EFFICACY OF ZINC ON GROWTH, PRODUCTIVITY AND QUALITY OF FIG (Ficus carica Linn.)

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PHK 630

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EFFICACY OF ZINC ON GROWTH, PRODUCTIVITY AND QUALITY OF FIG
(Ficus carica Linn.)

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Thesis submitted to the
University of Agricultural Sciences, Bangalore
in partial fulfillment of the requirement
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of

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in
POMOLOGY

BANGALORE JUNE, 2008
Affectionately Dedicated to my beloved Parents and In-laws (Baba and Ema), Brother and Sisters (Ango, De, Nimla and Nevi), and Husband (Tamo)
This is to certify that the thesis entitled “Efficacy of zinc on growth, productivity and quality of fig (Ficus carica Linn.)” submitted by Mrs. Y. ASHALATA DEVI, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE (Horticulture) in POMOLOGY to the University of Agricultural Sciences, GVKV, Bangalore is a bonafide research work carried out by her under my guidance and supervision and that no part of the thesis has been submitted for the award of any other degree, diploma, associateship, fellowship or other similar titles.

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(Y. ASHALATA DEVI)
ABSTRACT

Fig (*Ficus carica* Linn.) is a deciduous sub-tropical fruit originated in the east Mediterranean region. The fruits are valued for its laxative and medicinal properties. Zinc deficiency is the most wide spread nutritional disorder next to iron, vitamin A and iodine. Therefore, fruit nutrition focused on the significance of zinc will modify various enzymatic processes which in turn increase the productivity and quality of fruit crops. Hence, fig plants were given different quantities of zinc through soil application, foliar application and their combination. The observations indicated that soil application (20 g) in combination with foliar spray (1.5 %) of zinc sulphate significantly improves growth, yield and quality parameters of ‘Poona’ fig fruits.

Maximum index leaf area (357.90 cm$^2$), number of leaf (211.10), plant height (2.21 m) and plant spread (4.48 m$^2$) was recorded at 90 days after treatment with 20 g zinc sulphate per plant soil application as against control (247.00 cm$^2$, 102.20, 2.04 m and 2.65 m$^2$ respectively).

The highest yield per plant (5.86 kg) and total soluble solids (16.40 °Brix) were observed in soil application of 20 g zinc sulphate per plant, whereas, other quality parameters like acidity, total sugar, reducing sugar and non-reducing sugar were found significant with soil application of 20 g zinc sulphate per plant in combination with 1.5 per cent zinc sulphate as foliar application. The zinc content of the leaf (68.50 ppm) and fruit (101.50 ppm) was also highly significant with the combined application of soil (20 g) and foliar spray (1.5 %) of zinc sulphate. This increased amount of zinc in the fruit will help in overcoming zinc malnutrition in human beings.
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Introduction
I. INTRODUCTION

Fig (Ficus carica L.) is a deciduous fruit of the sub tropical region. It is said to have been originated in the east Mediterranean region, from where its cultivation expanded to the whole of the Mediterranean region. Along with date palm, grape and olive, the fig was one of the important fruit crops of the ancient civilization of the eastern Mediterranean region and appeared in many songs and legends of historical and mythological background.

Greece is now the leading fig producing country followed by Algeria, Morocco, Syria and Italy in the world (Lionakis and Llacer, 1985). Although wild figs have grown in India for thousands of years, the common fig is being cultivated commercially in a small area in spite of the fact that soil and climatic conditions are most suitable for its cultivation in the country.

Morphologically, the fig fruit is called as ‘Syconium’ which is a vegetative, fleshy tissue with tiny fruits enclosed inside. Figs are consumed fresh or dried, preserved and canned. Fresh fruits are very delicious and nutritious and used as a dessert or for making jam. Fig is a poor source of vitamin C, but it is a rich source of Ca, Fe and sugar. Fruits have been priced based on the medicinal and dietary properties. Fig is valued for its laxative properties and is used in the treatment of skin infection. Fruit helps to maintain acid alkali balance of the body. Latex is used to coagulate milk.

Though, fig is cultivated in an area of about 1000 ha in India, commercially it is cultivated only in Pune district of Maharashtra state. It is also cultivated in small areas in Bangalore, Mysore, Chitradurga and Bellary districts of Karnataka and also in Ananthapur district of Andhra
Pradesh. In north India, it is cultivated in U.P., Punjab, Bihar and West Bengal in small gardens or in home backyards. (Bose and Mitra, 2001)

All around the globe, several elements are reported to be below critical levels in the soil. After moisture stress, nutrient deficiency is one of the major limiting factors in crop productivity. Among the micronutrients, it is reported that, 25 to 30 per cent of cropped area is deficient in zinc alone (Takkar, 1996), which primarily limits the productivity of the crops. Secondly, the plants grown in such soils are unable to take-up and translocate enough zinc to edible parts, which leads to short supply of zinc for human nutrition.

The specific role of zinc in growth and development of plants is not very clear. But, this nutrient is an important component of various enzymes that are responsible for driving many metabolic reactions in all crops. Zinc is a component of certain enzymes and involved in synthesizing the growth hormone Indole Acetic Acid and also increases the nutrient use efficiency. Zinc is a co-factor of over 300 enzymes and protein biosynthesis.

Plants are critical components of the dietary food chain, providing almost all essential minerals and organic nutrients to humans either directly or indirectly. According to a recent survey, zinc deficiency is the most widespread nutritional disorder next to iron, vitamin A and iodine. Nearly 49 per cent of the global population does not meet their daily-recommended intake of 15 mg zinc per day for an adult. People in the developing countries are at great risk, since plant foods are their major source of vitamins, minerals and rare amino acids.

Globally, the soils are found to be zinc deficient and most of the fruit crops contain less amount of zinc in the edible parts. Mani (2000), reported that more than 70 per cent of the soils in Karnataka are found
to be deficient in zinc. The critical limits of zinc are 0.5-1.0 ppm. Normally zinc content of healthy plants usually ranges from 15-28 mg/kg of dry matter. Zinc deficiency in plants does not usually appear till the concentration of zinc falls below 12 mg/kg of dry matter.

