FRUIT SCIENCE)

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BY

PATIL ONKAR BALASAHEB

B.Sc. (Horticulture)

A thesis submitted to
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani
in partial fulfillment of the requirement for the degree of

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IN
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(FRUIT SCIENCE)

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2021

DECLARATION BY THE CANDIDATE

I hereby declare that the thesis entitled, **"STUDIES ON FOLIAR APPLICATION OF CHEMICALS ON FLOWERING, YIELD AND QUALITY OF POMEGRANATE (*Punica granatum* L.) IN *HASTA* BAHAR"** submitted by me is based on the actual work carried out by me under the guidance and supervision of Baslingappa Mallikarjun Kalalbandi. The extent of information derived from the existing literature have been duly cited and referenced. The existing research work or its any part is not submitted anywhere else for the award of any degree or diploma.

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Dr. B. M. Kalalbandi
Research Guide & Chairman

CERTIFICATE – II

This is to certify that the thesis entitled, **"STUDIES ON FOLIAR APPLICATION OF CHEMICALS ON FLOWERING, YIELD AND QUALITY OF POMEGRANATE (*Punica granatum* L.) IN *HASTA* BAHAR"** submitted by **Patil Onkar Balasaheb (Reg. No.2019H/04ML)** in partial fulfillment of the requirements for the award of the degree of **MASTER OF SCIENCE (Horticulture)** in the subjected of **FRUIT SCIENCE** to the Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani has been approved by the Student's Advisory Committee after viva voce examination of the student in collaboration with the External Examiner.

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46

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Patil

(Patil O. B.)

Place: Latur

Date: 11/08/*2021*

CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF PLATES

ABBREVIATIONS

A.O.A.C	-	Association of agricultural chemists
%	-	Per cent
/	-	Per
C.D.	-	Critical Difference
C.V.	-	Coefficient of variation
Cm	-	Centimeter (s)
Edn.	-	Edition
et al.	-	Et alia, and others
Fig.	-	Figure
Etc.	-	Et cetera (and other)
ML	-	Milliliter
@	-	At the rate
G	-	Gram
i.e	-	That is
m	-	Meter
Met.	-	Meteorological
T	-	Treatment
No.	-	number
^{0}C	-	Degree Celsius
Pp	-	Pages
S.E. +	-	Standard error of mean
Temp.	-	Temperature
Min.	-	Minimum
Max.	-	Maximum
viz.,	-	like, namely
Rs.	-	Rupees

B:C	-	Benefit cost ratio
RDF	-	Recommended dose of fertilizer
Cv.	-	Cultivar
Sr.	-	Serial
Mt	-	Metric tone
CCC	-	Cycocel
KNO3	-	Potassium Nitrate
Fe	-	Iron
ZnSo4	-	Zinc sulphate
Br	-	Boron
FYM	-	Farm yard manure
Ha	-	Hectare
0	-	Degree
RH	-	Relative humidity

THESIS ABSTRACT

1. **Title of the thesis** : Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) in *hasta* bahar
2. **Full Name** : Patil Onkar Balasaheb
3. **Full name of the Research Guide**: Kalalbandi Baslingappa Mallikarjun
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5. **College/University** : College of Agriculture, Latur. V.N.M.K.V. Parbhani.
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ABSTRACT

An investigation on "Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) in *hasta* bahar" was carried out at farmers field during the year 2020-21. The field experiment was laid out in Randomized Block Design with eleven treatments and three replications. The experiment consisted of eleven treatment combinations *viz.,* T_1-Cycocel1500ppm+0.2% $ZnSO_4$+0.2% boric acid,T_2-Cycocel 2000 ppm+0.2% $ZnSO_4$+0.2% boric acid, T_3- Nitrobenzene 5ml/lit+0.2% $ZnSO_4$+0.2% boric acid, T_4-Nitrobenzene 7.5ml/lit+0.2% $ZnSO_4$+0.2% boric acid, T_5-Salicylic acid 100 ppm +0.2% $ZnSO_4$+0.2% boric acid, T_6- Salicylic acid 200 ppm+0.2% $ZnSO_4$+0.2% boric acid, T_7-Ethrel 2%+0.2% $ZnSO_4$+0.2% boric acid, T_8-Ethrel 3%+0.2% $ZnSO_4$+0.2% boric acid, T_9-Potassium nitrate 2%+0.2% $ZnSO_4$+0.2% boric acid,T_{10}-Potassium nitrate 3%+0.2%$ZnSO_4$+0.2% boric acid,T_{11}- control. The treatments were imposed through foliar application which was sprayed three times.

The result obtained for flowering, yield and quality attributes had significantly influenced due to foliar application of different chemicals over control.

Flowering parameters *viz.* less number of male flowers (45.1) was recorded in treatment T_8 while maximum number of hermaphrodite flower (185.20), total number of flower (234.89), less number of days taken from flowering to fruit set (25.27 days), less number of days taken from flowering to harvest (173.2) days was recorded in treatment applied with Cycocel 2000 ppm+0.2% $ZnSO_4$+0.2% boric acid, while more fruit set % (51.53) was recorded in treatment consisting of Salicylicacid200ppm+0.2% $ZnSO_4$+0.2% boric acid.

With regards to fruit parameters *viz.* maximum fruit length (10.37 cm), fruit diameter (8.76 cm), fruit volume (316.16 ml), fruit weight (295.90 g), number of arils per fruit (597.62),aril weight per fruit(225.01 g) and aril recovery (76.04 %) was recorded in treatment Potassium nitrate 3%+0.2%$ZnSO_4$ +0.2 % Boric acid. Treatment control where no sprays were given recorded minimum values for above fruit parameters. Less peel weight was recorded in treatment applied with Potassium nitrate 2%+0.2% $ZnSO_4$+0.2% boric acid (68.40 g).

The yield parameters *viz.,* maximum total number of fruits per plant at fruit set (91.99), more fruit retention (77.12%), number of fruits retained per plant at harvest (70.94), yield per plant (19.28 kg), yield per hectare (9.64 t/ha), was obtained in the treatment applied with Salicylic acid 200ppm+0.2% $ZnSO_4$+0.2% Boric acid. Treatment control where no sprays were given recorded minimum values for above yield parameters.

Regarding quality parameters *viz.,*Total soluble solids (15.8 %), reducing sugar (10.71 %), non-reducing sugar (2.57 %), total sugar (13.28 %), total soluble solids (14.21 %) and minimum titrable acidity (0.29%), of pomegranate fruit were recorded by treatment Potassium nitrate 3%+0.2% $ZnSO_4$+0.2% Boric acid.

The economics of pomegranate cultivation revealed that gross return (Rs. 5,78,400), net return (Rs. 4,12,550) and B:Cratio (3.48) was recorded higher in treatment T_6 (Salicylic acid 200ppm+0.2% $ZnSO_4$+0.2% Boric acid) among treatments in present study. The minimum gross income (Rs. 3,02,400), net return (Rs. 1,51,400) and B:C ratio (2.00) were under the treatment control.

Hence, it can be concluded that, for getting higher yield and better quality of guava fruits with higher monetary returns and B:C ratio, the pomegranate trees should be foliar fertilized with Salicylic acid 200 ppm+0.2% $ZnSO_4$+0.2% Boric acid with three sprays.

(Key words : flowering, yield, quality, chemicals, pomegranate)

CHAPTER – I

INTRODUCTION

CHAPTER-I

INTRODUCTION

Pomegranate (*Punica granatum* L.) fruit can be considered as old as human life. Pomegranate is native to Iran and the Himalayas and is the most historic fruit tree domesticated for its innumerable health benefits. Folk medicines have been using this tree for a long time and its use in modern-day medicine continues. All parts of this miracle tree-roots, stems, leaves, bark, flowers, fruits, seeds, rind, etc. are being exploited in pharmacy, the leather or dye industry or for decorative value. The nutraceutical, pharmaceutical, and cosmetic industries are having proliferating business with pomegranate especially in the European, American and some Asian markets including India. About two decades back consumer awareness towards its innumerable health benefits increased market demand, resulting in alluring monetary returns from this horticulture crop especially in India, resulting in constant increase in area and production of this crop. (Anon. 2019)

The total area under cultivation of pomegranate in India is (246000 ha) and production is around (2865000 MT) (Anon. 2018-19). In India, pomegranate is commercially cultivated in Maharashtra followed by Andhra Pradesh, Karnataka, Gujarat, Rajasthan, Madhya Pradesh, Uttar Pradesh, Tamil Nadu, Punjab and Haryana. The prominent pomegranate producing districts in Maharashtra are Solapur, Nashik, Sangli, Ahmednagar, Pune, Dhule, Aurangabad, Satara, Osmanabad and Latur. Maharashtra state accounts for 54.8 per cent of total production of the country. Among different states, Maharashtra is the main pomegranate producing state where the area under pomegranate cultivation is about 78000 hectares with the production of 4.08 lakh tons and productivity as 5.2 tons per hectare. (Anon. 2019).

The pomegranate plant flower and provide fruits throughout the year in central and southern India however, it needs to be thrown into rest period so as to enable prolific harvest at a given time. Looking to the pattern of precipitation, flowering can be induced during January-February (*ambia* bahar), June- July (*mrig* bahar) and September-October (*hast* bahar). Water stress induces flowering in a stipulated period which ultimately leads to proper management and thereby receiving good quality of yield. (Durgude, *et al*. 2019)

The flowering habit of pomegranate is influenced by the prevailing climatic conditions of the geographical region where it is being grown (Pareek and Sharma, 1993). The inflorescence is a dichasial cyme. Flowers can appear solitary, in pairs or in clusters. There are two kinds of flowers borne on the same plant *viz.,* staminate and hermaphrodite which occur in about one month after bud break on newly developed branches of the same year, mostly on spurs or short branches. The male flowers are companulate (bell – shaped) whereas, the hermaphrodite flowers are urcerate (vase – shaped). The ovary of the male flower is rudimentary and are of the degenerating type. If fruit set takes place in male flowers, they may drop before reaching maturity, even if some fruits which reach maturity become misshaped. The ovary in bisexual flower is well developed with a broad base. The fruit set in pomegranate mainly occurs upon hermaphrodite flowers, (Chaudari and Desai, 1993). In tropical climate, pomegranate flowers almost throughout the year whereas, in subtropics, once a year. In temperate regions, during winter, the plant is deciduous, but in tropical conditions, it is evergreen. (Hayes, 1957). Since the crop behaves as evergreen under tropical climatic conditions of India, it flowers continuously throughout the year resulting lower yield and poor-quality fruit due to depletion of plant reserves. Thus, synchronization of flowering is an ideal option for fetching better yield and quality fruits.

The pomegranate sector has immense potential of generating employment. Government and private sectors are coming together and supporting the growers. Area under pomegranate is increasing day by day and becoming an important crop in cropping system of Latur district in particular and Marathwada region in general of Maharashtra state. With the increase in area under pomegranate cultivation in Marathwada region without sufficient knowledge, experience and meticulous planning, crop is facing several issues with respect to its cultivation, obtaining good yield and quality. To overcome these types of problems and to increase productivity, farmers are using various technologies for producing export-oriented quality fruits and using technologies recommended by agricultural universities to get higher returns. Foliar application of plant nutrients has various beneficial effects on pomegranate, therefore, foliar sprays of nutrients in adequate quantity should be applied at appropriate time for optimum growth, yield, fruit quality and control of fruit cracking. Foliar fertilization has the advantage of uniform distribution of

fertilizer materials and quick response to the applied nutrients. Potassium is involved in a number of physiological and regulation of the cation-anion balance. Potassium promotes the translocation of photosynthates(sugar) for plants growth and storage in fruits and roots. Zinc is an essential trace element for plants, being involved in many enzymatic reactions and is necessary for their good growth and development. Zinc is required for the activity of different enzymes, including dehydrogenases, aldolases, isomerases, transphosphorylases, aldolases, isomerases, transphosphorylases, RNA and DNA polymerases and is also involved in synthesis of tryptophan, cell division, maintenance of membrane structure and photosynthesis and acts as a regulatory cofactor in protein synthesis. Zinc availability to plants is reduced in high pH soils. So foliar feeding of Zinc nutrients has acquired importance in recent years which is utterly economical and obviously an ideal way of evading the problems of nutrients availability and supplementing the fertilizers to the soil. (Gaikwad, *et al.* 2019). Boron has been associated with lignin synthesis activity of certain enzymes, seed and cell wall formation, and sugars transport. Boron roles in plants include effects on the germination of pollen grains, the elongation of pollen tube, fruit set and yield, and is also indirectly responsible for the activation of dehydrogenase enzymes, sugar translocation, nucleic acids and plant hormones. (Kumar, *et al.*2020).

Although a lot of work regarding beneficial effects of PGRs namely GA_3, 6-BA, CPPU, Brassino steroid, NAA, 2,4-D and foliar application have been reported on many fruit crops and proved beneficial for improving quality and yield of fruit crop like grape, strawberry, apple. The plant growth regulators have role in metabolic activities which enhance the mobility of micronutrient in various functions in cell, which is resulted in growth, yield and quality of plants. It is therefore, felt necessary to layout a trial find out the various effects of above growth substances and micronutrients on pomegranate applied through foliar sprays at different intervals in *hasta* bahar treatment. However, such systematic works on use of plant growth regulators and chemical are inadequate and inconclusive in pomegranate for Marathwada region. (Gaikwad, *et al.* 2019). In order to generate research-based information for the use of chemicals and economically efficient chemicals in this present investigation entitled as “Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) in *hasta* bahar” with following objective.

Objective:

1.1 To study influence of foliar application of chemicals on flowering, yield and quality of pomegranate in *hasta* bahar.

CHAPTER – II

REVIEW OF LITERATURE

CHAPTER-II

REVIEW OF LITERATURE

The present research work entitled “Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) in *hasta* bahar” was carried out under Osmanabad conditions. Foliar application of different chemicals at proper time helps in improving flowering, fruit yield and quality and physiochemical characteristics of pomegranate. Application of chemicals at proper time through foliage increases the efficiency of applied chemicals. It also helps in correcting micro nutrients deficiency and improve quality and physiochemical characteristics of pomegranate. Keeping in view, the present investigation was undertaken to study the effect of foliar application of chemicals in flowering, yield and quality of pomegranate.

Keeping in view, a brief review of literature relevant to the present study for planning, execution of experiment and interpretation of the results are presented in this chapter under the following sub-headings:

2.1 Effect of foliar application of chemicals on flowering parameters

Sudha *et al.* (2012) studied the effect of foliar spray of nitrogenous chemicals on flowering, fruit set and yield in mango (M*angifera indica* L.) cv. Alphanso and reported that, maximum number of flowering shoots (68.7), number of panicles (7.5/m^2), number of hermaphrodite flowers (282.5/panicle), fruit set (17.0%) was obtained with foliar spray of KNO_3 at 2% concentration.

Kazemi (2013) studied the effect of foliar application of salicylic acid and calcium on yield, yield component and chemical properties of strawberry and reported that, maximum number of flowers (14.51) was recorded in spraying combination of salicylic acid a@ 0.25mM. with calcium chloride @ 2.5mM.

Eiada *et al.* (2013) observed the effect of foliar application with manganese and zinc on pomegranate growth, yield and fruit quality and reported that, spraying zinc at 3% combined with manganese at 60 mg/*l* was more effective than other treatments and gave highest fruit set (49.34 %) and (50.69 %) in both seasons, respectively.

Ahmed *et al*. (2014) observed the maximum number of flowers per shoot (4.9), and maximum fruit retention (45%) in plants sprayed with salicylic acid in combination with all nutrients followed by salicylic acid with calcium chloride in pomegranate plants.

Ngullie *et al.* (2014) conducted an experiment to study the effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (*Mangifera indica* L.) cv. Kesar and recorded that, number of male (1035) and hermaphrodite flowers (335) per panicle, hermaphrodite flower to male flower ratio (0.32), and fruit retention per panicle (1.40) was observed in treatment foliar applied with of 2000 ppm salicylic acid.

Amarcholi *et al.* (2016) studied the impact of chemicals on fruiting parameters, quality parameters and B:C ratio of 'Kesar' mango and noticed that, maximum number of fruits per panicle (2.10) was observed in treatment KNO_3 @ 1.0%.

Bhoyar *et al.* (2016) studied the effect of foliar spray of zinc, iron and boron on the growth, yield and sensory characters of guava (*Psidium guajava* L.) cv. L-49 and reported that, maximum number of flower (5.3) per shoot was obtained with 0.3% borax spraying.

Hussain *et al.* (2017) studied the use of chemicals to realize the productivity potential in pomegranate through increased flowering and fruiting and reported that, among the treatments tried more number of hermaphrodite flowers (264.66) was obtained with spraying of uracil @ 50 ppm.

Yadav *et al.* (2017) studied the influence of foliar application of nutrients on growth, flowering, fruiting and yield of guava (*Psidium guajava*) cv. L-49 and reported that, minimum number of days taken for fruit set from flowering (18.00 and 21.07), maximum fruit set percentage (61.17%) was obtained with application of $ZnSO_4$ @1.00 percentage.

Dhurve *et al.* (2018) observed the effect of foliar application of zinc and boron on growth, reproductive and yield of pomegranate cv. Ganesh in *hast* bahar and reported that, spraying of zinc and boron chemical @ 0.4% each influenced minimum days to 50% flowering (32.92) and maximum number of flowers per shoot (5.25).

Tanari *et al.* (2019) conducted the studies on fertigation of primary nutrients on pomegranate (*Punica granatum* L.) fruit productivity and quality and reported that, number of male flowers (94.00), number of hermaphrodite flowers (128.00), total number of flowers (222.00) was observed in foliar spraying of 25% salicylic acid + 75% fertigation in schedule -2 i.e., 5:15:15 as basal, 75:75:75 at active growth stage and 20:10:10 at rest period stage and RD N: P_2O_5: K_2O, respectively.

Durgude *et al.* (2019) observed the effect of different chemicals on flowering, fruit set and yield in pomegranate *(Punica granatum* L.*)* cv. Phule Bhagwa. The minimum number of days to emergence of flower bud (7.50), percentage of lowest male flowers (43.84%), maximum fruit set percentage (37.95), maximum number of hermaphrodite flower (56.16%) as influenced by foliar application of chemicals Cycocel 2000 ppm.

Kumar (2020) studied that, nitrobenzene influenced the flowering, fruiting and quality parameters of apple cv. 'Royal Delicious' under cold dry temperate region of Himachal Pradesh and reported that, maximum fruit set (11.54 %) was recorded in the treatment nitrobenzene 20% EW@ 3 ml/lit.