Hence, the major emphasis would be, to enhance the zinc levels in edible portions of fruit crops. The first step that needs to be taken is to systematically address these issues, to assess the uptake and accumulation in the edible portions. With this preamble the study was initiated to know the influence of soil and foliar applied zinc sulphate on growth, yield and quality of Poona fig with the following objectives,

1. To assess zinc status in soil and plant material.
2. To study the impact of zinc application on growth, yield and quality of Poona Fig.
3. To work out the cost benefit ratio.
Review of Literature
II. REVIEW OF LITERATURE

Fig is one of the important crops which are preferred in dryland horticulture. In this chapter an effort is made to review the existing literature on “Efficacy of zinc on growth, productivity and quality of fig (Ficus carica Linn.)”. The informations available on the above mentioned parameters in fig is limited; hence work done on the related fruit crops are also reviewed for better understanding of the problem.

2.1 Importance of zinc in soil

Micronutrient deficiencies in plants are becoming increasingly important globally. Among the micronutrient deficiencies reported to occur worldwide, Zn and Fe deficiencies are of greater importance (Chen and Borak, 1982). Available zinc in Indian soils varied from less than one gram to a few ppm, depending on the type of extractant (Kanwar and Randhawa, 1967). Katyal (1985) reported that 0.6 ppm zinc is fixed in soil as threshold level. Singh and Sekhar (1991) have found the optimal level of 0.45 to 1.05 ppm of zinc in red and lateritic soils of India.

2.2 Importance of zinc in plant

In many soils, either zinc is not present or the soil physiochemical composition does not allow uptake of zinc by plant roots (Cakmak et al., 1996). Plants grown in soils where zinc is not available resulted in less yield and has a low nutritional quality (Kochian and Garwin, 1999). Zinc is involved in the production of plant growth substances, enzyme systems, metabolic reaction and it is also essential for the production of chlorophyll and carbohydrates.

2.3 Importance of zinc in human nutrition

The world population is to grow from 6 billion to around 10 billion by 2050, representing the addition of an extra 4 billion people on to
present population (Byrnes and Bumb, 1998). Anderson et al., (1999) reported that more than 800 million people in the developing countries are under nourished, caused by inadequate food supply and the problems are widespread in Asia. About 70 per cent of globally under nourished people live in Asia, predominantly in India and China.

Hambridge (2000) reported that zinc is one of the nutrients most frequently deficient in human nutrition; also zinc has an important role in human development and immune function. Micronutrient deficiencies are also widespread in well developed industrialized countries and more than 3 billion people globally suffer from Fe and Zn deficiency. The primary source of all nutrients for people comes from agricultural products. If agricultural system fails to provide enough products containing adequate quantities of all nutrients, it results in dysfunctional systems, that cannot support healthy lives; unfortunately this is the core of many agricultural systems in many developing nations in global foundation (Graham et al., 2001) and sustainable in many developing nations. Critical health issues in developing countries are due to micronutrient deficiencies such as Fe, Zn, I and vitamin A which result in severe impairment of physical growth, immune system, cognitive development, enhancement in anemia and maternal mortality. (Anderson et al., 1999 and Welch and Graham, 2004)

2.4 Effect of foliar and soil application of zinc on growth

Bakhshi et al. (1990) reported that the soil application of 50 g ZnSO₄ per plant and 35 g Zn EDTA per plant gave significant response in the root growth as well as shoot growth of trifoliate orange seedlings. Sandhu et al. (2000) revealed that, 0.4 per cent foliar spray of zinc sulphate and soil application of 500 g zinc sulphate per tree recorded the highest fruit yield in ‘Patharnakh’ pear. Investigation was carried out to study the effect of foliar application of nitrogen alone and in combination
with ZnSO$_4$ on ber cv. Gola (Joon et al., 1983). The maximum increase in fruit length and breadth was recorded in ber plants treated with 500 g nitrogen (urea), applied in two split doses and foliar spray of 1.5 per cent urea and 0.5 per cent ZnSO$_4$ (Singh and Chandra, 2002). Saraswathy et al. (2004) observed maximum plant height and spread with soil application of 50 g ZnSO$_4$ and 25 g borax per tree, and two foliar sprays of ZnSO$_4$ at 0.5 per cent and borax at 0.3 per cent as compared to control in sapota.

2.5 Effect of foliar and soil application of zinc on yield

The yield of Muscat grapes was highest with soil application of ZnSO$_4$ 10 g and 20 g per vine and Borax 4 g and 8 g alone and in combination (Prabu and Singaram, 2001). The yield of sapota cv. PKM-1 was highest with soil application of ZnSO$_4$ 50 g and borax 25 g per tree and two foliar sprays of ZnSO$_4$ 0.5 per cent and borax 0.3 per cent at 50 per cent flowering and pea stage of fruit development stage respectively, in addition to the recommended dose of organic manures and N, P and K. (Saraswathy et al., 2004).

2.6 Effect of foliar and soil application of zinc on quality of fruits

Orphanos (1982) reported that, the soil application of zinc 750 g per tree gave erratic resulting with a wide range of leaf zinc contents in apple. Sandhu et al. (2000) observed significant result in breadth, juice content, T.S.S. and acidity of fruit in ‘Patharnakh’ pear. Lal and Sen (2001) reported that soil application of N, Zn and Mn in guava cv. Allahabad Safeda, increased the total soluble solids, ascorbic acid, pH and T.S.S.-acid ratio of fruit. They also recorded maximum reducing sugars, non reducing sugars, total sugars and pectin at the highest dose of N at 600 g per plant, Zn and Mn each at 4 g per plant. Investigation was carried out to study the effect of soil and foliar application of nitrogen alone and in combination with ZnSO$_4$ in ber cv. Gola and the
result was significant, with the physical characters like fruit length and fruit breadth. The maximum increase in these parameters were recorded in the treatment 500 g nitrogen (urea) applied in two split doses and foliar spray of 1.5 per cent urea and 0.5 per cent ZnSO₄ (Singh and Chandra, 2002).

Studies conducted by Muller (2003) revealed that the accumulation of zinc in the upper soil layers was more when compared to subsoil. Kumar et al. (2004) reported that the zinc content and uptake in pulp, peal and seed was appreciably increased with the application of 20 g zinc sulphate per vine in Muscat grapes. The highest T.S.S., total sugars, reducing sugars and ascorbic acid were recorded in sapota fruits treated with soil application of zinc sulphate (50 g) and borax (25 g/tree) with two foliar sprays of zinc sulphate (0.5 %) and borax (0.3 %) during 50 per cent flowering and pea stage of fruit development (Saraswathy et al., 2004).