2.2 Effect of foliar application of chemicals on yield parameters

Sharma *et al.* (1991) reported that foliar application of 0.6 per cent zinc sulphate resulted in significantly highest fruit set (71.96 %), fruit weight (165.8 g), number of fruits (498.6/plant), yield (82.39 kg/plant)

Abd El-Rahman (2010) investigated that, spraying with zinc sulphate ($ZnSO_4$) at 1% and kaolin spray at 6% on yield, fruit quality of pomegranate resulted in maximum fruit length (8.25 cm) and fruit diameter (8.47 cm).

Sudha *et al.* (2012) studied the effect of foliar spray of nitrogenous chemicals on flowering, fruit set and yield in mango (*Mangifera indica* L.) cv. Alphanso, Foliar spray of KNO_3 at 2% concentration resulted in more number of panicle ($7.5/m^2$), panicle length (31.4 cm), number of fruits (146.0/ tree) and fruit yield (43.8 kg/tree).

Kazemi (2013) reported that foliar application of salicylic acid and calcium on yield, yield component on strawberry fruits. Salicylic acid 0.25mM + Calcium chloride 2.5mM recorded that, maximum weight of primary fruit (18.97), weight of

secondary fruit (17), number of achenes on primary fruit (215.12) and number of achenes on secondary fruit (195).

Razek *et al.* (2013) studied the effect of foliar application with salicylic acid, benzyladenine and gibberellic acid on flowering, yield and fruit quality of olive trees. Foliar application of salicylic acid 20µg/L in two season 2011 and 2012 resulted in higher fruit weight (12.8g and 12.0g), fruit length (31.1mm and 29.5mm), fruit diameter (27.4mm and 25.8mm) and yield per tree (41.3kg and 38.8kg), respectively.

Sarker and Rahim (2013) studied that, yield and quality of mango (*Mangifera indica* L.) as influenced by foliar application of potassium nitrate and urea and reported that, foliar application of KNO_3 at 4% produced highest number of panicles per plant (220.67), maximum number of fruits per plant (136.67), maximum weight of fruit (202.83 g), maximum yield (23.14 kg /plant).

Gajarmal (2014) observed all the plant growth regulators were superior over control in pomegranate. The maximum number of arils in 100 gm (633.33), aril percentage (70.65%), number of arils per fruit (969.33) with maximum number of fruits per plant (53.66), average weight of fruits (260.36 g), yield of fruits per plant (13.96 kg), yield per hectare (7.74 tones) was recorded with application of GA_3 at 150 ppm.

Goswami *et al.* (2014) carried out an investigation to study the influence of preharvest application of calcium nitrate, boric acid and zinc sulphate on the physicochemical quality and storage behavior of guava and reported that the fruit length, diameter and volume were maximum under zinc sulphate 0.4 per cent.

Ngullie *et al.* (2014) studied the effect of salicylic acid and humic acid on flowering, fruiting, yield and quality of mango (*Mangifera indica* L.) cv. Kesar, Foliar application of 2000 ppm salicylic acid resulted in higher number of fruits per tree (236.67) and yield (66.46 kg/tree).

Amarcholi *et al.* (2016) studied the impact of chemicals on fruiting parameters, quality parameters and B:C ratio of Kesar mango. Study the foliar application of 1 % KNO_3 resulted in maximum number of fruits per panicle (2.10) and highest fruit yield (72.30 kg/tree).

Bhoyar *et al.* (2016) studied the effect of foliar spray of zinc, iron and boron on the growth, yield and sensory characters of guava (*Psidium guajava* L.) cv. L-49 and reported that, combination of 0.5 % zinc sulphate + 0.5 % ferrous sulphate + 0.3% borax resulted in more number of fruits per shoot (3.6) and maximum yield (57.1 kg/tree).

Hamouda *et al.* (2016) studied the yield, fruit quality and nutrients content of pomegranate leaves and fruit as influenced by iron, manganese and zinc foliar sprays. Zinc foliar spraying of 2000 ppm combination in two season 2011 and 2012, respectively resulted in higher fruit length (9.36cm and 9.67cm), diameter (9.06cm and 9.37cm), fruit weight (312.40g and 323.10g), peel weight (110.40g and 114.24g), higher fruit yield per shrub (12.50 kg/shrub and 16.16 kg/shrub) in pomegranate.

Korkmaz *et al.* (2016) reported that, foliar application of calcium nitrate, boric acid and gibberellic acid affected yield and quality of pomegranate *(Punica granatum* L.*)* and reported that, spraying of calcium nitrate @ 2% increased the yield of fruits per tree (38.34 kg/tree) on 5 years old pomegranate orchard.

Manju (2016) conducted an experiment on foliar application of KNO_3 on plant growth, flowering and fruiting of guava cv. Allahabad safeda. Foliar spray of 3% KNO_3 and 2% KNO_3 recorded maximum fruit weight, fruit length and fruit diameter of guava fruits.

Ramesh *et al.* (2016) conducted an experiment on foliar application of nutrients on yield and yield contributing characters of custard apple (*Annona squamosa* L) cv. Balanagar in which they concluded that number of fruits per plant (29.83), fruit length (10.45 cm), fruit breadth (12.35 cm), average fruit weight (264.72 g), fruit yield per plant (7.9 kg) and pulp per cent per fruit (40.1%) were reported highest with the foliar application of KNO_3 @ 1.5 %.

Sharma *et al.* (2016) studies revealed that, KNO_3 2% spray gave maximum fruit retention percentage (25.02%), yield (46.28 kg/ha), number of fruits per tree (406.67), fruit weight (106.84 g), fruit length (62.64 mm), fruit breadth (62.92 mm) and fruit volume (102.56 cc) in sapota.

Hussain *et al.* (2017) studies revealed that, use of chemicals to realize the productivity potential in pomegranate through increased flowering and fruiting and

noticed that, spraying of Uracil @ 50 ppm was effective for producing more number of fruits per plant (154.00) and yield (27.10 kg/tree and 18.86 t/ha.)

Jawandhar *et al.* (2017) investigation was planned to study the effect of foliar application of potassium nitrate on fruit yield and quality of plum cv. Satluj purple. Two foliar sprays of potassium nitrate @ 1.0, 1.5 and 2.0 %, first after two weeks of full bloom and second 10 days thereafter were applied on plum plants cv. Satluj purple. Foliar applications of KNO_3 were found effective in increasing fruit yield, fruit weight and size as compared to control.

Kumar *et al.* (2017) reported that, effect of foliar spray of chemicals on flowering and fruiting in litchi and observed that, 1% mono-potassium phosphate and 1% potassium nitrate led to largest fruit weight (>21g) and seed weight (4.00g).

Patoliya *et al.* (2017) noticed that, response of foliar spray of different chemicals on flowering and fruit retention of Dashehari mango under ultrahigh density plantation revealed that, KNO_3 @ 2% gave maximum yield (32.49 kg/tree).

Rahmani *et al.* (2017) studied, improving productivity in mango (*Magnifera indica* L.) cv. Kesar through foliar spray of silicon and salicylic acid and reported that, foliar application of salicylic acid 2000 ppm produced the maximum fruit weight (290.17 g), fruit length (12.10 cm), and breadth (8.60 cm) and foliar spray of 2500 ppm salicylic acid resulted in the maximum number of fruits per panicle (1.17), number of fruits per tree (419.00), total yield (120.64 kg/tree).

Yadav *et al.* (2017) studied the influence of foliar application of nutrients on growth, flowering, fruiting and yield of guava (*Psidium guajava*) cv. L-49 and reported that, application of $ZnSO_4$ @ 1.00% produced maximum yield in rainy and winter season, respectively (32.76kg/tree and 29.31 kg/tree).

Kumar *et al*. (2020) studied the effect of foliar application of zinc and boron on growth, reproductive and yield of pomegranate in *hast* bahar and observed that, spraying of boron and zinc @ 0.4% each influenced highest yield attributes like number of fruit/tree (57.67), weight of fruit/tree (301.74 g) and yield (18.44 kg/tree).

Kumar *et al.* (2018) carried out an investigation from which it is reported that spraying of KNO_3 three spray of 1.0% solution of KNO_3 alone at the interval of 15

days from the marble stage of fruit is recommended for better fruit quality and yield of ber (*Zizyphus mauritiana* Lamk.).

Gaikwad *et al.* (2019) studied the effect of foliar application of chemicals on yield of pomegranate cv. Bhagwa and reported that, spraying of GA_3 @ 75 ppm + boron 0.3% influenced higher yield characters like length of fruit (8.71cm), diameter of fruit (9.40 cm), volume of fruit (334.40 ml), average weight of fruit (310.11 g), number of fruit/plant (111.25), yield (34.49 kg/tree) and yield (19.14 t/ha.).

Abd el-all *et al.* (2019) reported the foliar application of gibberellic and salicylic acid improved fruit quality and yield and reduced aphid population in pomegranate (*Punica granatum* L.). Treatment application of salicylic acid 400 ppm had resulted in maximum number of fruits per tree (143.33 and 147.33), fruit weight (342.45g and 317.13g) and fruit yield (50.03 kg and 48.67 kg) in 2016 and 2017, respectively.

Tanari *et al.* (2019) reported that, foliar spraying of 25% Salicylic acid + 75% fertigation in schedule-2 i.e. 5:15:15 as basal, 75:75:75 at active growth stage and 20:10:10 at rest period stage RD N: P_2O_5: K_2O, respectively had the significant increase in fruit length (80.03mm), fruit diameter (78.78), number of fruits per plant (67.25) and fruit yield (18.49 kg/tree) and maximum fruit weight (288.5 g) was observed in 100% fertigation.

Brazinji *et al.* (2017) found that, effect of foliar spraying with salicylic acid influenced some quantity and quality characteristics of pear fruits and observed that, 0.5% salicylic acid increased fruit weight (134.94g and 153.00g) during the year 2015 and 2016 in both seasons, respectively.

Kumar *et al.* (2020) studied the, effect of foliar application of nutrients on growth, yield and fruit quality of pomegranate (*Punica granatum* L.) cv. Bhagwa and observed that, of foliar spray of KNO_3 (1%) + $CaCl_2$ (1%) + H_3PO_3 (0.4%) resulted in maximum fruit length (9.03 cm), fruit diameter (9.28 cm), fruit weight (383.88 g) and fruit yield (32.49 kg/plant).

Kumar (2020) studied effect of nitrobenzene on flowering, fruiting and quality parameters of apples cv. Royal Delicious under cold dry temperate region of Himachal Pradesh and reported that, foliar treatment of nitrobenzene 20% EW @

2ml/lit produced higher fruit length (70.71mm), breadth (76.13mm) and fruit weight (194.40g).

2.3 Effect of foliar application of chemicals on quality parameters

Burondkar *et al*. (2009) found that, both the sources of potassium (KNO_3 and K_2SO_4) resulted in significantly higher TSS (19.9 and 19.7 ^{0} Brix) and reducing sugars (7.92 and 7.59 %) over other treatments and control (16.8^0 Brix and 6.17 %). While, the ascorbic acid content was significantly higher with Ca-EDTA (49.68 mg/100 g) followed by KNO_3 (48.37 mg/100 g). The total sugars were found to be higher with K_2SO_4 (17.04 %) followed by KNO_3 (16.85 %), which were 14.1 and 12.8 percent higher over control (14.94 percent) in mango

Eiada *et al.* (2013) studied the effect of foliar application with manganese and zinc on pomegranate growth and fruit quality and reported that combination of foliar application of Zn and Mn with 1.5 and 3% respectively influenced the significant effect on total soluble solids 13.81% and13.77% in two seasons, respectively.

Kazemi (2013) observed, the effect of foliar application of salicylic acid and calcium on yield, yield component and chemical properties of strawberry and reported that, spraying combination of salicylic acid @ 0.25mM with calcium chloride @ 2.5mM resulted in highest TSS (7.8) B^0 and titratable acidity (3g/liter).

Sarker and Rahim (2013) observed that, yield and quality of mango (*Mangifera indica* L.) as influenced by foliar application of potassium nitrate and urea and reported that, foliar application KNO_3 at 4% resulted in highest TSS (25.15%), titratable acidity (0.22%), reducing sugar (5.12%), non-reducing sugar (13.71%) and total sugar (18.83%).

Ngullie *et al.* (2014) observed that, foliar application of 2000 ppm of salicylic acid produced maximum fruit TSS (18.59 Brix), acidity (0.23 %) and reducing sugar (3.95%).

Patoliya *et al.* (2017) conducted an experiment of foliar spray of different chemicals on yield and quality of Dashehari mango. They reported that KNO_3 2% sprayed twice, first fortnight of October and then in November gave maximum shelf life, total sugar (13.70%), reducing sugar (10.50%) and non-reducing sugar (3.27%) in Dashehari mango.

Kumar (2020) studied the effect of nitrobenzene on flowering, fruiting and quality parameters of apple cv. 'Royal Delicious' under cold dry temperate region of Himachal Pradesh revealed that, nitrobenzene 20% EW@ 3 ml/lit produced highest TSS (18.16^0Brix), titratable acidity (0.44%), total sugars (9.45%), reducing sugars (5.11%) and non-reducing sugars (4.34%).

CHAPTER – III

MATERIALS AND METHODS

CHAPTER-III

MATERIALS AND METHODS

The present investigation entitled "Studies on foliar application of chemicals on yield and quality of pomegranate (*Punica granatum* L.) in *hasta* bahar" was conducted during the academic year 2020-21. The details of the experiment materials used and methods adopted during the present investigation are described in this chapter under appropriate heading.

3.1Materials

3.1.1Experiment sites

The experiment was conducted on farmer's (Shri Dhananjay Hajgude) field at village Kini,Taluka and District- Osmanabad during the year 2020-21. The orchard was five years old and planted at 5m×4m spacing.

3.1.2Geographical situation and Climate conditions

Geographically Osmanabad district lies in the southern part of state. It lies on the deccan plateau, about 600m above sea level. The district located on the east side of the Marathwada region between latitude 17^0 35' to 18^0 40' north and latitude 75^0 16' to $76^0$40' east with geographical area 7569 km^2. The rainy season starts from mid-June and continues till first fortnight of September. The climate is dry in October and November and dry and cool from mid- November to January. From February to June the climate is dry and becomes increasingly hot. During summer the temperature of Osmanabad district is low compared to another district of Marathwada region. The average annual rainfall in district is 730 mm. with maximum temperature of 42.1^0C and minimum of 8^0C.

3.1.3Soil

3.1.3.1 Collection, preparation and chemical properties of soil of experimental plot.

To determine the physio-chemical properties of experimental soil, the soil samples from surface (0-30 cm depth) were collected from randomly selected plots

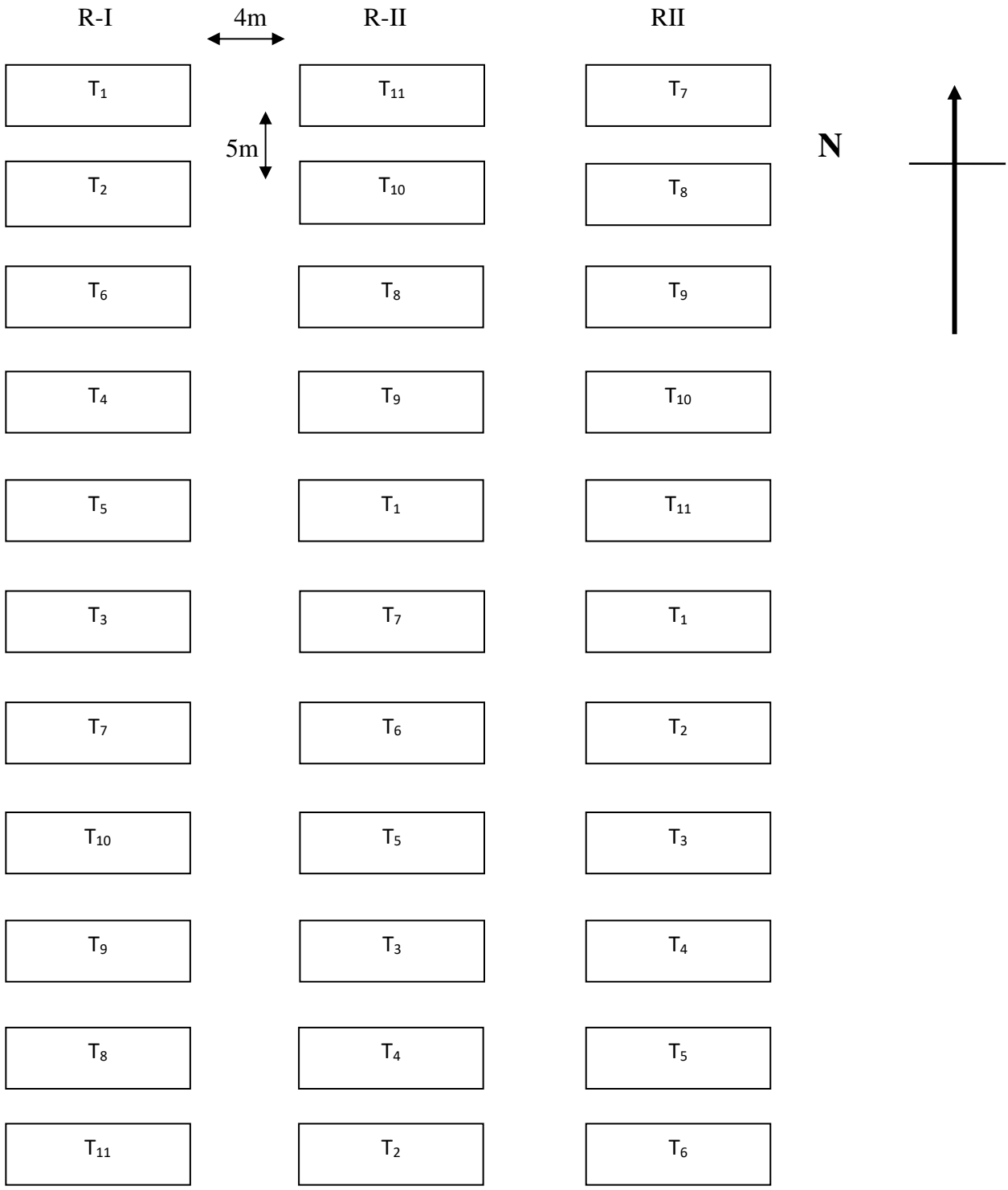

Fig. 3.1 :Plan of layout

covering experimental area. A composite sample was prepared for analytical purpose. These samples were dried, pounded in wooden mortar pestle, passed through sieve and were stored in polythene bags and analyzed.