### 2.7 Effect of foliar spray of zinc on growth of plants

Foliar application of 0.2, 0.4, 0.6 and 0.8 per cent ZnSO₄ significantly improved the shoot length, number of leaves and leaf area per shoot and also increased the number of hermaphrodite flowers and decreased male flowers in mango (*Mangifera indica*) according to Singh and Rajput (1976). Similarly, maximum fresh weight of mango cv. Chausa was recorded under 0.8 per cent ZnSO₄ spray. The maximum fresh weight of mango fruit cv. Dashehari was observed with the application of 1.0 per cent ZnSO₄ (Daulta et al., 1981).

Neilsen and Hogue (1983) reported that, the maximum shoot length of apple cv. McIntosh seedlings at $10^3 \mu g$ Zn per ml. Ghosh (1986) reported that zinc application with Mg and B; Mg, B and Mn in combinations recorded maximum length and diameter of fruits in guava.
cv. Lucknow-49. Daulta et al. (1986) recorded the maximum fruit length and breadth in mandarin hybrid Kinnow with foliar spray of 0.5 per cent ZnSO₄. Increased berry weight was recorded by foliar application of ZnSO₄ (0.2, 0.4 and 0.6 %) and FeSO₄ (0.1 and 0.2 %) in Perlette grapes as observed by Dhillon and Bindra (1995). Surender Singh and Ahlawat (1996) observed maximum plant height; plant spread and of shoots length with 1.0 per cent zinc sulphate spray in ber cv. Umran. Ahmed et al. (1997) observed that foliar spray of micro and macro nutrients significantly improved cane thickness in Red Roumy grapes (Vitis vinifera L.)

The effect of zinc on fruit length of ‘Patharnakh’ pear was non significant. However, maximum fruit length was observed with 0.6 and 0.8 per cent zinc sprays (Sandhu et al., 2000). Studies conducted by Sindhu et al. (2000) on ‘Perlette’ grapes revealed that the foliar application of 1.5 per cent urea and 0.5 per cent ZnSO₄ increases the shoot length, number of leaves per shoot, leaf area and total chlorophyll content of leaves. According to Prabu and Singaram (2001), foliar application of 0.5 per cent ZnSO₄ + 0.2 per cent borax in combination excelled in increasing the shoot length, number of internodes per shoot and number of leaves per shoot in ‘Muscat’ grapes. The maximum fruit weight, fruit length and fruit width was observed with foliar application of ZnSO₄ (0.5 %) + borax (0.2 %) + CuSO₄ (0.4 %) in aonla cv. Francis (Singh et al., 2001).

Chaturvedi et al. (2003) reported that foliar application of zinc sulphate at 0.4 per cent and ferrous sulphate at 0.2 per cent increases the number of leaves and plant height in strawberry cv. Chandler. Neilsen et al. (2005) recorded maximum number of leaves in apple cv. McIntosh at lower zinc concentration (500µg/l) spray solution, while the least was recorded at highest concentration (4 mg/l). The shoot growth
was least at the highest zinc solution spray (400 mg/l). Wali et al. (2005) reported that the fruit length and fruit breadth of phalsa cv. Purple Round was significantly increased under different concentrations of ZnSO₄. The maximum fruit length was obtained with 0.6 per cent ZnSO₄ spray, whereas, maximum fruit breadth was obtained with 0.4 per cent concentration. Asha (2006) observed that foliar application of zinc sulphate at 0.3 per cent increases cane length, cane girth, index leaf area and chlorophyll content in ‘Bangalore Blue’ grapes.

2.8 Effect of foliar spray of zinc on yield

The different concentration of zinc sprays were tried by Singh and Rajput (1977) in mango cv. Chausa resulted in increase in fruit yield. Zinc sprays doubled the yield of Thompson Seedless grapes due to increase in berry set, number of bunches and their weight (Yamdagni et al., 1979). Sharma and Dhillon (1984) observed maximum fruit yield in ‘Dehra Dun’ litchi by foliar application of 1.5 per cent ZnSO₄. The maximum fruit yield per plant was recorded with foliar application of Zn + Mn (0.5 % each) and maximum number of fruits per plant was recorded highest in Zn + Mn (0.5 % each) + 1.0 per cent urea spray (Daulta et al., 1986).

The maximum berry set, length of the bunch and reduced panicle drying at lower concentration of ZnSO₄ (0.2 %) was reported by Ravikumar and Suneel Sharma (1988) in grapes cv. Gold. Foliar application of ZnSO₄ (0.6 %) gave significantly highest fruit yield, fruit number and fruit weight in Allahabad Safeda guava (Sharma et al., 1991). The experiment carried out by Ram and Bose (1994) in Darjeeling district with an objective to improve the yield and fruit quality of the mandarin orchard, revealed that the maximum number of fruits were produced in urea (soil application) + urea (1.5 % foliar application) + Zn (0.5 % foliar application). The size of the fruit fresh weight was increased
greatly with the increase in spray concentration of boric acid, zinc sulphate and copper sulphate in litchi fruits (Babu and Singh, 1994). Balakrishna et al. (1996) studied the effect of foliar application of Zn (0.5 %), Fe (0.4 %), Mn (0.6 %) and B (0.8 %) on yield of pomegranate cv. Ganesh.

Durga et al. (1997) conducted an experiment to find out the effect of zinc, iron and manganese on chlorotic trees of Sathgudi orange. The study revealed that trees treated with soil application of 50 g per plant with foliar application of 0.5 per cent each of zinc sulphate, ferrous sulphate and manganese sulphate gave the highest fruit yield. The highest fruit weight of mandarin orange was observed in Zn + Mn (0.5 % each) + 1.0 per cent urea spray (Saraswathi et al., 1998). Increase in femaleness percentage in papaya was recorded with foliar application of FeSO₄ 0.15 per cent with ZnSO₄ 0.15 per cent. Foliar application of ZnSO₄ 0.15 per cent with borax 0.15 per cent per plant increases the yield per plant in papaya (Veena Pant and Lavania, 1998). Foliar spray of 0.5 per cent zinc along with 0.1 per cent boron at 4th, 8th, 12th and 16th month after planting also increases the fruit yield and latex yield in papaya cv. Co. 5 (Kavitha et al., 2000).

Bhatia et al. (2001) found that foliar application of ZnSO₄ (1.0 %) increases fruit weight and fruit yield in guava cv. L-49. Rani and Brahmachari (2001) reported the minimum fruit drop with 1.0 per cent zinc sulphate in litchi fruits. They also observed that the size and weight of fruit and pulp weight were increased greatly with Borax 0.4 per cent and zinc sulphate 1.0 per cent. Barun and Kumar (2003) reported that the number of fruits per plant in litchi cv. Purbi increased significantly by zinc sulphate 0.5 per cent application. Similarly, they also reported that foliar feeding of 0.5 per cent zinc sulphate, 20 ppm NAA and 2.0 per cent urea proved to be the optimum doses for increasing the size of litchi
fruits cv. Purbi. Dhinesh Babu and Yadav (2005) reported that foliar spray of ZnSO\(_4\) (0.5 \%) gave maximum number of fruits per tree, fruit weight and maximum yield per tree in Khasi mandarin. Asha (2006) observed that foliar spray of ZnSO\(_4\) (0.3 \%) gave maximum yield per vine in ‘Bangalore Blue’ grapes.

2.9 Effect of foliar spray of zinc on quality of fruits

Morchan and Sobornikova (1972) reported that foliar spray of P, Ca, Fe and Zn increased the leaf ash content in grape cv. Riesling. Awasthi et al. (1975) observed that foliar spray of ZnSO\(_4\) 0.1 to 1.5 per cent, significantly influenced the total soluble solids and reduced acidity in litchi fruits. The reducing sugars and non-reducing sugars were maximum in 0.8 per cent ZnSO\(_4\) spray. Musamukhamedor (1976) observed that foliar application of B, Mn, Mo and Zn improved the berry weight and number of berries per bunch in ‘Taifi Razouyi’ grapes. Pradeepwali and Sharma (1997) recorded improved quality parameters with the application of 0.75 per cent zinc in Kinnow mandarin. Rath et al. (1980) recorded the maximum size and fresh weight of mango fruit cv. Langra under 0.8 per cent ZnSO\(_4\) spray. Total sugars, ascorbic acid content and total soluble solids of the fruit pulp were also increased with increased supply of ZnSO\(_4\). The maximum increase was obtained in 0.8 per cent ZnSO\(_4\) sprays, which was followed by 0.6, 0.4 and 0.2 per cent.

The highest total soluble solids of mango fruit cv. Dashehari was recorded with 0.8 per cent ZnSO\(_4\) (Daulta et al., 1981). Bhullar et al. (1981) reported, the highest juice content and total soluble solids of Kinnow mandarin fruit with foliar spray of ZnSO\(_4\) + FeSO\(_4\) (1.0 \% each). Babu et al. (1982) reported the maximum total soluble solids and ascorbic acid content of Kagzi lime fruits with 0.4 per cent foliar application ZnSO\(_4\). Improved berry size and maximum total soluble solids in ‘Beauty Seedless’ grape was recorded with combined effect of
fertilizers containing Zn, Mo, Mn and Cu and also application of 0.2 and 0.4 per cent ZnSO₄ was reported by Daulta et al. (1983). Foliar application of zinc (0.4 %) during ambe bahar and mrig bahar increases the total soluble solids, non-reducing sugars and reducing sugars in guava (Singh and Chhonkar, 1983). The highest total soluble solids and total sugars were obtained by Ghosh (1986) with the foliar spray of Mg, Zn and B in guava cv. L-49.

Ravikumar and Suneel Sharma (1988) reported that lower concentration of ZnSO₄ (0.2 %) influence the quality parameters of berries and juice content in grape cv. Gold. Berry weight was improved by combined effect of B, Zn, Mo, Mn and Cu sprays (Bose et al., 1988). Langthasa and Bhattacharya (1991) recorded the maximum total soluble solids, total sugars, reducing sugars and minimum acidity in Assam lemon fruits. Sharma et al. (1991) observed highest total soluble solids content and minimum acidity in guava fruit with zinc sulphate (0.6 %) spray. Sindhu et al. (1994) reported maximum T.S.S., bunch weight and yield in vines which received 1.5 and 0.5 per cent urea and ZnSO₄ sprays respectively in grapes cv. Perlette. Ram and Bose (1994) recorded the maximum total soluble solids, total sugars, reducing sugars and minimum acidity in mandarin orange with urea 1.5 per cent + Zn 0.5 per cent sprays. Increased fruit quality in Navel orange with 75 ppm Zn spray was recorded by Hassan (1995).

Balakrishna et al. (1996) observed the maximum total soluble solids with ZnSO₄ 0.4 per cent + Boric acid 0.2 per cent whereas minimum acidity was recorded with ZnSO₄ 0.5 per cent spray in pomegranate fruits. The size of the fruit (length x breath) increased greatly when ZnSO₄ was sprayed at 0.4 per cent concentration in mango cv. Fazli (Banik et al., 1997). They also found that foliar application of zinc caused increase in the total soluble solids, total sugars, reducing
and non-reducing sugars in mango cv. Fazli. The spray of ZnSO₄ at 0.3 per cent and borax 0.3 per cent was found to increase the total soluble solids content of fruit in guava cv. Lucknow-49 (Chaitanya et al., 1997). Saraswathi et al. (1998) reported the highest total soluble solids and total sugars with Zn + Mn (0.5 % each) + 1.0 per cent urea whereas minimum acidity was recorded with Zn (0.5 %) + 1.0 per cent urea spray in mandarin orange.