Soil of experimental plot was fairly uniform, medium type, with well drained medium texture. The plot was ploughed and then harrowed twice to bring the soil to the fine tilth. The soil of the experimental plot was analyzed for knowing its nutritional status prior to conduct of the experiment and the details obtained from the soil testing laboratory are as below.

Table 3.1 : Chemical properties of soil of experimental plot

Sr. No.	Particulars	Values
1.	Available nitrogen (kg ha^{-1})	240
2.	Available phosphorous (kg ha^{-1})	25.0
3.	Available potassium (kg ha^{-1})	195.56
4.	Organic carbon (%)	0.60
5.	Electrical conductivity (dsm^{-1})	0.44
6.	pH	7.40

3.2Methods

3.2.1Preparation of chemical solutions

For preparation of working solution of 1500 ppm and 2000 ppm Cycocel, 100 ppm and 200 ppm Salicylic acid, 30 ml and 60 ml of Cycocel and 1g and 2 g of Salicylic acid were dissolved in ten litter of distilled water and applied as treatment details.

For preparation of 2 % and 3% potassium nitrate solution, 200 g and 300 g of potassium nitrate was dissolved in ten litter of water. For preparation of 2 % and 3 % solution of ethrel solution, 20 ml and 30 ml of ethrel was dissolved in ten litter of water.

Similarly, for preparation of 0.2 % Zinc sulphate and 0.2 % Boric acid solution, 20 g respective chemicals were dissolved in 10 litter of water.

3.2.2Experimental details

Table 3.2 : Experimental details

1	Name of crop	**:**	Pomegranate
2	Family	**:**	Lythraceae
3	Variety	**:**	Bhagwa
4	Age of orchid	**:**	05 years
5	Spacing	**:**	5m×4m
6	Number of treatments	**:**	11
7	Number of replications	**:**	03
8	Experimental design	**:**	Randomized Block Design
9	Number of plants/treatments	**:**	01
10	Total number of plants	**:**	33
11	Selection of bahar	**:**	*Hasta* bahar
12	Number of sprays	**:**	03
13	Stage of applications	**:**	First spray was applied one month before bud break stage, second spray at full bloom stage and third spray one month after full bloom stage.

3.2.3Treatment details

The detail of treatments are shown in Table 3.3

Table 3.3 :The detail of treatments

Sr.no.	Treatment no.	Treatment details
1	T_1	Cycocel 1500 ppm+0.2% $ZnSO_4$+0.2% boric acid
2	T_2	Cycocel 2000 ppm +0.2% ZnSO4+0.2% boric acid
3	T_3	Nitrobenzene 5ml/lit+0.2% $ZnSO_4$+0.2% boric acid
4	T_4	Nitrobenzene 7.5m/lit+0.2% $ZnSO_4$+0.2% boric acid
5	T_5	Salicylic acid 100 ppm +0.2% $ZnSO_4$+0.2% boric acid
6	T_6	Salicylic acid 200 ppm +0.2% $ZnSO_4$+0.2% boric acid
7	T_7	Ethrel 2%+0.2% $ZnSO_4$+0.2% boric acid
8	T_8	Etherl 3%+0.2% $ZnSO_4$+0.2% boric acid
9	T_9	Potassium nitrate 2%+0.2% $ZnSO_4$+0.2% boric acid
10	T_{10}	Potassium nitrate 3%+0.2% $ZnSO_4$+0.2% boric acid
11	T_{11}	Control (no spray)

3.3Methodology

3.3.1Cultural practices

3.3.1.1Bahar treatment

The experiment was carried out during *hasta* bahar of 2020-21. The pomegranate plants were grown on light soil of the five years age having uniform growth and vigour were subjected to bahar treatment by giving water stress from first fortnight of September month. The various operations like land preparation, removal

and disposal of diseased fruits of previous bahar was done. All the plants were pruned uniformly to remove the last season's growth, disease; pest infected branches and dried branches.

3.3.1.2Applications of treatments

Objective of present investigation was to study influence of foliar application of chemicals in flowering, yield and quality of pomegranate in *hast* bahar. The foliar spray of different chemical treatments on tagged tree was done in three stages: first spray was given one month prior to bud break stage, second spray at full bloom stage and third spray one month after second spray. Recommended dose of fertilizer (N:625g + P_2O_5:250g + K_2O: 250 g per tree along with 30 kg FYM was applied.

3.3.1.3 Irrigation

First flow of light irrigation was given to break the bahar treatment then irrigations were given as per the need through drip to all the experimental plants particularly during fruit development stage to harvest of the crop.

3.3.1.4 Aftercare

All cultural practices like earthing up, weeding and removal of water shoots were done when required.

3.3.1.5Plant protection measures

The recommended plant protection measures to control diseases and pests were followed.

3.3.1.6 Harvesting

Harvesting of fruits was done at full maturity stage. During the experimental period harvestings of fruits was done in two picking at seven to eight days interval.

3.4 Observations recorded

All observational plants were numbered. The average values for each trait were worked out from the data collected and these values were subjected to statistical analysis. The procedures adopted for recording the observations of each character are described as under following.

3.4.1Flowering parameters

3.4.1.1 Male flower

The total number of male flowers which were bell shape flower structure and contains pollengrains and no pistil or infertile ovary were counted and expressed in numbers.

3.4.1.2 Perfect (Hermaphrodite) flower

The total number of perfect flowers which were vase shape structure and fertile with normal ovary and capable of developing fruit while stigma was covered with functional anthers were counted and expressed in numbers.

3.4.1.3 Total number of flowers

Total sum of male flower and hermaphrodite(perfect) flower on experimental tree were counted and summed up to obtain total number of flower and expressed in numbers.

3.4.4Days taken from flowering to fruit set

The total number of days required from flowering to fruit set was calculated and expressed in days.

3.4.5Fruit set (%)

The percentage of fruit set was calculated and expressed in per cent (%).

$$\text{Percentage of fruit set} = \frac{\text{Total number of fruits per plant}}{\text{Total number of hermaphrodite flowers}} \times 100$$

3.4.6Days taken from flowering to harvest

Total number of days required form flowering to harvest was calculated and expressed in days.

3.5 Fruit characters

3.5.1 Fruit length (cm)

The length of the fruit represented the distance between the distal end of the fruit. This was measured in cm with the help of Vernier caliper and average length of five fruits for each treatment was worked out.

3.5.2 Fruit diameter (cm)

Diameter of selected fruits was measured with the help of Vernier caliper at the middle portion with maximum thickness and average diameters of five fruits for each treatment were worked out and recorded as fruit diameter in centimeter.

3.5.3 Fruit volume (ml)

The volume of each fruit was obtained in ml through water displacement technique (Archimedes principle) by measuring with the help of volumetric beaker. The mean volume of the five fruits for each treatment was calculated separately.

3.5.4Number of arils per fruit

All the arils from five fruits per treatment were separated and the average number of arils per fruit was calculated and expressed in numbers.

3.5.5Aril weight per fruit (g)

Arils of selected five fruits were weighted with the help of electronic weight balance and average were calculate in grams (g).

3.5.6Aril recovery (%)

The percentage of aril recovery was estimated by following formula and expressed in percentage (%)

$$\text{Percentage of aril recovery} = \frac{\text{Average aril weight of fruit}}{\text{Mean fruit weight}} \times 100$$

3.5.7100 aril weight per fruit (g)

The arils from five uniform fruits per treatment were separated, from which 100 arils were weighed and the average weight of 100 arils per fruit was calculated and expressed in gram (g).

3.5.8Peel weight (g)

The peel weight of five uniform fruits per treatments were recorded and the average peel weight was calculated in gram (g).

3.6Yield parameters

3.6.1Total number of fruits per plant at fruit set

The total number of fruits were counted at marble size *i.e* end of fruit set, the total number of fruits per plant was recorded.

3.6.2Fruit retention (%).

Fruit retention percent was calculated by following formula: **-**

$$\text{Fruit retention (\%)} = \frac{\text{Total number of fruits at marketable stage} - \text{Total number of fruits dropped}}{\text{Total number of fruits at marketable stage}} \times 100$$

3.6.3Number of fruits retention per plant

In each of the treatment the fruits were harvested at maturity stage and the number of marketable fruits were counted after each harvest and it was expressed as number of fruits retention per plant.

3.6.4Average fruit weight (g)

Five matured fruits from each of the treatment combinations were randomly selected at field level and each fruit was weighed on electronic balance and average weight of the fruit per treatment was computed in gram (g).

3.6.5Fruit yield per plant (kg/plant)

Yield per plant was arrived at by harvesting the total number of fruits produced from selected plants individually and expressed in kilogram (kg/plant).

3.6.6Yield per ha (t/ha)

The fruit yield per hectare was computed by multiplying the yield per plant with the number of plants in one hectare and was expressed in tons per hectare.

3.7Quality parameters

3.7.1Total soluble solids (%)

The total soluble solid was recorded by Erma hand refractometer (0-32 %) by taking three to four drops juice of arils on prism of the refractometer and observing against the light. The refractometer calibrated with distilled water before use.

3.7.2Reducing sugars (%)

Reducing sugars of juice were determined by method and given by Ranganna (1986). The percentage of reducing sugar was calculated according to following formula.

$$\text{Reducing sugars (\%)} = \frac{\text{Glucose equivalent} \times \text{Total volume made up}}{\text{Titrate value} \times \text{weight of sample}} \times 100$$

3.7.3Non reducing sugars (%)

The quantity of non-reducing sugars was calculated by the subtracting the reducing sugar from the total sugars and multiplying the difference by a factor 0.95 as given in A.O.A.C. (1975).

$$\text{Non reducing sugars} = \text{Total sugars- reducing sugars)} \times 0.95$$

3.7.4 Total sugars (%)

Total sugars of juice were estimated by method given by Ranganna (1986).

$$\text{Total sugars (\%)} = \frac{\text{Glucose equivalent} \times \text{Total volume made up} \times \text{Volume made up after inversion}}{\text{Titrate} \times \text{wt. of sample} \times \text{Aliquot taken for inversion}} \times 100$$

3.7.5Titrable acidity (%)

The titrable acidity of the juice extract was determined according to A.O.A.C. (1975) method by titrating the extract against 0.1 N NaOH using Phenolphthalein as indicator. Ten ml of juice was taken in conical flask and volume was made to up 100 ml with distilled water. 10 ml of aliquot was titrated against standard 0.1 N sodium hydroxide solution using phenolphthalein as an indicator until permanent faint pink colour developed. The titrable acidity was calculated and expressed in terms of anhydrous citric acid as per cent.

$$\text{Titrable acidity (\%)} = \frac{\text{Titrate} \times \text{Normality of alkaline (0.1 N)} \times \text{Vol. made up} \times \text{Eq. wt. of citric acid}}{\text{Wt. of sample taken} \times \text{Aliquot taken for estimation} \times 1000} \times 100$$

3.8 Benefit: cost ratio (B:C)

Treatment-wise cost of cultivation was worked out. The total expenditure on cultivation and management of crop was recorded in terms of rupees and per hectare cost of cultivation was calculated. The gross monetary returns per hectare was worked out considering the average prevailing price. The net returns were calculated by subtracting the cost of cultivation from gross returns and B: C ratio was worked out by using following formula:

$$\text{Benefit: cost ratio} = \frac{\text{Gross income}}{\text{Total expenditure}}$$

3.9 Statistical analysis

The data obtained in respect of various observations were subjected to the statistical analysis as per procedure given by Panse and Sukhatme (1985) for completely randomized design and critical difference has been calculated at 5 per cent level of significance.

Plate 3.1 : General view of experimental plot

CHAPTER – IV

RESULTS AND DISCUSSION

CHAPTER-IV

RESULT AND DISCUSSION

Results of the present investigation entitled "Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) in *hast* bahar" was carried out during 2020-21 are presented in this chapter with the help of tables and suitable illustrations. Data obtained for various parameters *viz.* flowering, yield and quality parameters of pomegranate were used for evaluation of treatments and were statistically analyzed in Randomized Block Design and analysis of variance for the data have been furnished in Table 4.1 to 4.12 and Fig 4.1 to 4.11**.** The economics of the different treatments are given in Table-4.12**.** The results of the investigation embodied in this chapter have been discussed under this chapter, under the light of possible reasons supported by relevant findings.

4.1 Effect of foliar application of chemicals on flowering parameters of pomegranate

The data on flowering components *viz.* male flowers, perfect flowers, total number of flowers, fruit set percent, days taken from flowering to fruit set and days taken from fruit set to harvest as influenced by the foliar application of chemicals are presented in the Table 4.1 and Fig. 4.1.

4.1.1.1 Number of male flowers

The data pertaining to the number of male flowers of pomegranate cv. Bhagwa as influenced by foliar sprays of different chemicals is presented in Table 4.1 and illustrated in Fig. 4.1.

The number of male flowers in pomegranate varied significantly as influenced by foliar sprays of chemicals in present study as compared to control. The number of male flowers ranged from 45.15 to 57.33 in different treatments under study. Significantly less number of male flowers were recorded in the treatment applied with T_8 Ethrel 3%+0.2% $ZnSO_4$+0.2% Boric acid (45.15), however was found at par with the treatment T_7 (47.34) and T_2 (49.67). The next best treatments that recorded less number of male flowers were treatment T_2 (49.67) and T_1 (50.1) and were at par with each other. The remaining

treatment showed intermediate results and were at par with each other. The treatment control recorded more number of male flowers in pomegranate (57.83) in present study.

Chaudhari and Desai (1993) reported that application of Ethrel (250 ppm) on pomegranate cv. Ganesh one month before expected flowering reduces percentage of male which supports the present findings.

4.1.1.2 Number of hermaphrodite flowers

The data of *hasta* bahar experiment regarding number of hermaphrodite flowers of pomegranate as influenced by foliar application of chemicals is presented in Table 4.1 and graphically represented in Fig. 4.1.

The number of hermaphrodite flowers increased with treatments applied with different chemicals as compared to control. The number of hermaphrodite flowers ranged from 155.34 to 185.20 in different treatments under present study. The treatment application of Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly maximum number of hermaphrodite flower (185.2) as compared with rest of the treatments in present study. It was followed by the treatment T_1, T_3, T_4, T_8, T_7, T_6, and T_5 however, were found at par with each other. The minimum number of hermaphrodite flower (155.34) was recorded in treatment control.

Similar findings were observed by Ngullie *et al.* (2014) in mango and Ashraf *et al.* (2013) in kinnow, which are in support and agreement with present study.

4.1.1.3 Total number of flowers

The data of *hasta* bahar experiment regarding total number of flowers in pomegranate as influenced by foliar application of chemicals is presented in Table 4.1 and illustrated in Fig.4.1. It is evident that the total number of flowers increased with treatments applied with different chemicals as compared to control. The total number of flowers ranged from 212.67 to 234.89 in different treatments under present study. The treatment application of Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly a greater number of total flower (234.89) as compared with rest of the treatments in present study however, was found at par with the treatment T_1, T_3, T_4, and T_6. It was followed by the treatment T_5, T_7 and T_5 which showed intermediate results and

Table 4.1 :Effect of foliar application of different chemicals on number of male flowers, number of hermaphrodite flowers and total number of flowers in pomegranate

Treatment. No.	Treatment details	Number of male flowers	Number of hermaphrodite flower	Total number of flowers
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	50.10	180.70	235.8
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	49.67	185.20	234.89
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	53.67	179.70	233.37
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	52.33	179.40	231.73
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	55.67	173.20	228.87
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	56.07	175.3	231.37
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	47.34	177.60	224.94
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	45.15	178.7	223.85
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	55.33	157.3	212.63
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	54.33	161.3	215.63
T_{11}	Control (no spray)	57.33	155.34	212.67
S.E. (m)±		1.07	3.06	3.94
C.D. at 5%		3.17	9.18	11.84

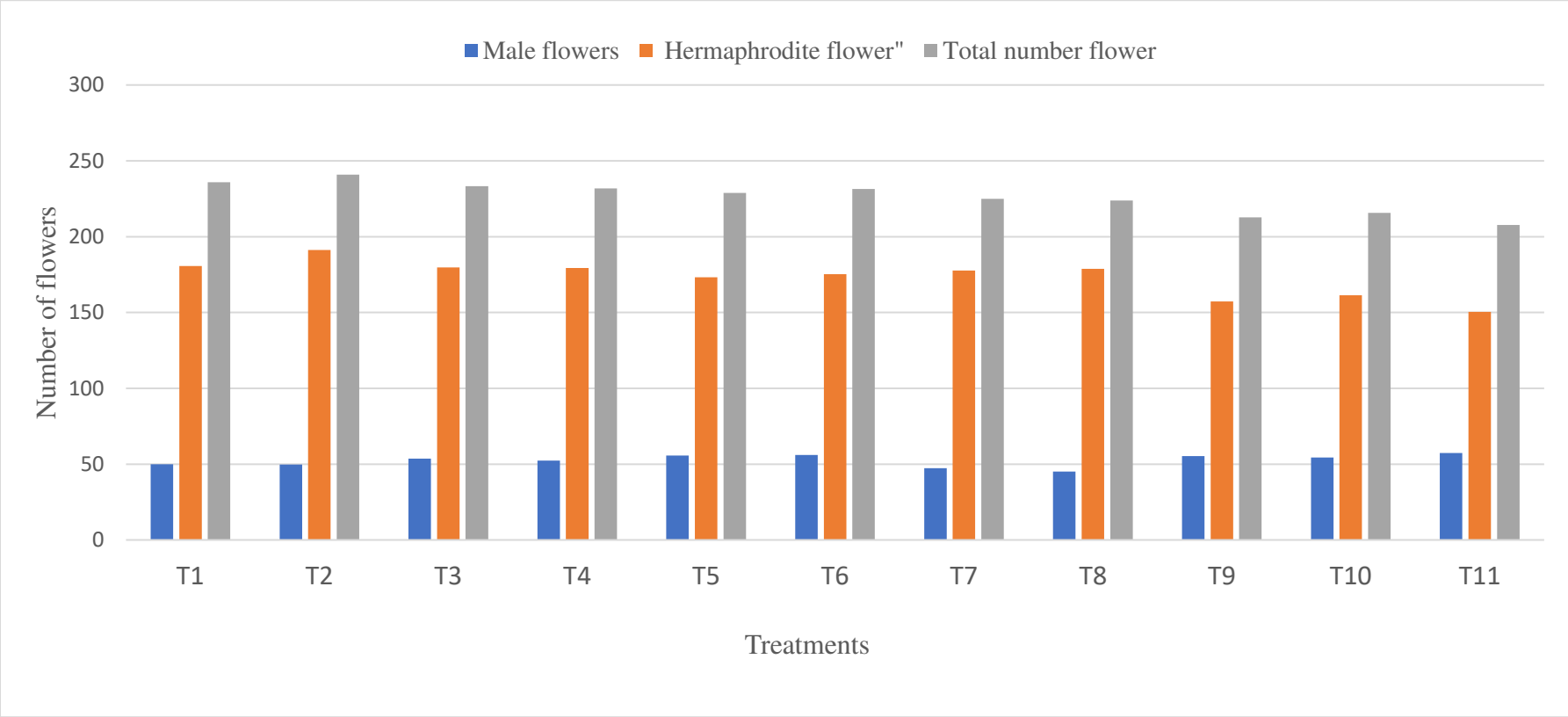

Fig 4.1 :Effect of foliar application of different chemicals on number of male flowers, number of hermaphrodite flowers and total number of flowers in pomegranate

were at par with each other. The treatment control recorded less number of total flowers (212.67) in present study.