Kavitha et al. (2000) observed maximum ascorbic acid, total sugars and total soluble solids with 0.5 per cent zinc along with 0.1 per cent boron sprays at 4th, 8th, 12th and 16th month after planting in papaya cv. Co.5. Increased in total soluble solids and total sugars was recorded by foliar application of ZnSO₄ (0.1 %), K₂SO₄ (1.5 %) and H₃BO₄ (1.0 %) in guava cv. L-49 as observed by Bhatia et al. (2001). Total soluble solids and acidity was found to be significantly maximum with ZnSO₄ 0.5 per cent + borax 0.2 per cent + CuSO₄ 0.4 per cent in the fruits of aonla cv. Francis (Singh et al., 2001). Kar et al. (2002) reported that pre-harvest foliar spray of Zn 0.6 per cent increases fruit weight, volume of fruit, pulp weight, length and breadth of fruit, pulp per peel ratio and juice content in pineapple. Maximum T.S.S., total sugars and ascorbic acid was observed by foliar application of Zn 0.6 per cent along with boron 0.15 per cent. Maximum total soluble solids in Kagzi lime fruits was observed with the foliar application of 2, 4, 5-T 10 ppm followed by ZnSO₄ 0.5 per cent + 2, 4, 5-T 20 ppm (Sharma et al., 2002).

Micro elements Zn, Fe and Mn in general and Zn in particular improved the fruit quality in terms of size, weight and yield of fruit in ‘Himsagar’ mango irrespective of the stage of application. The effect of zinc was more marked when applied at a concentration of 0.2 per cent twice (at flowering and pea stage) as compared to other nutrient (Dutta and Dhua, 2002). Foliar application of ZnSO₄ at 0.4 per cent and FeSO₄
at 0.2 per cent increases ascorbic acid content and total soluble solids of fruits in strawberry cv. Chandler (Chaturvedi et al., 2003). Alila et al. (2004) found that the maximum ascorbic acid was recorded with foliar application of B (0.1 %) + Fe (0.1 %) + Zn (0.2 %) but total sugars and reducing sugars were found maximum with foliar application of Fe (0.1 %) alone in papaya cv. Ranchi. Vinod Kumar et al. (2005) reported that improved total soluble solids, total sugars and reducing sugars in phalsa cv. Purple Round with 0.5 per cent ZnSO₄ spray. Dhinesh Babu and Yadav (2005) recorded the maximum total soluble solids, total sugars, ascorbic acid and minimum acidity in Khasi mandarin sprayed with 0.5 per cent ZnSO₄. The maximum total soluble solids, total sugars, reducing sugars, non-reducing sugars and lowest titratable acidity were recorded with (0.3 %) zinc spray in ‘Bangalore Blue’ grapes (Asha, 2006).

### 2.10 Zinc content in plant parts

Labanauskas et al. (1971) reported that foliar spray of zinc at higher concentration increased zinc content in new flush of leaves and juice in Valencia orange. Manchanda (1974) suggested that zinc spray alone, as well as its combination with Cu, Mn, Fe, Cu + Mn, Cu + Fe or Mn + Fe, significantly increased leaf zinc concentration in sweet orange cv. Pineapple. Aggarwal et al. (1975) reported that zinc content increased significantly by foliar spray of zinc (327.5 ppm) in orange leaf. Further, zinc uptake in the leaves increased still higher (424.2 ppm and 290 ppm) by the addition of Cu and Fe in the Zn spray. They conclude that addition of Cu and Fe influence Zn uptake and increased shoot growth. Khetawat and Vashishtha (1978) reported that, 12.8 ppm and 17.7 ppm zinc concentration in normal leaves of ‘Beauty Seedless’ and ‘Thompson Seedless’ grapes, by foliar spray of zinc sulphate, the level raised up to 29.1 and 40 ppm in the respective varieties. Effect of foliar application of zinc at 0.5, 0.75 and 1.0 per cent on mineral composition of Kinnow was studied. It was found that zinc sprays significantly increased Zn content
which progressively increased with the increased in concentration. The maximum zinc status was attained in 1.0 per cent treatment (Dixit et al., 1979).

Orphanos (1982) observed that soil application of zinc (750 g of ZnSO₄ per tree) with placement in 6 holes recorded maximum zinc in leaf dry matter in apple. In case of foliar sprays, two spring sprays of (0.3 % each) recorded maximum concentration of zinc in leaves. Maximum leaf zinc concentration was recorded with treatment Zn + Cu + Fe (0.5 % each) followed by Zn alone (0.5 %). Similarly, zinc sprays significantly increased the zinc concentration in leaves of Kinnow mandarin (Mann and Sidhu, 1983). Bakhshi et al. (1990) reported that Dithizone and 0.1 N HCL extractable zinc varies from 0.62 to 12.18 ppm and 2.5 to 99.7 ppm, respectively. The maximum concentration of zinc was recorded in 100 g zinc sulphate followed by 50 g zinc sulphate and EDTA treatments. They also recorded the zinc content in leaves which varies from 32.6 to 201.5 ppm. The maximum concentration was found in zinc sulphate 100 g per plant treatment followed by the EDTA treatments. Increasing number of zinc sulphate sprays linearly increased the zinc content of leaves of Trifoliate orange.

The chlorotic symptoms of the leaves are due to the deficiency of micronutrients like zinc and manganese. The leaf content of zinc, iron and manganese was increased correspondingly with the application of zinc sulphate, ferrous sulphate and manganese sulphate either as soil application or foliar spray or combination of both. The maximum leaf zinc content of Sathgudi orange was achieved by soil and foliar application of zinc sulphate at 75 g per tree and 0.5 per cent respectively (Durga et al., 1997). Soil and foliar treatments with zinc concentrations of leaf micronutrients were measured in mango cv. Kensington Pride by Littlemore et al. (2005) in order to determine the best method of
application. Quarterly foliar application was done to maintain leaf zinc content above the critical concentration of 20 mg per kg dry matter. The application of pre bloom + post bloom L-1333, an organic zinc product (500 mg/l) recorded the maximum fruit zinc content in apple (Neilsen et al., 2005). Walworth et al. (2006) observed that zinc application at 28 kg per hectare (28 kg ZnSO₄ + 468 l water + 1.75 l UAN) during spring season increases both leaf tissue zinc concentrations and leaf area of pecans.
Material and Methods
III. MATERIAL AND METHODS

The experiment on growth, yield and quality of Poona fig as influenced by soil and foliar applied ZnSO$_4$ was carried out in the fig orchard of the Horticulture Research Station, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore. The experiment was conducted during September 2007 to April 2008. The details of the material and methods adopted during the investigation are described hereunder.

3.1 Geographical location and climate

The Horticultural Research Station is situated at 12.68° north latitude, 77°35' longitude at an altitude of about 930 m above mean sea level. The average annual rainfall of the area is 953 mm. Minimum and maximum temperature ranged from 12°C to 27°C, relative humidity ranged between 30 and 80 per cent. The soil of the area is red sandy loam with reddish brown colour, deep, well drained with the pH ranged from 5 to 6.