Similar findings were observed by Dhurve *et al.* (2018) in pomegranate, Ngullie *et al.* (2014) in mango and Ashraf *et al.* (2013) in kinnow, which are in support and agreement with present study.

4.1.2 Fruit set (%)

The critical analysis of data pertaining to the fruit set (%) of pomegranate as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.2 and Fig.4.2.

The fruit set (%) increased with foliar application of treatments applied with different chemicals as compared to control. The fruit set (%) ranged from 42.82 to 52.48 in different treatments under present study. The treatment application of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly maximum fruit set (%) of pomegranate (52.48) as compared with rest of the treatments in present study, however was found at par with the treatment T_{10} (51.53) and T_6 (51.12). The next best treatment which showed more fruit set (%) was T_9(49.29), The treatments T_2, T_1 and T_4 revealed intermediate results and were at par with each other. The minimum fruit set (%) of pomegranate (42.82) was recorded in treatment control.

More fruit set per cent in treatment applied with aqueous spraying of salicylic acid before and after flowering might have interfered with the biosynthesis action of ethylene, which in turn reduced fruitlet abscission and resulted in more fruit set.

Similar findings were observed by Shinde *et al.* (2010), Ngullie *et al.* (2014) in mango and Ashraf *et al.* (2013) in kinnow, which are in support and agreement with present study.

4.1.3.1 Days taken from flowering to fruit set

The data pertaining to the days taken from flowering to fruit set of pomegranate cv. Bhagawa as influenced by foliar application of different chemicals is presented in Table 4.3 and illustrated in Fig.4.3.

Table 4.2 :Effect of foliar application of different chemicals on fruit set (%) in Pomegranate

Treatment. No.	Treatment details	Fruit set (%)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	46.60 (43.05)*
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	46.65 (43.07)
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	44.35 (41.76)
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	45.69 (42.52)
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	51.12 (45.65)
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	52.48 (46.42)
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	43.58 (41.31)
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	43.10 (41.03)
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	49.29 (44.59)
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	51.53 (45.87)
T_{11}	Control (no spray)	42.82 (40.86)
S.E. (m)±		0.70
C.D. at 5%		2.12

*figures in parenthesis indicates arc sin values

Fig 4.2 :Effect of foliar application of different chemicals on fruit set (%) in pomegranate

The present study revealed that foliar application of chemicals showed significant differences for days taken from flowering to fruit set as compared to control. The days taken from flowering to fruit set ranged from 25.27 days to 28.27 days in different treatments in present study. Significantly less number of days taken from flowering to fruit set of pomegranate was recorded in the treatment T_2 (25.27days) i.e. treatment applied with Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_1, T_{10}, T_9, T_8, T_7 T_6 and T_5. It was followed by the treatment T_4 (27.33 days). More number of days taken from flowering to fruit set of pomegranates was recorded in the treatment T_{11} (28.27 days) i.e. control.

Similar findings were observed by Shinde *et al.* (2010), Ngullie *et al.* (2014) in mango and Ashraf *et al.* (2013) in kinnow, which are in support and agreement with present study.

4.1.3.2 Days taken from flowering to harvest

The perusal of data pertaining to the days taken from flowering to harvest of pomegranate cv. Bhagwa as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.3 and Fig.4.3

The present study revealed that days taken from flowering to harvest of pomegranate ranged from 173.3 days to 181.2 days in different treatments. Significantly less number of days taken from flowering to harvest of pomegranate was recorded in the treatment applied with Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid(173.3) over rest of the treatments under study, except treatment applied with Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid, which were at par with each other. It was followed by the treatment T_{10} (175.3), T_9 (176.2), T_8 (177.3) and T_7 (177.7) and were found at par with each other. More number of days taken from flowering to harvest of pomegranate was recorded in the treatment control (181.2).

Similar findings were observed by Ngullie *et al.* (2014) in mango and Ashraf *et al.* (2013) in kinnow, which are in support and agreement with present study.

Table 4.3 : Effect of foliar application of different chemicals on days taken for flowering to fruit set and days taken for flowering to harvest of pomegranate

Treatment. No.	Treatment details	Days taken from flowering to fruit set	Days taken from flowering to harvest
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	25.33	174.4
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	25.27	173.3
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	27.50	179.2
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	27.33	179.1
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	26.60	178.4
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	26.32	178.3
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	26.20	177.7
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	25.82	177.3
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	25.74	176.2
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	25.60	175.3
T_{11}	Control (no spray)	28.27	181.2
S.E. (m)±		0.24	0.80
C.D. at 5%		0.73	2.42

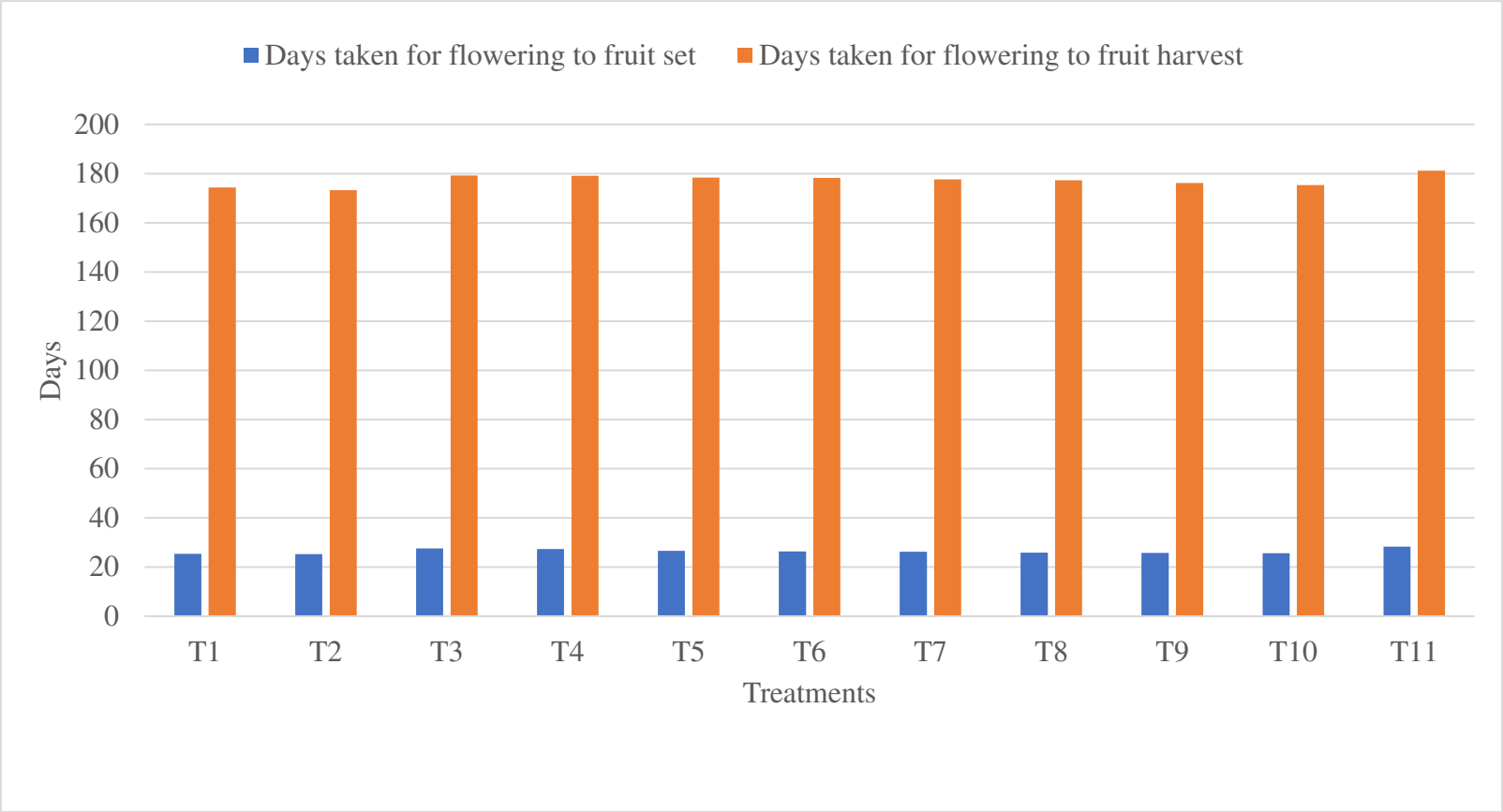

Fig 4.3 :Effect of foliar application of different chemicals on days taken for flowering to fruit set and days taken for Flowering to harvest of pomegranate

4.1.3.1 Fruit length (cm)

The perusal of data pertaining to the fruit length of pomegranate fruit as influenced by different foliar sprays of chemicals showed significant difference as presented in Table 4.4 and Fig 4.4.

The present study revealed that different chemicals significantly increased fruit length of pomegranate as compared to control. The fruit length ranged from 8.68 cm to 10.37 cm in different treatments in present study. Significantly maximum fruit length of pomegranate was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.37 cm) over rest of the treatments under study. It was followed by the treatment T_9 (10.01 cm). The next best treatments were T_2 (9.53 cm), T_1 (9.39 cm) and T_6 (9.37 cm) and were found at par with each other. The remaining treatment showed intermediate results and were at par with each other. The minimum fruit weight of control (8.68 cm) was recorded in treatment control.

Increase in fruit length in potassium nitrate might be due to the fact that nitrate form is extremely mobile and developing fruits act as metabolic sink for nutrient elements and its central role in various metabolic processes in plant (Naira *et al.* 2013). The application of Zn might have a role in increasing the auxin level of fruits which, in turn, might have helped in the development of fruit components as there is direct correlation between auxin content and fruit growth Sharma *et al.* (2016).

The results are in line with the findings of Gill and Bal (2009), Burondkar *et al*. (2009), Manju (2016) and Sharma *el al.* (2016).

4.1.3.2 Fruit diameter (cm)

The data pertaining to fruit diameter of pomegranate is presented in Table 4.4 and exhibited with Figure 4.4. A critical analysis of data indicated there existed significant variation in fruit diameter of pomegranate fruit due to combined foliar application of different chemicals in present investigation.

The fruit diameter of pomegranate ranged from 7.22cm to 8.76 cm in different treatments in present study. Significantly maximum fruit diameter of pomegranate was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 %

Boric acid (8.76 cm), over rest of the treatments under study, except the treatments T_9 (8.54 cm), T_2 (8.26 cm), T_1 (8.20 cm), T_6 (8.17 cm), T_5 (8.10 cm) and T_4 (8.09 cm), which were at par with each other. The treatments T_3, T_7, T_{11}, and T_8 showed intermediate results and were at par with each other. The treatment control recorded minimum fruit diameter of pomegranate (7.22 cm).

Increase in diameter of fruit applied with different forms of potassium showed that the potassium is needed for cell enlargement of fruit as reported by (Marschner, 1995). Singh and Tripathi, (1978) reported that potassium nitrate has most effective role in increasing fruit diameter. Similarly, Das (2004) has reported that K in better photosynthesis assimilation and development which might have helped in increasing fruit size. The increase in fruit size might be due to the higher accumulation of photosynthates in response to potassium application. The increased fruit diameter can be attributed to the involvement of Zn in cell division, cell expansion and increased volume of inter-cellular spaces in the mesocarpic cells. Foliar sprays of boron improved the diameter of fruit which might have brought beneficial effects on fast growing meristematic tissues. It might also affect cell division, development and carbohydrate metabolism.

The results are in line with the findings of Chaitanya *et al.* (1997) and Sarrwy (2012). These findings are also in conformity with the work of Gill *et al.* (2012) in pear and Ramesh *et al.* (2016) in custard apple.

4.1.3.3 Fruit volume (ml)

The critical analysis of data pertaining to the fruit volume of pomegranate fruit as influenced by foliar application of chemicals showed significant difference as presented in Table 4.4 and Fig. 4.4.

The fruit volume of pomegranate increased with treatments applied with different chemicals as compared to control. The fruit volume of pomegranate ranged from 225.30 ml to 316.16 ml in different treatments under present study.

Table 4.4 : Effect of foliar application of different chemicals on fruit length (cm), fruit diameter (cm) and fruit volume (ml) of pomegranate

Treatment. No.	Treatment details	Fruit length (cm)	Fruit diameter (cm)	Fruit volume (ml)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.39	8.20	298.23
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.53	8.26	303.63
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.25	8.05	276.87
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.21	8.09	277.47
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.29	8.10	280.53
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.37	8.17	287.50
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.17	7.86	272.67
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.21	7.94	273.20
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	10.01	8.54	310.07
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	10.37	8.76	316.16
T_{11}	Control (no spray)	8.68	7.22	225.30
S.E. (m)±		0.05	0.06	1.81
C.D. at 5%		0.16	0.20	5.44

Fig 4.4 :Effect of foliar application of different chemicals on fruit length (cm), fruit diameter (cm) and fruit volume (ml) of pomegranate

The treatment application of Potassium nitrate 3%+ 0.2% $ZnSO_4$ + 0.2% Boric acid resulted in significantly maximum fruit volume of pomegranate fruit (316.16 ml) as compared with rest of the treatments in present study. It was followed by the treatment T_9 (310.07ml) and T_2(303.63ml). The next best treatments in these regards were T_1 and T_6, however were found at par with each other. The treatment T_4, T_3, T_8, and T_7 revealed intermediate results and were at par with each other. The minimum fruit volume of pomegranate (225.3 ml) was recorded in treatment control.

The possible reasons for enhancement in fruit volume with the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid might be due to the easier availability of potassium form as an essential element increased fruit enlargement and cell turgidity by reducing carbohydrate contents Prakash and Balakrishnan, (2014). The results are in line with the findings of Sharma *et al.* (2016).

Zinc is an important ingradient which regulates the semi permeability of cell wall by which more water is mobilized into fruit by which increasing the volume, Further zinc regulates metabolic activities, which might result in increased stored food material in the tissue and in return increased in volume of fruit.

Similar results were also obtained by Digrase *et al.* (2016) Pandey *et al.* (1988) and Sarrwy (2012).

4.1.4.1 Peel weight(g)

The perusal of data pertaining to peel weight of pomegranate fruit as influenced by foliar application of different chemicals showed significant differences as presented in Table 4.5 and Fig 4.5.

The present study revealed that peel weight of fruit varied significantly with foliar application of different chemicals in all the treatments. The peel weight of fruit ranged from 68.40 g to 85.85 g in different treatments in present study. Significantly less peel weight of fruit was recorded in the treatment T_9 (68.40 g) over rest of the treatments under study, however was found at par with the treatment T_{10}. The next best treatments which showed less peel weight were treatment T_3, T_5 and T_6 and were found at par with each other. The treatments T_6, T_4, T_2 and T_7 showed intermediate results and

were at par with each other. The maximum peel weight of pomegranate fruit (85.85 g) was recorded in treatment control.

Lowest pulp weight in treatment applied with potassium nitrate might be due to an increase in aril content by an increase in accumulation of starch in the intercellular spaces of fruit cells which result in decrease in peel weight per fruit.

The experimental findings are similar to Ramesh *et al.* (2016) and Pippal *et al.* (2019).

4.1.4.2 Number of arils per fruit

The perusal of data pertaining to number of arils per fruit as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.5 and Fig. 4.5.

The present study revealed that foliar application of different chemicals on pomegranate significantly increased number of arils per fruit as compared to control. The number of arils per fruit ranged from 496.57 to 597.57 in different treatments in present study. Significantly maximum number of arils per fruit of pomegranate var. Bhagwa was recorded in the treatment T_{10} (597.62) over rest of the treatments under study, however was found at par with the treatment $T_{9,}$ T_2 and T_1. It was followed by the treatment T_4 (567.8) and T_3 (560.2) and were found at par with each other. The treatment T_8 and T_7 showed intermediate results and were at par with each other. The minimum number of arils per fruit of pomegranate (496.57) was recorded in treatment control.

Similar results were obtained by Digrase *et al.* (2016) and Gaikwad *et al* (2019) in pomegranate which supports present findings.

4.1.4.3 Arils weight per fruit (g)

The critical analysis of data pertaining to the aril weight per fruit of pomegranate as influenced by foliar application of chemicals showed significant difference as presented in Table 4.5 and Fig. 4.5.

The fruit volume of pomegranate increased with treatments applied with different chemicals as compared to control.

Table 4.5: Effect of foliar application of different chemicals on peel weight (g), number of arils per fruit and arils weight per fruit (g) in pomegranate

Treatment No.	Treatment details	Peel weight (g)	Number of arils per fruit	Arils weight per fruit (g)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	77.4	580.4	197.03
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	80.26	596.58	204.87
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	76.58	560.2	177.09
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	80.10	567.8	181.7
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	74.23	570.2	187.5
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	76.47	578.56	197.01
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	80.92	501.64	169.21
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	85.16	508.24	175.21
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	68.40	590.82	213.17
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	70.89	597.62	225.01
T_{11}	Control (no spray)	85.85	496.57	144.40
S.E. (m)±		1.04	9.55	4.14
C.D. at 5%		3.12	28.67	12.44

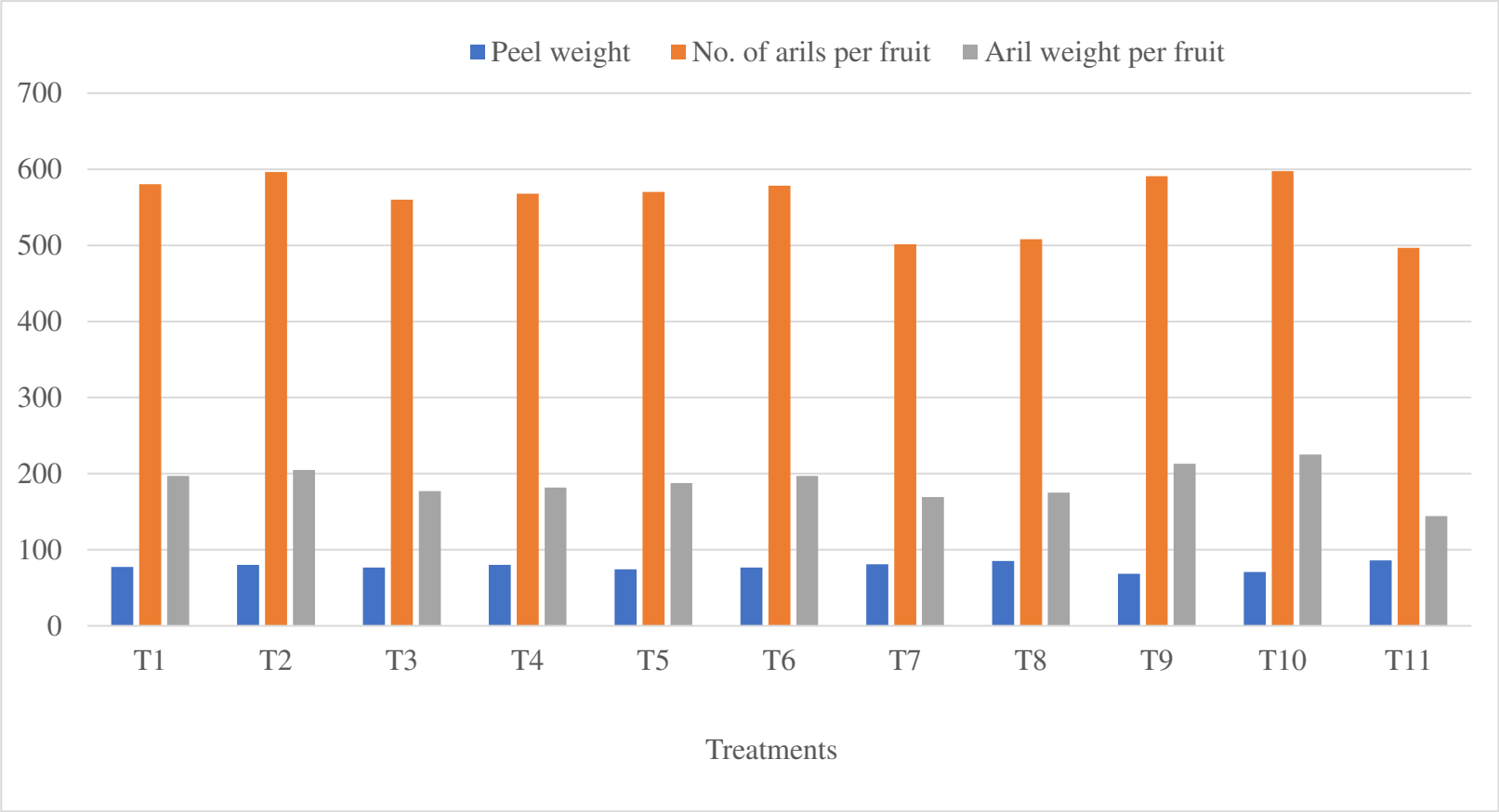

Fig 4.5 :Effect of foliar application of different chemicals on peel weight (g), number of arils per fruit and arils weight per fruit (g) of pomegranate

The aril weight per fruit of pomegranate ranged from 144.4 g to 225.01 g in different treatments under present study.

The treatment application of Potassium nitrate 3% + 0.2% ZnSO4 + 0.2% Boric acid recorded significantly maximum aril weight per fruit of pomegranate (225.01 g) as compared with rest of the treatments in present study, however was found at par with the treatment T_9. It was followed by the treatment T_2 (204.87 g) and T_1 (197.03 g) and found at par with each other. The treatment T_5, T_4, T_3 and T_8 revealed intermediate results and were at par with each other. The minimum aril weight per fruit of pomegranate (144.4 g) was recorded in treatment control.

The possible reasons for more aril weight in treatment applied with potassium nitrate and zinc might be due to the involvement of these chemicals in cell division, cell expansion, increased volume of intercellular space in the mesocarpic cells and increased absorption of water and mobilization of sugars and minerals in the expanded cells and intercellular space of the mesocarp. Zinc is an important ingredient which regulates the semi permeability of cell wall by which more water is mobilized into fruit by which increasing the volume and diameter of the fruit thus increasing pulp of fruit.

The experimental findings are similar to Sharma *et al.* (2016), Digrase *et al.* (2016) and Waskela *et al.* (2013)

4.1.5.1 100 arils weight per fruit (g)

It is evident from data pertaining to 100 arils weight (g) of pomegranate fruit as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.6 and Fig. 4.6.

The present study revealed that 100 arils weight of fruit varied significantly with foliar application of different chemicals in all the treatments under present study. The 100 arils weight of fruit ranged from 31.1 g to 43.3 g in different treatments. Significantly more 100 arils weight of fruit was recorded in the treatment T_{10} (43.3 g) over rest of the treatments under study, however was found at par with the treatment T_9. The next best treatments which recorded more 100 arils weight were treatment T_1,

Table 4.6 : Effect of foliar application of different chemicals on 100 arils weight per fruit (g) and aril recovery (%) of pomegranate

Treatment No.	Treatment details	100 arils weight per fruit	Aril recovery (%)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	39.2	71.79
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	40.8	71.85
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	36.4	69.20
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	37.10	69.40
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	37.8	71.64
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	38.1	72.23
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	34.1	67.64
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	34.2	67.29
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	41.62	75.70
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	43.3	76.04
T_{11}	Control (no spray)	31.10	63.14
S.E. (m)±		0.90	0.88
C.D. at 5%		2.72	2.67

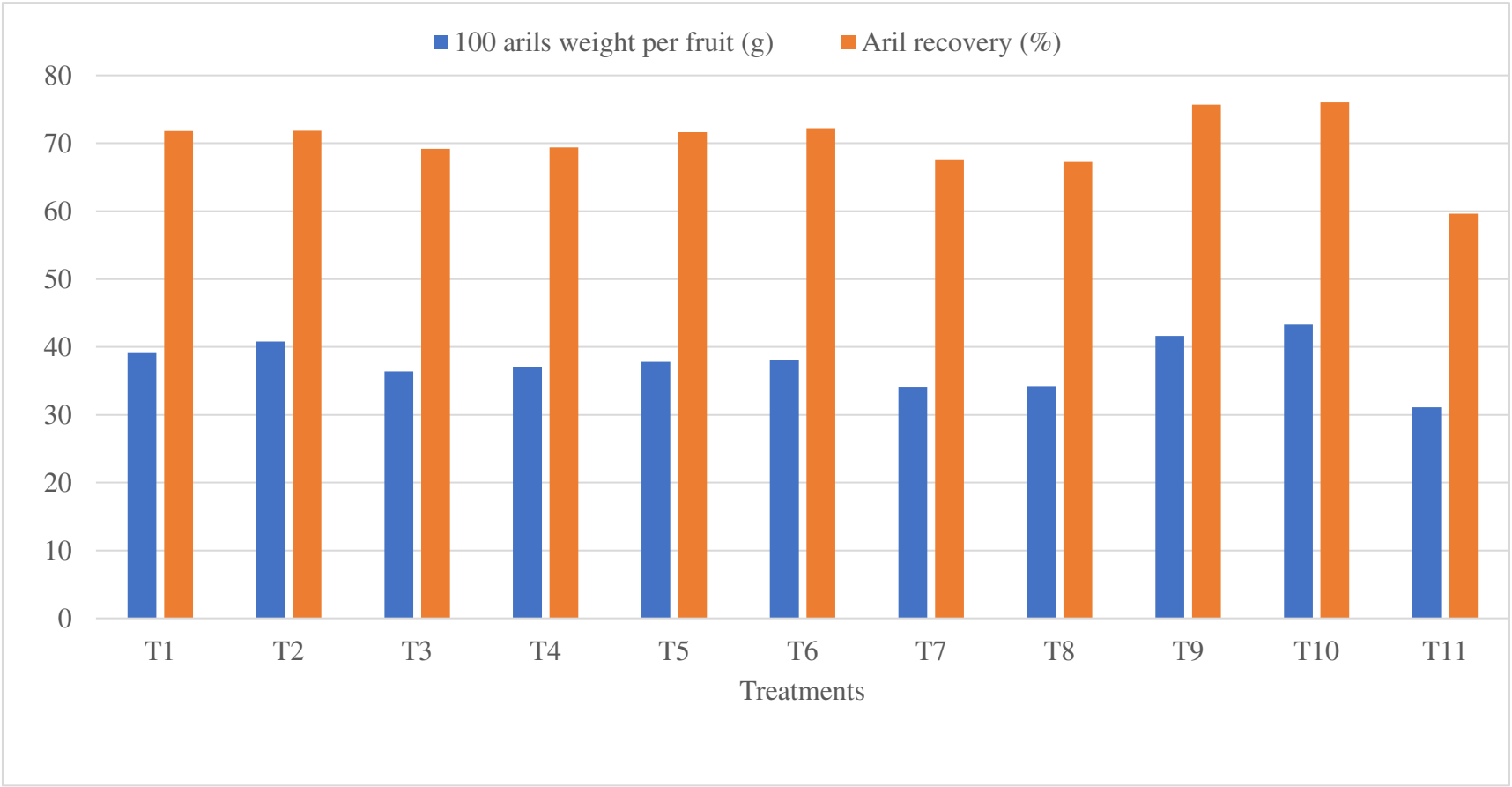

Fig 4.6 :Effect of foliar application different chemicals on 100 arils weight per fruit (g) and aril recovery (%) in pomegranate

T_6, T_5 and T_4 and were found at par with each other. The treatments T_3, T_8 and T_7 showed intermediate results and were at par with each other. The minimum 100 arils weight of pomegranate fruit (31.10 g) was recorded in treatment control.

Similar results were obtained by Gaikwad *et al.* (2019) in pomegranate which supports present findings.

4.1.5.2 Aril recovery (%)

The perusal of data pertaining to aril recovery (%) of pomegranate fruit as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.6 and Fig.4.6.

The present study showed that aril recovery of fruit ranged from 63.14 % to 76.04 % in different treatments. Significantly more aril recovery (%) of fruit was recorded in the treatment T_{10} (76.04 %) over rest of the treatments under study, however was found at par with the treatment T_9. The next best treatments which recorded more aril recovery (%) were treatment T_2, T_1,T_5, T_6 and T_3 and were found at par with each other. The treatments T_4, T_7 and T_8 showed intermediate results and were at par with each other. The minimum aril recovery (%) of pomegranate fruit (63.14 %) was recorded in treatment control.

Similar results were obtained by Gaikwad *et al.* (2019) in pomegranate which supports present findings.

4.1.6.1 Number of fruits per plant at fruit set

The critical analysis of data pertaining to total number of fruits per plant at fruit set of pomegranate fruit as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.7 and Fig. 4.7.

It is clearly revealed that total number of fruits per plant varied significantly with foliar application of different chemicals in all the treatments and ranged from 66.51 to 91.99. Significantly more total number of fruits per plant was recorded in the treatment applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (91.99) over rest of the treatments under study, however was found at par with the treatment applied with Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid. The next best treatments which recorded more total number of fruits per plant were

treatment T_2, T_1 and T_{10} and were found at par with each other. The treatments T_4, T_3, T_9, T_7 and T_8 showed intermediate results and were at par with each other. The minimum total number of fruits per plant of pomegranate fruit (66.51) was recorded in treatment control.

The beneficial effects of salicylic acid and micronutrient in increasing number of fruits per plant seems to be through enhanced rapid mobilization of food reserves from the plant during the vegetative growth by salicylic acid.

The present results obtained through spraying of chemicals in present study are in accordance with Gajarmal (2014) and Reddy (2010).

4.1.6.2 Fruit retention (%)

The perusal of data regarding to fruit retention (%) of pomegranate var. Bhagawa as influenced by foliar application of different chemicals is presented in Table 4.7 and Fig .4.7.

The findings of the present study showed that there was significant improvement in the fruit retention (%) with the foliar sprays of different chemicals in comparison with control. Fruit retention (%) varied significantly with foliar application of different chemicals in all the treatments and ranged from 62.80 to 77.12. Significantly more fruit retention (%) was recorded in the treatment applied with Salicylic acid 200 ppm + 0.2% $ZnSO_4$ + 0.2% Boric acid (77.12) over rest of the treatments under study, however was found at par with the treatment T_5, T_1 and T_2. The next best treatments which recorded more fruit retention (%) of pomegranate were treatment T_{10} and $T_9$and were found at par with each other. The treatments T_3, T_4, T_7 and T_8 showed intermediate results and were at par with each other. The minimum fruit retention (%) of pomegranate fruit (65.92) was recorded in treatment control.

There is high probability that spraying salicylic acid may have interfered with biosynthesis of ethylene which in turn reduced fruitlet abscission and enhanced fruit retention. Another probable reason for increased fruit retention might be due to better photosynthetic activity leading to proper supply of carbohydrates to the fruits.

Similar findings were also observed by Singh *et al.* (2011) in mango.

Table 4.7 :Effect of foliar application of different chemicals on total number of fruits per plant at fruit set, fruit retention (%) and number of fruits retention at harvest of pomegranate

Treatment No.	Treatment details	No. of fruits per plant at fruit set	Fruit retention (%)	No. of fruits retention at harvest
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	84.20	76.86 (61.25) *	64.71
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	86.39	74.11 (59.41)	64.02
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	79.71	67.19 (55.05)	53.55
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	81.98	66.27 (54.50)	54.32
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	88.53	76.12 (60.75)	67.38
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	91.99	77.12 (61.42)	70.94
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	77.40	66.70 (54.76)	49.62
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	76.48	67.80 (55.42)	48.02
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	77.54	72.43 (58.32)	56.16
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	83.13	71.73 (57.87)	59.62
T_{11}	Control (no spray)	66.51	65.92 (53.20)	43.84
S.E. (m)±		2.19	0.72	1.98
C.D. at 5%		6.58	2.16	5.94

*figures in parenthesis indicates arc sin values.

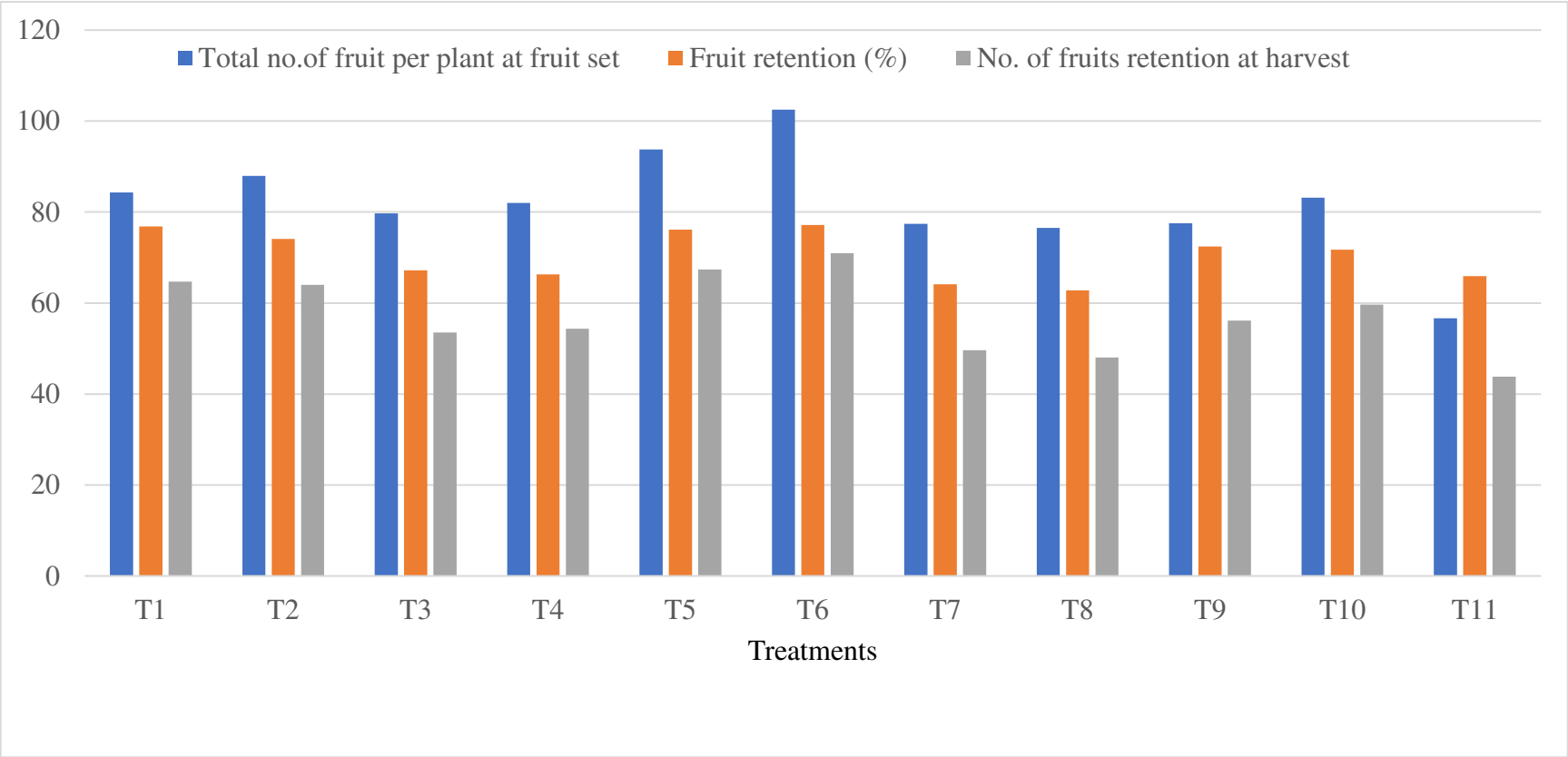

Fig 4.7 :Effect of foliar application of different chemicals on total number of fruits per plant at fruit set, fruit retention (%) and Number of fruits retention at harvest of pomegranate

4.1.6.3 Number of fruits retained per plant at harvest

The data regarding number of fruits retained per plant at harvest of pomegranate fruit cv. Bhagwa as influenced by different chemicals showed significant difference as presented in Table 4.7 and Fig. 4.7.