3.2 Selection of orchard

The experiment was carried out during September, 2007 to April, 2008 on three years old Poona fig plants (Plate 1) spaced at 3m x 3m, planted with square system of planting. It was conducted at Division of Horticulture, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore.

3.3 Experimental details

The experiment was conducted by using zinc sulphate. In addition to normal soil application of recommended fertilizers, ZnSO$_4$ was applied to soil and sprayed on foliage at different concentrations.
Plate 1 : View of experimental plot
3.4 Treatment details

T₁: Control (No application of ZnSO₄)

T₂: Soil application of ZnSO₄ 20 g per plant

T₃: Foliar application of ZnSO₄ 1.0 per cent

T₄: Foliar application of ZnSO₄ 1.5 per cent

T₅: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent

T₆: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent

There were five plants per treatment replicated five times by following Randomized Complete Block Design.

The recommended fertilizer dosage for Poona fig as per the UAS package of practice i.e., nitrogen (150 g/plant), phosphorous (100 g/plant) and potassium (100 g/plant) were applied in addition to farm yard manure (25 kg/plant). The actual amount of zinc content in zinc sulphate is 40.49 g per 100 g zinc sulphate.

3.5 Methods of Application

In case of soil application (Plate 3), a depth of 10 cm soil of about 1.5 feet from tree trunk was dug open and applied by mixing with sand and covered with soil. Foliar spraying (Plate 2) was done using Ganesh sprayer. The application was taken up after pruning.

3.6 Observations recorded

Following observations on growth, yield and quality parameters were recorded on each treatment.
Plate 2: Foliar spray of zinc sulphate to ‘Poona’ fig plant

Plate 3: Soil application of zinc sulphate to ‘Poona’ fig plant
3.6.1 Growth parameters

3.6.1.1 Plant height (cm)

The plant height was recorded from ground level to apex of the plant. It was recorded before treatment and at 30, 60 and 90 days after treatment. Then the mean height was calculated by averaging the values of each treatment and expressed in centimeters.

3.6.1.2 Number of leaves per plant

The leaves per plant were counted at 30 days after treatment and the average number of leaves per plant was worked out.

3.6.1.3 Number of branches per plant

Number of branches per plant was recorded at 30 days interval after the treatment. The mean number of branches per plant was calculated.

3.6.1.4 Plant spread (cm²)

Measurement was made in centimeters from four directions from the centre of the plant at 30, 60 and 90 days after treatment and the mean plant spread per plant were calculated.

3.6.1.5 Leaf area of index leaves (cm²)

Three fully matured index leaves (9th leaf) were collected randomly from each treatment and leaf area was measured using portable leaf area meter. Mean individual leaf area (cm²) was calculated by dividing the total area by number of leaves.

3.6.1.6 Leaf chlorophyll content (mg/g leaf)

Chlorophyll was extracted by immersing 100 g of leaf discs collected randomly from three leaves of each treatment using 80 per cent
acetone and DMSO (Dimethyl sulphoxide) 10ml each and left overnight. The extract was used for measuring optical density. The optical density of the extract was measured at three wavelength that is, 645, 652 and 663 nm by using ‘Spectrophotometer’.

Chlorophyll fractions a, b and total were calculated as per the following formula:

\[
\begin{align*}
\text{a) Chlorophyll 'a':} & \quad 12.7(A_{663}) - 2.69(A_{645}) \times \frac{V}{1000 \times FW} \\
\text{b) Chlorophyll 'b':} & \quad 22.9(A_{645}) - 4.68(A_{663}) \times \frac{V}{1000 \times FW} \\
\text{c) Total chlorophyll :} & \quad \frac{(A_{652}) \times V}{34.5 \times FW}
\end{align*}
\]

Where: FW is fresh weight of leaf sample taken
V is volume of extractant
A is absorbance value at different wavelengths

3.6.1.7 SCMR (Spad Chlorophyll Meter Reading)

Spad 502 chlorophyll meter instantly measured the amount of chlorophyll content, a key indicator of plant health. Clamp the meter over leafy tissue and the indexed chlorophyll content reading (0-99.9) was displayed which was recorded.

3.6.2 Yield parameters

3.6.2.1 Number of fruits per plant

The total number of fruits harvested from each plant was counted and expressed as number of fruits per plant.
3.6.2.2 **Average fruit weight (g)**

Average fruit weight was recorded in grams and it was calculated as the total fresh weight of fruits (g) per plant and was divided by the number of fruits per plant.

3.6.2.3 **Fruit yield per plant (kg)**

Fruit yield per plant was obtained by adding the weight of all the fruits harvested from the plant during fruiting period.

3.6.2.4 **Fruit length (cm)**

Length of each fruit from stalk end to the distal end was measured with the help of measuring scale and average length of fruit was worked out for each treatment and expressed in centimeters.

3.6.2.5 **Fruit breadth (cm)**

Breadth of each fruit was measured by using measuring scale and average breadth of fruit was worked out for each treatment and expressed in centimeters.

3.6.2.6 **Fruit shape index (cm²)**

Fruit shape index was worked out for each treatment by multiplying fruit length and fruit breadth. It was measured in centimeter square.

3.6.2.7 **Sensory evaluation of fruit**

Six point scales was used for sensory evaluation. Fig fruits harvested at optimum maturity stages were used for sensory analysis. A panel consisting of twelve judges (Professor and students of post-harvest section, GKVK, UAS, Bangalore) evaluated the samples based on the parameters like shape, skin colour, pulp colour, flavour, taste, aroma,
sweetness, texture and overall acceptability. The scoring technique was done using hedonic scale and is given as follows:

- Dislike extremely 1
- Dislike very much 2
- Dislike moderately 3
- Like moderately 4
- Like very much 5
- Like extremely 6

3.6.2.8 Post harvest of fruit

Fresh weight of individual fruit was recorded in grams. Weight loss was measured by subtracting the consecutive weight of fruit from the fresh weight of fruit. Then the physiological loss in weight was worked out for each treatment and expressed in percentage.