The findings of the present study showed that there was significant difference in the number of fruits retained per plant at harvest with the foliar sprays of different chemicals compared with control. The number of fruits retained per plant at harvest ranged from 43.84 to 70.94 in different chemical sprays in present study. Significantly more number of fruits retained per plant at harvest of pomegranate was recorded in the treatment applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (70.94) over rest of the treatments under study however was found at par with the treatment T_5. The next best treatments which recorded more number of fruits retained per plant at harvest of pomegranate were treatment T_1 and T_2 and were found at par with each other. The treatments T_{10}, T_9, T_3 and T_4 showed intermediate results and were at par with each other. The minimum number of fruits retained per plant at harvest of pomegranate fruit (43.84) was recorded in treatment control.

Similar findings were also observed by Singh *et al.* (2011) in mango

4.1.7.1 Average weight of fruit (g)

It is evident from the data pertaining to average weight of fruit of pomegranate cv. Bhagwa as influenced by different chemicals showed significant difference as presented in Table 4.8 and Fig. 4.8.

In present study there was significant improvement in the average weight of fruit with the sprays of different chemicals in comparison to control. The average weight of fruit ranged from 230.25 g to 295.9 g in different treatments under study. Significantly maximum average weight of fruit (295.9 g) of pomegranate was recorded in the treatment Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_9 (285.57 g). The next best treatment in that regards were T_2 and T_1. The remaining treatment showed intermediate results and were at par with each other. The treatment control recorded minimum average weight of fruit of pomegranate (230.25 g) in present study.

This result accepted the hypothesis that the fruit weight is a function of length, width and thickness of fruit. The possible explanation for increase in fruit size and

weight was also due to faster movement of simple sugar into fruit and involvement in cell expansion Brahmachari *et al.* (1997). Potassium increases cell size Marschner, (1995) and is also responsible for the production and transport of plant sugars that increases the weight of fruit Singh (1980). Such findings have also been reported by Sharma *et al.* (2016), Gill and Bal (2009) and Manju (2016).

The increased fruit weight due to zinc appears to have indirect role in hastening the processing of cell division and cell elongation due to which weight of fruit would have improved. Zinc regulates the semi permeability of cell of fruit resulting more water mobilized into the cell. Yadav *et al.* (2011) also reported similar findings of Gajarmal (2014) and Reddy (2010).

4.2.4 Fruit yield per plant (kg)

The data pertaining to the yield per plant of pomegranate as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.8 and Fig. 4.8.

In present study there was significant improvement in the yield per plant with the foliar sprays of different chemicals as compared to control. The yield per plant ranged from 10.09 kg to 19.28 kg in different treatments. Significantly maximum yield per plant (19.28 kg) of pomegranate was recorded in the treatment Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_5 (18.14 kg), T_2 (17.93 kg) and T_1 (17.82 kg). The next best treatments were T_{10} and T_9 and were at par with each other. The remaining treatment showed intermediate results and were at par with each other. The treatment control recorded minimum yield per plant of pomegranate (10.09 kg) in present study.

The increase in yield parameters due to salicylic acid observed in the present investigation can be attributed to increased photosynthetic activity in leaves and translocation of more photo assimilates to fruits. Salicylic acid is responsible for increasing yield by increasing fruit set percentage, number of fruits per tree.

It also stimulates cell division and the tolerance of plants to all stresses namely diseases, water and salt stresses and protects plant cells from oxidation by free radicals which can explain the above results. Raskin, (1992).

Table 4.8 : Effect of foliar application of different chemicals on average weight (g) of fruit (g) and yield per plant (kg) of pomegranate

Treatment No.	Treatment details	Average weight of fruit (g)	Fruit yield per plant (kg)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	275.43	17.82
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	280.13	17.93
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	258.67	13.85
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	261.80	14.22
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	269.83	18.14
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	270.37	19.28
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	237.13	11.76
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	250.37	12.17
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	285.57	16.03
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	295.90	17.64
T_{11}	Control (no spray)	230.25	10.09
S.E. (m)±		4.13	1.64
C.D. at 5%		12.42	9.93

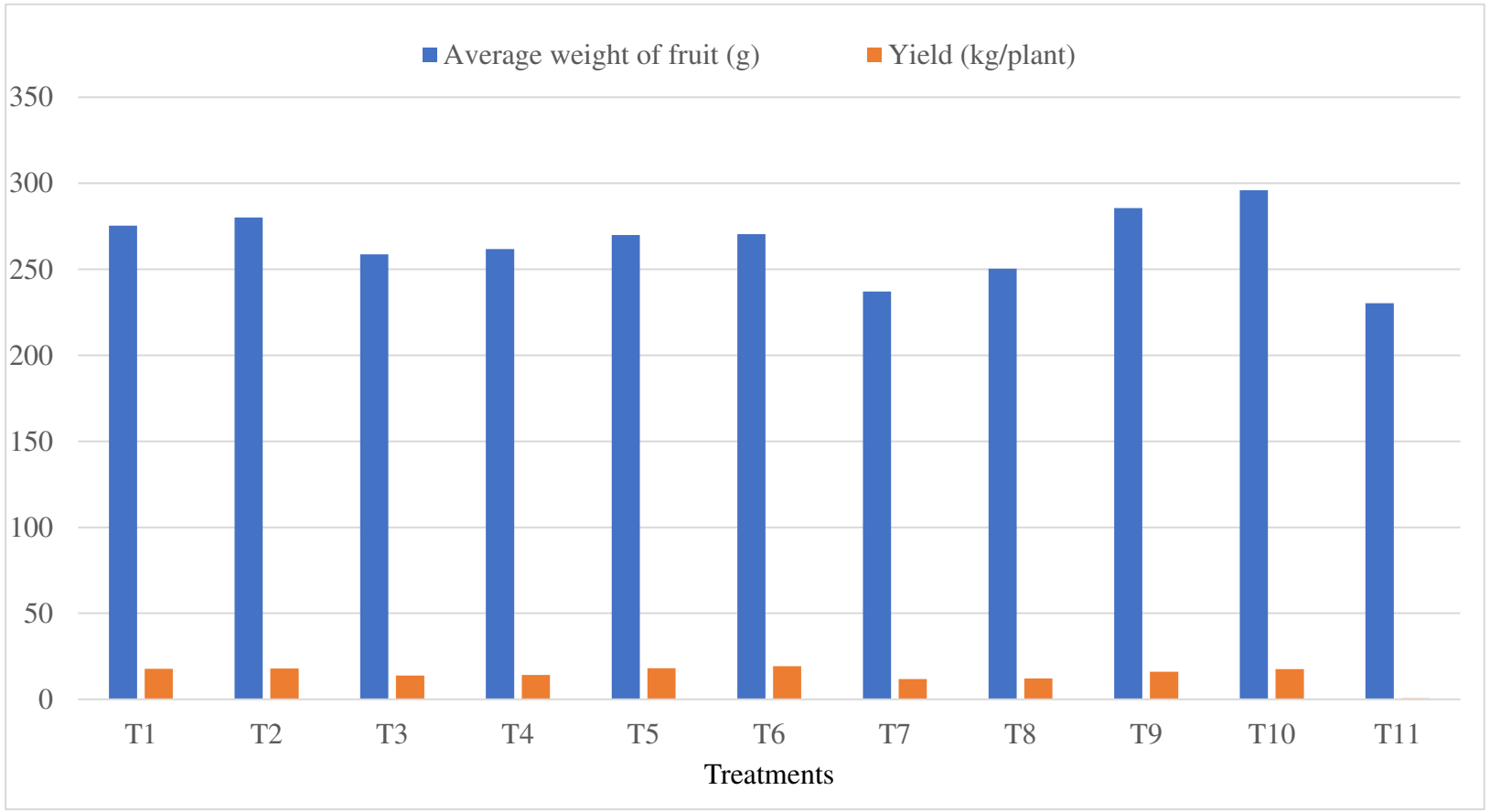

Fig 4.8 :Effect of foliar application of different chemicals on average weight (g) of fruit and yield per plant (kg) of pomegranate

Similar findings were also represented by Singh *et al.* (2011) in mango which corroborate present findings.

4.2.5 Fruit yield per hectare (t/ha)

The data pertaining to the yield per hectare of pomegranate fruits as influenced by foliar application of different chemicals showed significant difference as presented in Table 4.9 and Fig. 4.9. There was significant improvement in the yield per tree with the foliar sprays of different chemicals compared with control.

The yield per hectare ranged from 5.04 t/ha to 9.64 t/ha in different treatments of present study. Significantly maximum yield per hectare (9.64 t/ha) of pomegranate was recorded in the treatment Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_5 (9.07 t/ha), T_2 (8.96 t/ha) and T_1 (8.91 t/ha). The next best treatment was T_{10} (8.82t/ha). The treatment T_9 and T_4 showed intermediate results and were at par with each other. The treatment control recorded minimum yield per hectare of pomegranate (5.04t/ha) in present study.

The beneficial effects of salicylic acid combined with zinc and boron resulted in more number of fruits per plant ultimately yield metric tons per hectare seems to be through enhanced rapid mobilization of food reserves from the plant during the vegetative growth by salicylic acid. This might also be due to more accumulation of food material and increase in size of fruit, as fruit weight positively correlated with fruit size. The present results obtained through spraying of salicylic acid are in accordance with Ngullie *et al*. (2014) and Ashraf *et al.* (2013).

The possible reason for increase in yield per hectare in treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid than control might be due to more fruit yield per tree which might be the reflection of cumulative effect of potassium which helped in improving the yield attributing characters like increase in weight of fruits, volume of fruits and size of fruits. Similar findings have been reported by Waskela *et al.* (2013) and Yadav *et al.* (2017).

Table 4.9 : Effect of foliar application of different chemicals on yield per hectare (t/ha) of pomegranate

Treatment No.	Treatment details	Yield per hectare (t/ha)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	8.91
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	8.96
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	6.92
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	7.11
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.07
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.64
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	5.88
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	6.08
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	8.01
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	8.82
T_{11}	Control (no spray)	5.04
S.E. (m)±		0.26
C.D. at 5%		0.77

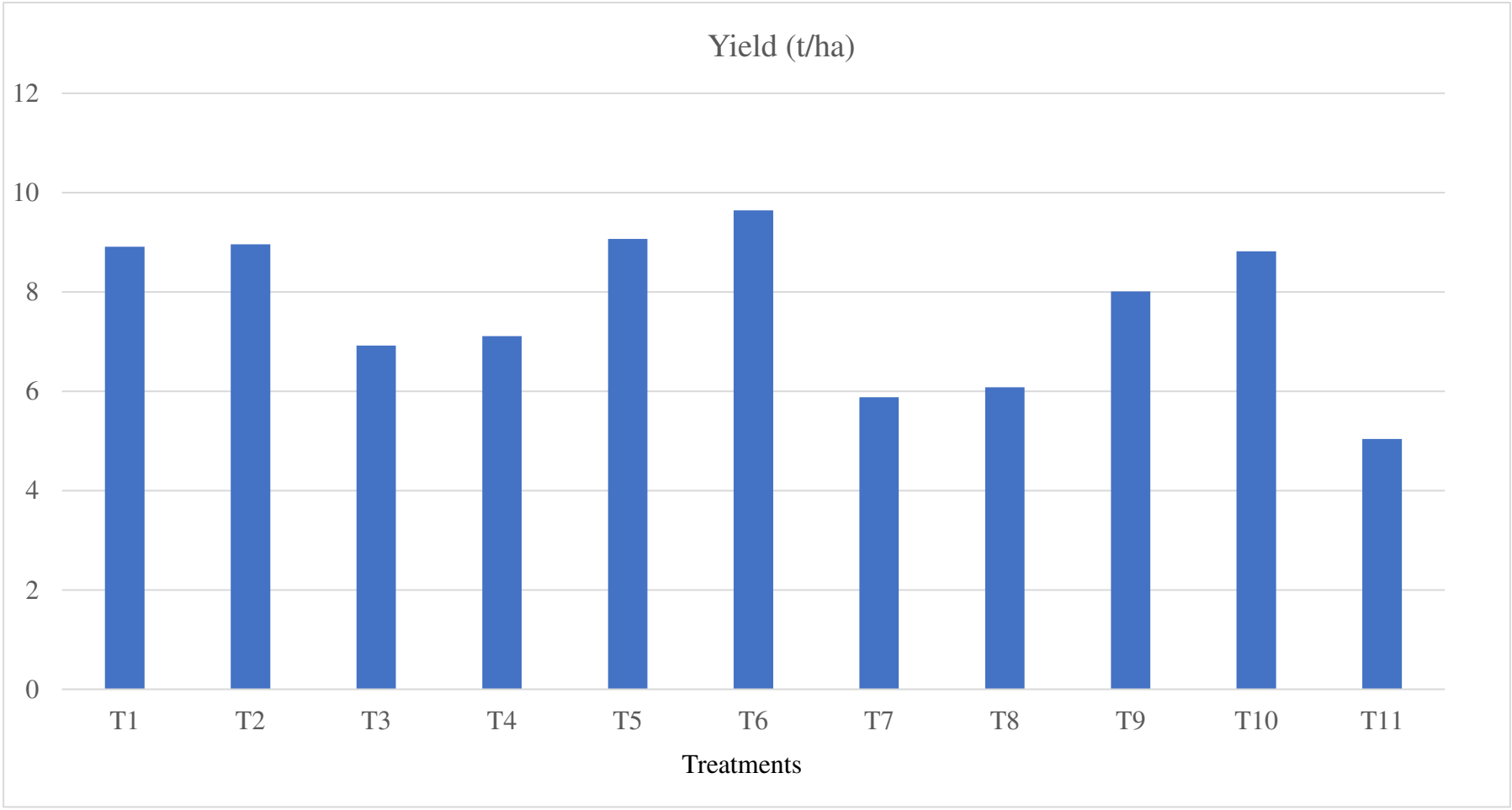

Fig 4.9 :Effect of foliar application of different chemicals on yield per hectare (t/ha) of pomegranate

4.2.6.1 Total soluble solids (%)

The data pertaining to the total soluble solids (%) of pomegranate fruit cv. Bhagwa as influenced by foliar spray of different chemicals is presented in Table 4.10 and Fig.4.10.

The findings of the present study revealed that there was significant increase in the total soluble solids with the treatments applied with foliar sprays of different chemicals in comparison with control treatment. Total soluble solids ranged from 13.71 % to 15.8% in different treatments under present study. Significantly maximum total soluble solids were recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (15.8 %) over rest of the treatments under study. It was followed by the treatment T_9(15.67 %), T_6 (15.61 %), T_5 (15.39 %), T_2 (15.37 %), and T_1 (15.33 %) and were found at par with each other. The remaining all treatments showed intermediate results and were at par with each other. The treatment control recorded minimum total soluble solids (13.71 %) in present study.

The foliar application of potassium nitrate resulted in higher TSS content may be due to the role of potassium in translocation of sugar from the leaves to fruits, resulting in better quality fruits and the reduction in acidity Prasad *et al.* (2015). Singh (1980) opined that; nitrate treatments stimulated functioning of a number of enzymes in the physiological process which enhanced TSS content in mango. Kumar and Bhushan (1980) suggested that foliar application of $ZnSO_4$ increased the TSS contents by increasing photosynthetic activity of the plants resulting into the production of more sugars.

Similar findings have been reported by Prasad *et al.* (2015), Sarrwy (2012) and Gill and Bal (2009).

4.2.6.2 Titrable acidity (%)

The data regarding the titrable acidity (%) of pomegranate fruit as influenced by foliar sprays of different chemicals is presented in Table 4.10 and Fig. 4.10.

The results of the present study revealed the titrable acidity of fruits was significantly affected by the foliar sprays of different chemicals and showed that decrease in acidity in fruits as compared with control.

The titrable acidity of fruits ranged from 0.29 % to 0.48 % in different treatments of present investigation. Significantly minimum acidity of pomegranate fruits was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.29%), however was found at par with the treatment applied with Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.31 %) and Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.32 %). The next best treatments were treatment T_5 (0.34 %) and T_2 (0.37%). The remaining treatment showed intermediate results and were at par with each other. The treatment control recorded maximum acidity of pomegranate fruits (0.48 %) in present study.

Minimum acidity in treatment applied with potassium nitrate and zinc may be because the treatment act as a source of nitrogen which might have modified the vegetative growth, which in turn increased sugar metabolism and consequently decreased the acidity due to conversion of acid into sugar which resulted decrease in the acidity of fruits. The reduction in the acidity under potassium treatment might also be owing to increased TSS of the fruits. These results also elucidate the finding of Gill *et al*. (2012). Zinc being a major substrate of respiration, the decline in the malic acid during fruit ripening might be the results of an increase in membrane permeability due to potassium which allows acids to be stored in the respiring cells. The downwards trend in the levels of organic acids was also possibly due to dilution effect with the increase in volume of fruits in these treatments.

Similar findings have been reported by Jawandhar *et al.* (2017), Yadav *et al.* (2011) and Prasad *et al.* (2015).

4.3.5.1 Reducing Sugar (%)

The perusal of data regarding the reducing sugar (%) of pomegranate fruit as influenced by different chemicals showed significant difference as presented in Table 4.11 and Fig.4.11.

The findings on reducing sugar (%) in pomegranate fruits was significantly affected by the foliar sprays of different chemicals and the content increased as compared with treatment control. Reducing sugar of fruits ranged from 9.20 % to 10.71 % in different treatments of present study.