3.6.3 Quality parameters

3.6.3.1 Total soluble solids (°Brix)

The pulp was squeezed and total soluble solids content of juice was determined using hand refractometer having a scale of 0-30 °Brix and expressed as degree brix.

3.6.3.2 Titratable acidity (%)

The titratable acidity of juice was determined by titrating freshly extracted juice against 0.1N sodium hydroxide (NaOH) solution and standardized against acetic acid using phenolphthalein indicator. Titratable acidity was calculated and expressed in terms of grams of acetic acid equivalent in 100 ml of juice.
3.6.3.3 Total sugars (%)

Total sugars in the fruit juice were determined using Lane and Eynon method and sugar content of the juice was expressed in percentage (Ranganna, 1977).

3.6.3.4 Reducing sugars (%)

Twenty grams of fruit pulp was taken and homogenized using mortar and pestle. Pulp was clarified using lead acetate and potassium oxalate and volume was made up to 250 ml and filtered through Whatman No. 4 filter paper. The filtrate was used for estimating reducing sugars by Lane and Eynon method (Ranganna, 1977).

3.6.3.5 Non-reducing sugars (%)

The non-reducing sugars were estimated by removing reducing sugars from total sugars.

3.6.4 Zinc estimation in leaf as well as fruits of Poona fig

The plant and fruit samples of different treatments were collected and dried in the oven at 50°C for about 48 hours. Then the dried samples were ground using the mixture.

3.6.4.1 Sample preparation

The dried samples were ground with the mixture to make a fine powder. Five ml of concentrated nitric acid was added to 5 mg of powdered sample and incubated 5 ml of di acid mixtures (nitric acid: perchloric acid; 10:4) was added to each sample and placed on a hot plate and digested till all the white fumes evaporated and thick white residue was left out in flask. It was allowed to cool and volume was made up to 25 ml using triple distilled water and further dilutions were made if
the concentration of the solution were too high. These diluted solutions were used for zinc estimation.

3.6.4.2 Estimation of zinc

Zinc was estimated in the leaves and fruits using Atomic Absorption Spectrophotometer.

3.6.4.3 Standard

100 ppm standard Zn solution was prepared using 1000 ppm Zn atomic absorption standard solution and appropriate dilutions were made to get standard solution. These standards were fed to Atomic Absorption Spectrophotometer as that of the sample to get standard curve and a standard graph was plotted. To this standard curve, the sample readings were compared and then computed.

3.6.4.4 Protocol

Di acid digested extracts of plant samples were diluted using triple distilled water. The diluted samples were fed to Atomic Absorption Spectrophotometer and zinc concentration was recorded in ppm using standard curve.

3.6.5 Analysis of zinc content in soil

The soil samples were collected from different treatment basins of Poona fig at different depths (15 and 30 cm). The soil samples were air dried and powdered in pestle mortar and passed through 2 mm sieve and stored.

3.6.5.1 Soil sample preparation

About 10 g of soil from each treatment was used for estimation of zinc; 20 ml of DTPA (Diethylene Triamine Penta Acetic Acid) extract was
added to it. The sample was shaken for two hours. Then it was filtered and the filtered sample was used for zinc estimation.

3.6.5.2 Estimation of zinc

Zinc was estimated in the soil using Atomic Absorption Spectrophotometer and expressed in ppm.

3.7 Statistical analysis

Data obtained from the experiments was subjected to statistical analysis by using randomized complete block design, Panse and Sukathme (1978). The F test values were tested at five per cent level of significance.
Experimental Results
IV. EXPERIMENTAL RESULTS

The field experiment was conducted during September, 2007 to April, 2008 at the Horticultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore to study the effect of zinc on growth, yield and quality of Poona fig. The results of the experiment are presented in this chapter.

4.1 Growth parameters

4.1.1 Number of leaves per plant

Number of leaves per plant was significantly influenced by soil and foliar application of ZnSO₄ and presented in Table 1. The treatments were at par and significantly superior over the control. The maximum number of leaves (200, 207 and 211, respectively) was recorded due to soil application of 20 g ZnSO₄ per plant at 30, 60 and 90 days after treatment (DAT) followed by 1.0 per cent ZnSO₄ foliar sprays at 30, 60 and 90 DAT. The lowest number of leaves per plant was recorded in control.

4.1.2 Number of branches per plant

Significant difference in number of branches per plant due to zinc nutrition was observed at 30, 60 and 90 DAT (Table 1). Soil application of 20 g ZnSO₄ per plant (T₂) recorded higher number of branches per plant (84, 87 and 91) which was on par with T₃ treatment (78, 81 and 87) at 30, 60 and 90 DAT respectively.

However the minimum number of branches per plant was recorded in control treatment (60, 63 and 66, respectively).
Table 1. Effect of zinc on number of leaves and number of branches per plant in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>30 DAT</th>
<th>60 DAT</th>
<th>90 DAT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of leaves</td>
<td>No. of branches</td>
<td>No. of leaves</td>
</tr>
<tr>
<td>T1</td>
<td>92 $^f$</td>
<td>60 $^e$</td>
<td>99 $^f$</td>
</tr>
<tr>
<td>T2</td>
<td>200 $^a$</td>
<td>84 $^a$</td>
<td>207 $^a$</td>
</tr>
<tr>
<td>T3</td>
<td>175 $^b$</td>
<td>78 $^b$</td>
<td>184 $^b$</td>
</tr>
<tr>
<td>T4</td>
<td>158 $^c$</td>
<td>69 $^c$</td>
<td>165 $^c$</td>
</tr>
<tr>
<td>T5</td>
<td>155 $^d$</td>
<td>68 $^c$</td>
<td>163 $^d$</td>
</tr>
<tr>
<td>T6</td>
<td>141 $^e$</td>
<td>62 $^d$</td>
<td>147 $^e$</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SEM±</td>
<td>0.22</td>
<td>0.40</td>
<td>0.28</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>0.66</td>
<td>1.17</td>
<td>0.83</td>
</tr>
</tbody>
</table>

*: Significant at 5 %  
DAT: Days after treatment

Note: Means with the same superscript are not statistically significant

T1: Control (No application of ZnSO$_4$)
T2: Soil application of ZnSO$_4$ 20 g per plant
T3: Foliar application of ZnSO$_4$ 1.0 per cent
T4: Foliar application of ZnSO$_4$ 1.5 per cent
T5: Soil application of ZnSO$_4$ 20 g per plant along with foliar application of ZnSO$_4$ 1.0 per cent
T6: Soil application of ZnSO$_4$ 20 g per plant along with foliar application of ZnSO$_4$ 1.5 per cent
4.1.3 Leaf area of three index leaves (cm²)