Table 4.10 : Effect of foliar application of different chemicals on Total Soluble Solids (%) and Titrable acidity (%) in -pomegranate

Treatment No.	Treatment details	T.S.S. (%)	Titrable acidity (%)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.33	0.37
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.37	0.39
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	14.80	0.43
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	14.94	0.42
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.39	0.34
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.61	0.32
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	14.10	0.45
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	14.48	0.43
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.67	0.31
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.80	0.29
T_{11}	Control (no spray)	13.71	0.48
S.E. (m)±		0.11	0.001
C.D. at 5%		0.38	0.03

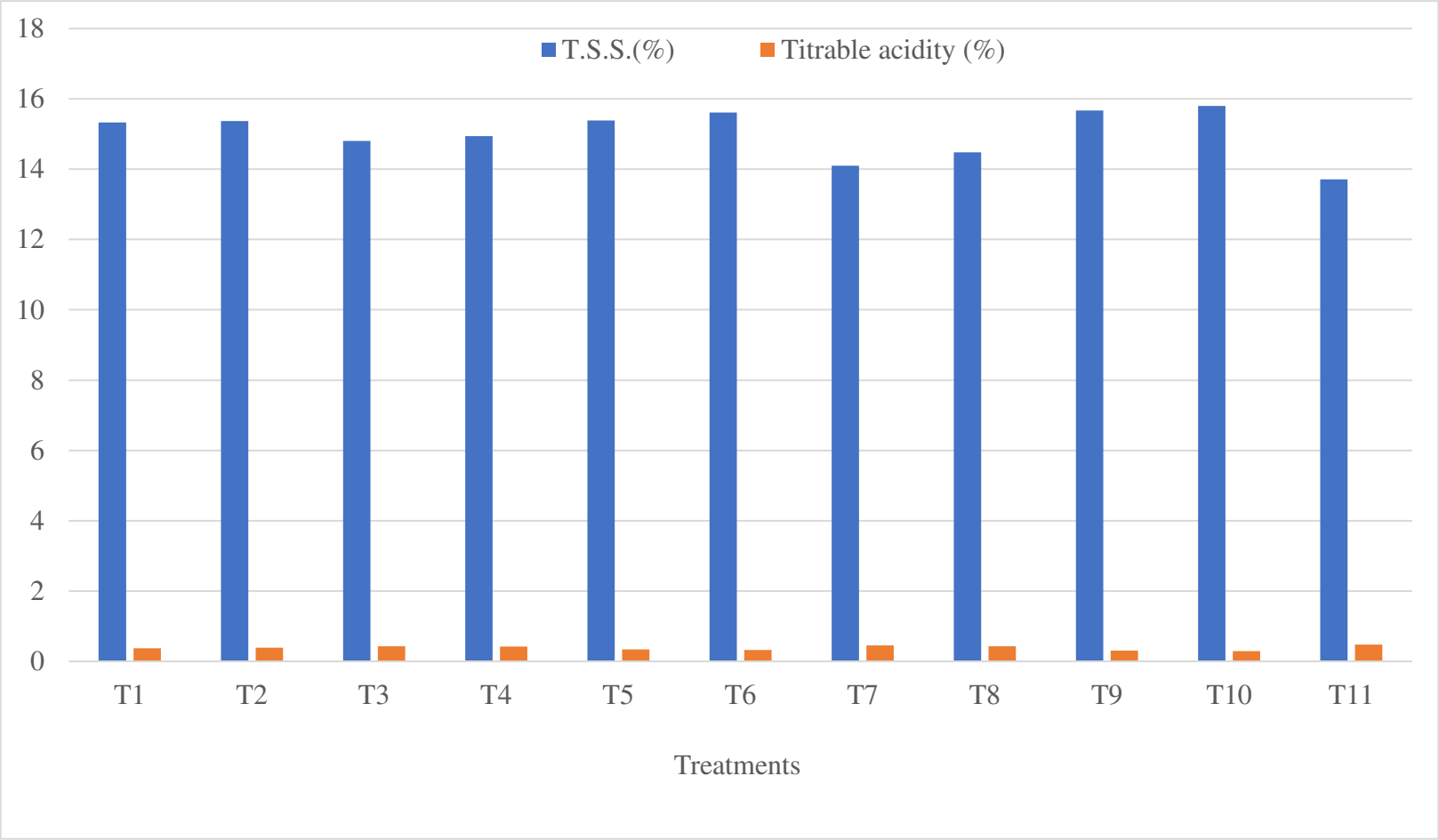

Fig 4.10 :Effect of foliar application of different chemicals on Total Soluble Solids (%) and Titrable acidity (%) of pomegranate

Significantly maximum reducing sugar of pomegranate fruits was recorded in the treatment Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.71 %), however was found at par with the treatment Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.64 %). The next best treatments in this regard were treatment T_6 (9.57 %) and T_5 (9.52 %). The treatments T_1, T_2, T_3, T_4, T_8, and T_7 showed intermediate results and were at par with each other. The treatment control recorded minimum reducing sugar of pomegranate fruits (9.20 %) in present study.

An increase in reducing sugars percentage in pomegranate juice may be due to involvement and enhancement of photophosphorylation and dark reaction of photosynthesis by potassium which might again resulted in accumulation of more carbohydrates in the fruits and helps in better accessibility of nutrients to the developing fruits. Similar observations have been reported by Prasad *et al*. (2015) in pear and Patoliya *et al*. (2017) in mango.

Zinc acts as catalyst in the oxidation and reduction process and is also of great importance in sugar metabolism. Present investigation finds support from Pandey *et al.* (1988), Sharma *et al.* (1991) and Prasad *et al.* (2015) in guava. Singh and Chhonkar (1983) recorded significant increase in reducing sugar in guava pulp with foliar spray of zinc sulphate @ 0.40% Waskela *et al.* (2013) which supports present findings.

4.3.5.2 Non-Reducing Sugar (%)

It is evident from the data regarding the non-reducing sugar (%) of pomegranate fruit as influenced by different chemicals showed significant difference as presented in Table 4.11 and Fig. 4.11.

The critical analysis from present findings revealed that non reducing sugar (%) in pomegranate fruits was significantly affected by the foliar sprays of different chemicals and the content increased as compared with treatment control. Non reducing sugar of fruits ranged from 1.11 % to 2.57 % in different treatments of present study. Significantly maximum non reducing sugar of pomegranate fruits was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (2.57 %). It was followed by the treatment Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (2.21%). The next best treatments in this regard were treatment T_6 (1.59 %), T_2 (1.56 %), T_5 (1.55 %) and T_1 (1.55 %) and were at par with each other. The treatment

control recorded minimum non reducing sugar of pomegranate fruits (1.11 %) in present study.

Sarker and Rahim (2013). reported that, KNO_3 4% spray increased non-reducing sugars percentage in mango, indicating that, and increased concentration of 'K' as foliar spray increases sugars including non-reducing sugars. These results corroborate the earlier records of Prasad *et al.* (2015) and Patoliya *et al.* (2017).

4.3.5.3 Total Sugar (%)

The perusal of data regarding the Total sugar (%) of pomegranate fruit as influenced by different chemicals showed significant difference as presented in Table 4.11 and Fig.4.11.

The findings on Total sugar (%) in pomegranate fruits was significantly affected by the foliar sprays of different chemicals and the content increased as compared with treatment control. Total sugar of fruits ranged from 10.31 % to 13.28 % in different treatments of present study. Significantly maximum total sugar of pomegranate fruits was recorded in the treatment applied Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (13.28 %). The next best treatment in this regard was Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (12.85%). It was followed by the treatment T_6 (11.16 %) and T_5 (11.07 %). The treatments T_1, and T_2 showed intermediate results and were at par with each other. The treatment control recorded minimum total sugar of pomegranate fruits (10.31 %) in present study.

Highest total sugars might be due to potassium effect on enhancing the synthesis and accumulation of sugars Shinde *et al*. (2006). K application also favours the conversion of starch into simple sugar during ripening by activating the sucrose synthase enzyme (Dutta *et al*.2011). Ramzy *et al.* (2011). observed that, potassium nitrate induced the highest total sugars percentage in mango cv. Ewais. Singh and Tripathi (1978). reported that, spraying a mixture of potassium nitrate and sodium dihydrogen orthophosphate increased total sugars content in cv. Banarasi Langra. The results are in confirmation with the findings Prasad *et al.* (2015). and Pandey and singh (2018).

Table 4.11 :Effect of foliar application of different chemicals on Reducing sugars (%) and Non-reducing sugars (%) and Total sugars (%) in pomegranate

Treatment No.	Treatment details	Reducing sugars (%)	Non - reducing sugar (%)	Total sugars (%)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.35	1.55	10.90
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.42	1.56	10.98
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.31	1.39	10.70
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.34	1.41	10.75
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.52	1.55	11.07
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.57	1.59	11.16
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.24	1.18	10.42
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.27	1.27	10.54
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	10.64	2.21	12.85
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	10.71	2.57	13.28
T_{11}	Control (no spray)	9.20	1.11	10.31
S.E. (m)±		0.05	0.03	0.06
C.D. at 5%		0.14	0.10	0.17

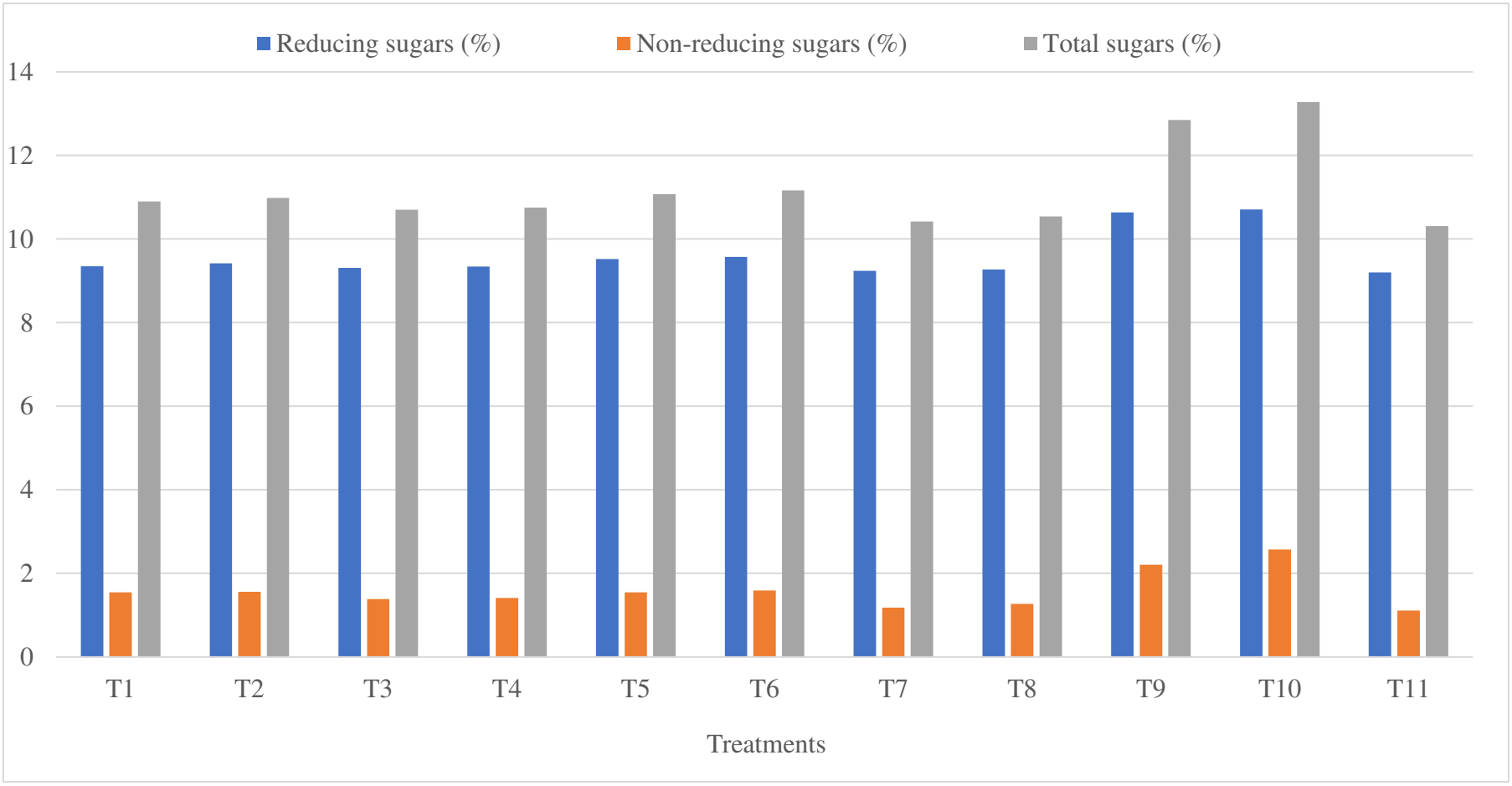

Fig 4.11 :Effect of foliar application of different chemicals on Reducing sugars (%) and Non-reducing sugars (%) and Total sugars (%) in pomegranate

The possible reason for increase in total sugar due to zinc might be due to the conversion of starch and acid into sugars and accumulation of oligosaccharides and polysaccharides and continuous mobilization of sugars from leaves to fruits Gowsami *et al.* (2014).

The results are in confirmation with the findings of Manivannan *et al*. (2015).

4.4 Economic Analysis:

Computed data on economics as result of foliar application of different chemicals on pomegranate cv. Bhagwa was presented in Table 4.12. Maximum gross income (Rs. 5,78,400) and net return (Rs.4,12,550) both were obtained with the treatment application of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid. The minimum gross income (Rs. 3,02,400) and net return (Rs. 1,51,400) were obtained in the treatment T_{11} (control).

In present study, B:C ratio as influenced by the foliar sprays of different chemicals revealed differences. The treatment applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid gave the maximum (3.48) B:C ratio during the investigation proved superior over rest of the treatments. The treatment control (2.00) recorded minimum B:C during the experimentation.

Economic viability is a function of gain or loss. Any practice or technology in order to be economically viable must have substantial balance in its cost in order to assume the profitability of treatments. Thus, it is more important to justify the increase in economic yield with respect to expenditure involved. The gross return of guava crop varied markedly by influence of various treatments which ultimately influenced the overall net return and B:C ratio. The results are in confirmation with findings of Vishwakarma (2015) and Sonkariya *et al.* (2016) in guava.

Table 4.12 : Economics of pomegranate fruits as influenced by foliar application of different chemicals

Treatments	Total Expenditure/ha	Gross income/ha	Net return/ha	B:C ratio
T_1	1,72,090	5,34,600	3,62,510	3.10
T_2	1,74,355	5,37600	3,63,245	3.08
T_3	1,79,080	4,15,200	2,36,120	2.31
T_4	1,85,980	4,26,600	2,40,620	2.29
T_5	1,66,645	5,44,200	3,77,555	3.26
T_6	1,65,850	5,78,400	4,12,550	3.48
T_7	1,86,764	3,52,800	1,66,036	1.88
T_8	2,02,264	3,64,800	1,62,536	1.80
T_9	1,78,884	4,80,600	3,01,716	2.68
T_{10}	1,90,444	5,29,200	3,38,756	2.77
T_{11}	1,51,000	3,02,400	1,51,400	2.00

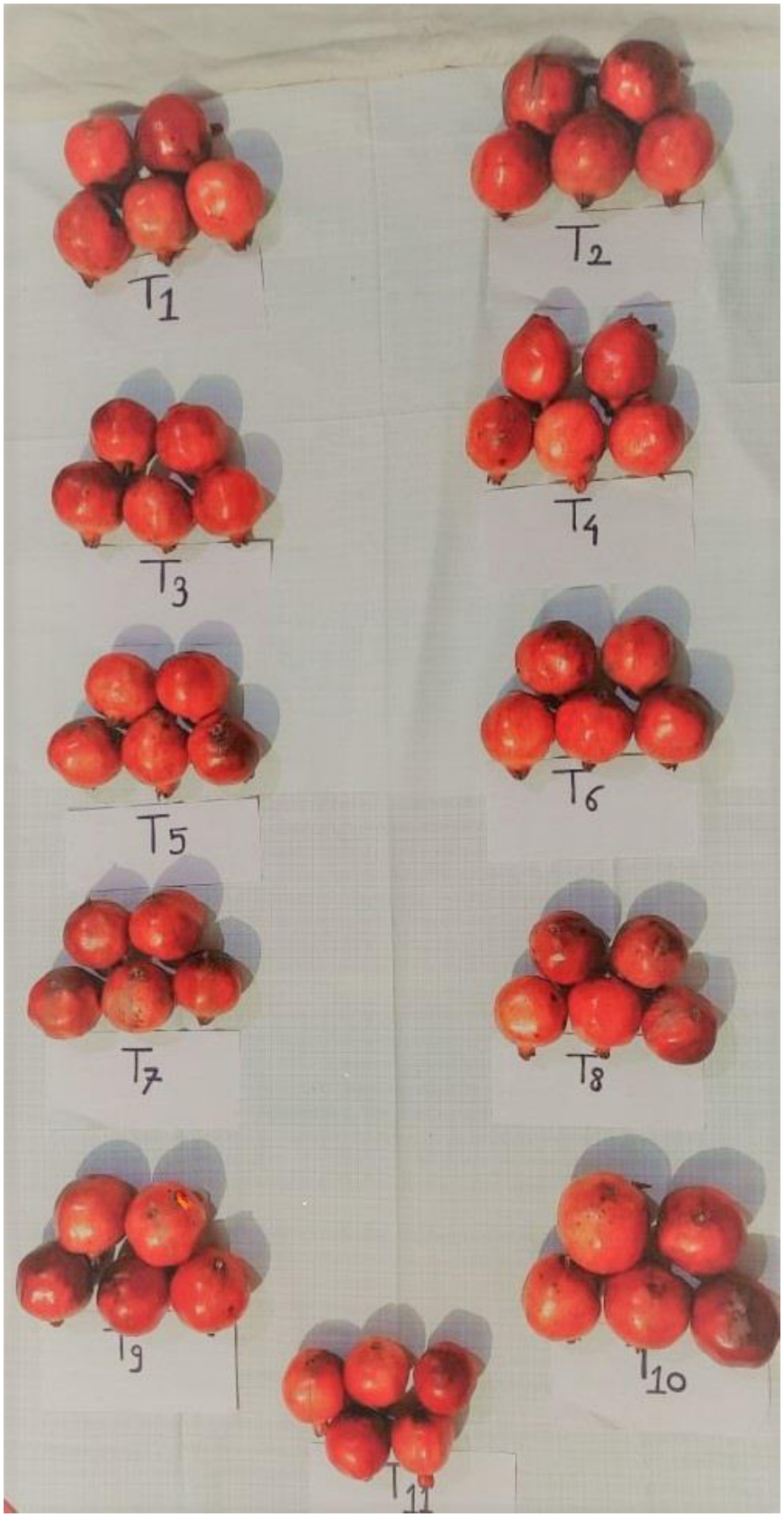

Plate 4.1 : Effect of foliar application of different chemicals on average size of pomegranate fruit

CHAPTER – V

SUMMARY AND CONCLUSIONS

CHAPTER-V

SUMMARY AND CONCLUSION

The field experiment entitled "Studies on foliar application of chemicals on flowering, yield and quality of pomegranate (*Punica granatum* L.) *hast* bahar" was carried out at farmers field Shri Dhanjay Hajgude at post Kini Taq. and District Osmanabad during the academic year 2020-21.

The experiment was laid out in randomized block design (RBD) with eleven treatments and three replications. Significant improvement was recorded in the flowering parameters *viz.* male flowers, perfect flowers, total number of flowers, fruit set per cent; fruit characters *viz.* fruit weight, fruit length, fruit diameter, fruit volume, number of arils per fruit, 100 aril weight, weight of rind; quality parameters *viz.* TSS, titrable acidity, reducing sugar, non-reducing sugar, total sugar, yield parameters *viz.* average fruit weight, fruit retention, number of fruit(s) per plant at harvest, yield per plant and yield per hectare and economics aspect of pomegranate crop due to foliar application of chemicals over control. The results obtained and discussed in previous chapters are summarized below:

5.1 Flowering parameters

5.1.1 Number of male flowers

The number of male flowers in pomegranate varied significantly as influenced by foliar spray of chemicals in present study as compared to control. Significantly less number of male flowers were recorded in the treatment applied with Ethrel 3%+0.2% $ZnSO_4$+0.2% Boric acid (45.15), however was found at par with the treatment T_7 (47.34) and T_2 (49.67). The treatment control recorded more number of male flowers in pomegranate (57.33) in present study.

5.1.2 Number of hermaphrodite flowers

The number of hermaphrodite flowers increased with treatments applied with different chemicals as compared to control. The treatment application of Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly maximum number of hermaphrodite flower (185.20) as compared with rest of the treatments in present study. The minimum number of hermaphrodite flower (155.34) was recorded in treatment control.

5.1.3 Total number of flowers

The treatment application of Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly more number of total flower (234.89) as compared with rest of the treatments in present study however, was found at par with the treatment T_1, T_3, T_4, and T_6, The treatment control recorded less number of total flowers (212.67) in present study

5.1.4Fruit set (%)

The data pertaining to the fruit set (%) of pomegranate as influenced by foliar application of different chemicals showed significant difference the treatment application of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly maximum fruit set (%) of pomegranate (52.48) as compared with rest of the treatments in present study, however was found at par with the treatment T_{10} (51.53) and T_5 (51.12). The minimum fruit set (%) of pomegranate (42.82) was recorded in treatment control.

5.1.5 Days taken from flowering to fruit set

The present study revealed that foliar application of chemicals showed significantly differences for days taken from flowering to fruit set as compared to control. Significantly less number of days taken from flowering to fruit set of pomegranate was recorded in the treatment T_2 (25.27days) i.e. treatment applied with Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_1, T_{10}, T_9, T_8, T_7 T_6 and T_5. More number of days taken from flowering to fruit set of pomegranates was recorded in the treatment T_{11} (28.27 days) i.e control.

5.1.6 Days taken from flowering to harvest

Significantly less number of days taken from flowering to harvest of pomegranate was recorded in the treatment applied with Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (173.3) over rest of the treatments under study, except treatment applied with Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid, which were at par with each other. More number of days taken from flowering to harvest of pomegranate was recorded in the treatment control (181.2 days).

5.2 Fruit parameters

5.2.1 Fruit length (cm)

The fruit length of pomegranate fruit as influenced by different foliar spays of chemicals showed significant difference. Significantly maximum fruit length of pomegranate was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.37 cm) over rest of the treatments under study. It was followed by the treatment T_9 (10.01 cm). The minimum fruit weight (8.68 cm) was recorded in treatment control.

5.2.2 Fruit diameter (cm)

A critical analysis of data indicated there existed significant variation in fruit diameter of pomegranate fruit due to combined foliar application of different chemicals in present investigation. Significantly maximum fruit diameter of pomegranate was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (8.76 cm), over rest of the treatments under study, except the treatments T_9 (8.54 cm), T_2 (8.26 cm), T_1 (8.20 cm), T_6 (8.17 cm), T_5 (8.10 cm) and T_4 (8.09 cm), which were at par with each other. The treatment control recorded minimum fruit diameter of pomegranate (7.22 cm).

5.2.3 Fruit volume (ml)

The fruit volume of pomegranate ranged from 225.30 ml to 316.16 ml in different treatments under present study. The treatment application of Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid resulted in significantly maximum fruit volume of pomegranate fruit (316.16 ml) as compared with rest of the treatments in present study. The minimum fruit volume of pomegranate (225.30 ml) was recorded in treatment control.

5.2.4Peel weight (g)

The present study revealed that peel weight of fruit varied significantly with foliar application of different chemicals in all the treatments. Significantly less peel weight of fruit was recorded in the treatment T_9 (68.40 g) over rest of the treatments under study, however was found at par with the treatment T_{10}.The maximum peel weight of pomegranate fruit (85.85 g) was recorded in treatment control.

5.2.5 Number of arils per fruit

Significantly maximum number of arils per fruit of pomegranate *var.* Bhagwa was recorded in the treatment T_{10} (597.62) over rest of the treatments under study, however was found at par with the treatment $T_{9,}$ T_2 and T_1. The minimum number of arils per fruit of pomegranate (496.57) was recorded in treatment control.

5.2.6 Arils weight per fruit (g)

The treatment application of Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid recorded significantly maximum aril weight per fruit of pomegranate (225.01 g) as compared with rest of the treatments in present study, however was found at par with the treatment T_9. The minimum aril weight per fruit of pomegranate (144.40 g) was recorded in treatment control.

5.2.7 100 arils weight per fruit (g)

The 100 arils weight of fruit ranged from 31.1 g to 43.3 g in different treatments. Significantly more 100 arils weight of fruit was recorded in the treatment T_{10} (43.3 g) over rest of the treatments under study, however was found at par with the treatment T_9. The minimum 100 arils weight of pomegranate fruit (31.10 g) was recorded in treatment control.

5.2.8 Aril recovery (%)

Significantly more aril recovery (%) of fruit was recorded in the treatment T_{10} (76.04 %) over rest of the treatments under study, however was found at par with the treatment T_9. The next best treatments which recorded more aril recovery (%) were treatment $T_{2,}$ $T_{1,}$ $T_{5,}$ T_6 and T_3 and were found at par with each other. The treatments T_4, T_7 and T_8 showed intermediate results and were at par with each other. The minimum aril recovery (%) of pomegranate fruit (63.14%) was recorded in treatment control.

5.3 Yield parameters

5.3.1 Number of fruits per plant at fruit set

Total number of fruits per plant at fruit set of pomegranate fruit as influenced by foliar application of different chemicals showed significant difference. Significantly more total number of fruits per plant was recorded in the treatment

applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (91.99) over rest of the treatments under study, however was found at par with the treatment applied with Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid. The minimum total number of fruits per plant of pomegranate fruit (66.51) was recorded in treatment control.

5.3.2 Fruit retention (%)

Significantly more fruit retention (%) was recorded in the treatment applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (77.12) over rest of the treatments under study, however was found at par with the treatment T_5, T_1 and T_2 while minimum fruit retention (%) of pomegranate fruit (65.92) was recorded in treatment control.

5.3.3 Number of fruits retained per plant at harvest

The number of fruits retained per plant at harvest ranged from 43.84 to 70.94 in different chemical sprays in present study. Significantly more number of fruits retained per plant at harvest of pomegranate was recorded in the treatment applied with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (70.94) over rest of the treatments under study however was found at par with the treatment T_5. The minimum number of fruits retained per plant at harvest of pomegranate fruit (43.84) was recorded in treatment control.

5.3.4Average weight of fruit (g)

Significantly maximum average weight of fruit (295.90 g) of pomegranate was recorded in the treatment Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_9 (285.57 g). The treatment control recorded minimum average weight of fruit of pomegranate (230.25 g) in present study.

5.3.5 Fruit yield per plant (kg)

The yield per plant of pomegranate as influenced by foliar application of different chemicals showed significant difference. Significantly maximum yield per plant (19.28 kg) of pomegranate was recorded in the treatment Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however

was found at par with the treatment T_5 (18.14 kg), T_2 (17.93 kg) and T_1 (17.82 kg). The treatment control recorded minimum yield per plant of pomegranate (10.09 kg) in present study.

5.3.6 Fruit yield per hectare (t/ha)

Significantly maximum yield per hectare (9.64 t/ha) of pomegranate was recorded in the treatment Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid over rest of the treatments under study, however was found at par with the treatment T_5 (9.07 t/ha), T_2 (8.96 t/ha) and T_1 (8.91 t/ha). The treatment control recorded minimum yield per hectare of pomegranate (5.04t/ha) in present study.

5.4 Quality parameters

5.4.1Total soluble solids (%)

Total soluble solids ranged from 13.71% to 15.8% in different treatments under present study. Significantly maximum total soluble solids were recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (15.8 %) over rest of the treatments under study while treatment control recorded minimum total soluble solids (13.71 %) in present study.

5.4.2Titrable acidity (%)

Significantly minimum acidity of pomegranate fruits was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.29%), however was found at par with the treatment applied with Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.31 %) and Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (0.32 %). The treatment control recorded maximum acidity of pomegranate fruits (0.48 %) in present study.

5.4.3Reducing Sugar (%)

Significantly maximum reducing sugar of pomegranate fruits was recorded in the treatment Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.71 %), however was found at par with the treatment Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (10.64 %). The treatment control recorded minimum reducing sugar of pomegranate fruits (9.20 %) in present study.

5.4.4 Non-Reducing Sugar (%)

Non reducing sugar of fruits ranged from 1.11 % to 2.57 % in different treatments of present study. Significantly maximum non reducing sugar of pomegranate fruits was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (2.57 %). The treatment control recorded minimum non reducing sugar of pomegranate fruits (1.11 %) in present study.

5.4.5 Total Sugar (%)

Significantly maximum total sugar of pomegranate fruits was recorded in the treatment applied with Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid (13.28 %) while treatment control recorded minimum total sugar of pomegranate fruits (10.31%) in present study.

5.5 Economics of the treatments

Economics is governed by yield and economic produce of the plant. The gross return (Rs. 5,78,400), net return (Rs. 4,12,550) and B: Cratio (3.48) was recorded higher in treatment T_6 (Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid) among treatments in present study. The minimum gross income (Rs. 3,02,400), net return (Rs. 1,51,400) and B:C ratio (2.00) were under the treatment control.

CONCLUSION

In summing up the present investigation based on obtained results it may be concluded that,

1. Among combination treatment of different forms of potassium and micronutrients, the treatment consisting of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid applied as foliar spray in pomegranate resulted in improving yield and quality parameters of pomegranate fruits.

2. The treatment combination consisting of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid applied in pomegranate was beneficially accompanied with higher B:C ratio among all the treatment combination.

In nut shell, it can be concluded that three foliar sprays: first spray one month before bud break stage, second spray at full bloom stage and third spray one month after second spray with Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid in

pomegranate var. Bhagwa was highly effective in producing more yield, improving post- qualities and achieving higher B:C ratio among the treatments applied. Thus, arriving to conclusion to advice for large scale use of Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid in pomegranate orchards of Marathwada region.

As these findings are based on one season, experimentation needs further detail studies for confirmation of results.

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APPENDIX

APPENDIX I

DNYAN PRABODHINI AGRICULTRAL TECHNICAL SCHOOL, HARALI

TQ. LOHARA DIST. OSMANABAD

Latitude : 17^0 35'N

Zone : Deccan platau Longitude : 75^0E16'

State : Maharashtra Altitude : 653.0 m

District /location: Osmanabad Soil type :Vertisol/Typicchromostar

Weekly Metrological data for the year 2020-21

M.W.	Date	Total rain fall (mm)	Rainy days (No.)	Temp.		Relative Humidity (%)	
				Min.	Max.	I	II
24	11-17 June 2020	40.5	4	22.0	31.6	83	65
25	18-24 June	8.1	1	21.5	32.3	71	52
26	25 June-1 July	24.5	2	21.4	31.3	79	56
27	2-8 July	38	3	21.2	30.5	84	65
28	9-15 July	66.5	4	20.6	25.3	90	83
29	16-22 July	122.2	6	21.1	26.1	90	81
30	23-29 July	100	6	21.3	23.6	82	84
31	30 July-5 Aug.	45.7	3	20.9	27.1	85	73
32	6-12 Aug.	44	5	21.2	26.3	84	81
33	13-19 Aug.	57.6	6	21.2	26.5	80	75
34	20-26 Aug.	7.2	1	20.6	27.7	79	68
35	27Aug. -2 sept.	10.2	1	20.5	29.0	76	76
36	3-9 Sept.	4	1	21.1	30.4	78.7	64.1
37	10-16 Sept.	0	0	20.5	30.7	88.7	66.1
38	17-23 Sept.	0	0	21.8	29.6	81.1	65.9
39	24-30 Sept.	0	0	20.6	30.2	69.3	53.0
40	1-7Oct.	0	0	20.3	28.9	83.0	80.7
41	8-14 Oct.	0	0	21.0	27.7	77.7	74.3
42	15-21Oct.	0	0	21.1	30.4	77.7	64.3
43	22-28Oct.	0	0	20.1	28.3	79.6	67.1
44	29 Oct-4Nov.	0	0	18.4	28.7	70.1	64.0
45	5-11Nov.	0	0	17.8	28.5	63.3	42.4
46	12-18 Nov.	0	0	14.5	27.4	62.9	46.0

47	19-25 Nov.	21.6	2	13.9	29.0	65.1	47.1
48	26 Nov.-2Dec.	0	0	15.6	28.0	67.9	60.9
49	3-9 Dec.	81	1	13.6	26.1	61.3	54.0
50	10-16 Dec.	0	0	9.7	27.0	47.0	50.9
51	17-23 Dec.	0	0	9.8	28.1	55.4	57.0
52	24-31 Dec.	0	0	12.3	26.9	53.9	38.6
1	1-7 Jan.,2021	0	0	15.3	30.7	49	57
2	8-14 Jan.	0	0	12.0	30.2	49	39
3	15-21 Jan.	0	0	13.9	29.7	50	25
4	22-28 Jan.	0	0	15.1	29.2	61	41
5	29 Jan.- 4 Feb.	3.1	1	15.8	29.2	59	34
6	5-11 Feb.	0	0	16.8	29.6	57	37
7	12-18 Feb.	0	0	16.1	31.8	52	42
8	19-25 Feb.	0	0	14.2	32.4	57	46
9	26Feb.- 4 march	0	0	16.3	33.1	45	40
10	6-11 March	0	0	16.4	36.1	60	38
11	12-18 March	0	0	17.1	36.3	66	44
12	19-25 March	0	0	17.4	36.0	68	48
13	26 – 1 April	0	0	19.7	37.7	51	40
14	2-8 April 2012	0	0	21.3	37.8	52	41
15	9-15 April	5	1	21.9	39.1	60	34
16	16-22 April	0	0	20.7	38.0	45	32
17	23-29 April	3	0	21.7	37.6	58	40
18	30 April-6 May	0	0	22.5	40.9	33	19
19	7-13 May	0	0	24.4	41.4	23	15
20	14-20 May	0	0	25.7	36.9	26	17
21	21-27 May	0	0	27.5	40.6	28	17
22	28 May – 3 June	18.4	2	23.2	37.1	56	28
23	4-10 June	24.6	1	21.5	30.2	95	69

APPENDIX II
Common cost of cultivation of pomegranate

Sr. No.	Particular	Unit	Cost/Unit (Rs.)	Cost/ha (Rs.)
1	Land Preparation (1 ploughing,2 harrowing and one planking)	Rs.3500/ha	Rs.3500/ha	3500
2.	FYM and Fertilizers	-	-	60,000
3.	Labour charges			
i)	Fertilizer application, spraying of fungicide and insecticide	20 man days	300/man/day	6000
ii)	Pruning	15 man days	300/man/day	4500
iii)	Weeding	20 man days	300/man/day	6000
iv)	Harvesting	20 man days	300/man/day	6000
4.	Transportation	-	-	15000
5.	Insecticide and fungicide	-	-	20000
6.	Irrigation	-	-	20000
	Others	-	-	10000
Total cost				1,51,000

APPENDIX III
Treatment cost

Treatment No.	Treatment details	Cost of one treatment/plant (Rs.)	Cost of treatment/ha (Rs.)
T_1	Cycocel 1500 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	14.06	21,090
T_2	Cycocel 2000 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	15.57	23,355
T_3	Nitrobenzene 5ml/lit + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	18.72	28,080
T_4	Nitrobenzene 7.5m/lit 0.2 % $ZnSO_4$ + 0.2 % Boric acid	23.32	34,980
T_5	Salicylic acid 100 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	9.98	15,645
T_6	Salicylic acid 200 ppm + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	10.43	14,850
T_7	Ethrel 2% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	71.52	35,764
T_8	Ethrel 3% + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	102.52	51,264
T_9	Potassium nitrate 2 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	55.76	27,884
T_{10}	Potassium nitrate 3 % + 0.2 % $ZnSO_4$ + 0.2 % Boric acid	78.88	39,444
T_{11}	Control (no spray)	-	-

*** Plant population is 500/ha (Planting distance 5m x 4m)**

*** Market price of pomegranate fruits Rs. 60/kg**

CURRICULUM VITAE

CIRRUCULAM VITA

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Title of the thesis : "Studies on foliar application of chemicals on flowering yield and quality of pomegranate (*Punica granatum* L)" in *hasta* bahar

Academic qualification

Course / Degree	**Name of the college / institute**	**University / Board**	**Year of passing**	**Percentage (%) / CGPA**	**Class / Grade**
SSC	Chhatrapati Shivaji high school Osmanabad	Latur divisional board	2012	82.36	First Class with Distinction
HSC	Shripatrao Bhosale jr. college Osmanabad	Latur divisional board	2014	65.85	First Class
B. Sc. (Horti)	College of Horticulture, Parbhani	V.N.M.K.V. Parbhani	2018	7.83	First Class

Patil

(Patil O. B.)

Place : Latur

Date : 11/08/2024