The leaf area varied significantly with zinc application in Poona fig and the data’s are presented in Table 2 and Fig. 1. All the treatments were significantly superior over the control. The maximum leaf area was recorded in the treatment T₂ (357.90 cm², 349.40 cm² and 339.50 cm² respectively) as soil application of 20 g ZnSO₄ per plant followed by the treatment T₃ (342.50 cm², 337.60 cm² and 331.70 cm² respectively) as foliar application of 1.0 per cent ZnSO₄ at 90, 60 and 30 DAT. However, the minimum leaf area was recorded in the control (247 cm², 247.90 cm² and 232.20 cm²) at 90, 60 and 30 DAT respectively.

4.1.4 Plant height (m)

The plant height differs significantly among the treatments (Table 3) at all the stages of crop growth. Soil application of 20 g ZnSO₄ per plant (T₂) recorded maximum plant height at 30, 60 and 90 DAT (2.18m, 2.20m and 2.21 m, respectively). The minimum plant height was recorded in control treatment (T₁) at 30, 60 and 90 DAT (2.00m, 2.02m and 2.04 m, respectively) which was on par with treatment T₄ of 1.5 per cent ZnSO₄ foliar sprays.

4.1.5 Plant spread (m²)

Plant spread differs significantly due to zinc application (Table 3). The maximum plant spread (4.66, 4.79 and 4.84 m²) was recorded in plants treated with soil application of 20 g ZnSO₄ per plant (T₂) followed by (T₃) 1.0 per cent ZnSO₄ as foliar application. However, minimum plant spread (2.56, 2.60 and 2.65 m²) at 30, 60 and 90 DAT respectively was recorded in control treatment.
Table 2. Effect of zinc on index leaf area (9th leaf from top) at different stages of plant growth in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Index leaf area (cm²)</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 DAT</td>
<td>60 DAT</td>
<td>90 DAT</td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td>232.20 c</td>
<td>247.90 c</td>
<td>247.00 c</td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td>339.50 a</td>
<td>349.40 a</td>
<td>357.90 a</td>
<td></td>
</tr>
<tr>
<td>T₃</td>
<td>331.70 ab</td>
<td>337.60 ab</td>
<td>342.50 a</td>
<td></td>
</tr>
<tr>
<td>T₄</td>
<td>291.90 ab</td>
<td>295.30 ab</td>
<td>297.70 ab</td>
<td></td>
</tr>
<tr>
<td>T₅</td>
<td>297.60 ab</td>
<td>299.70 ab</td>
<td>302.00 a</td>
<td></td>
</tr>
<tr>
<td>T₆</td>
<td>256.70 bc</td>
<td>264.80 bc</td>
<td>286.00 bc</td>
<td></td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>SEm±</td>
<td>24.91</td>
<td>24.93</td>
<td>22.40</td>
<td></td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>73.49</td>
<td>73.55</td>
<td>66.09</td>
<td></td>
</tr>
</tbody>
</table>

*: Significant at 5 %  
DAT: Days after treatment  
Note: Means with the same superscript are not statistically significant

T₁ : Control (No application of ZnSO₄)  
T₂ : Soil application of ZnSO₄ 20 g per plant  
T₃ : Foliar application of ZnSO₄ 1.0 per cent  
T₄ : Foliar application of ZnSO₄ 1.5 per cent  
T₅ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent  
T₆ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
Fig. 1: Effect of zinc sulphate on leaf area at different stages of growth in 'Poona' fig

- T1 - Control
- T2 - 20 g ZnSO₄/pl
- T3 - 1.0 % ZnSO₄
- T4 - 1.5 % ZnSO₄
- T5 - 20 g ZnSO₄/pl + 1.0 % ZnSO₄
- T6 - 20 g ZnSO₄/pl + 1.5 % ZnSO₄

Leaf area (cm²)

Fig. 1: Effect of zinc sulphate on leaf area at different stages of growth in 'Poona' fig
Table 3. Effect of zinc on plant height and plant spread in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>30 DAT Plant height (m)</th>
<th>Plant spread (m²)</th>
<th>60 DAT Plant height (m)</th>
<th>Plant spread (m²)</th>
<th>90 DAT Plant height (m)</th>
<th>Plant spread (m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>2.00 d</td>
<td>2.56 f</td>
<td>2.02 d</td>
<td>2.60 f</td>
<td>2.04 d</td>
<td>2.65 f</td>
</tr>
<tr>
<td>T₂</td>
<td>2.18 a</td>
<td>4.66 a</td>
<td>2.20 a</td>
<td>4.79 a</td>
<td>2.21 a</td>
<td>4.84 a</td>
</tr>
<tr>
<td>T₃</td>
<td>2.13 b</td>
<td>4.27 b</td>
<td>2.15 a</td>
<td>4.35 b</td>
<td>2.19 ab</td>
<td>4.38 b</td>
</tr>
<tr>
<td>T₄</td>
<td>2.04 c</td>
<td>3.20 e</td>
<td>2.07 c</td>
<td>3.25 e</td>
<td>2.10 c</td>
<td>3.30 e</td>
</tr>
<tr>
<td>T₅</td>
<td>2.09 c</td>
<td>3.51 d</td>
<td>2.11 b</td>
<td>3.58 d</td>
<td>2.15 bc</td>
<td>3.64 d</td>
</tr>
<tr>
<td>T₆</td>
<td>2.11 b</td>
<td>3.88 c</td>
<td>2.13 b</td>
<td>3.90 c</td>
<td>2.17 ab</td>
<td>3.95 c</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
<td>0.02</td>
<td>0.06</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>0.07</td>
<td>0.04</td>
<td>0.06</td>
<td>0.03</td>
<td>0.05</td>
<td>0.19</td>
</tr>
</tbody>
</table>

*: Significant at 5 %  
DAT: Days after treatment

Note: Means with the same superscript are not statistically significant

T₁ : Control (No application of ZnSO₄)  
T₂ : Soil application of ZnSO₄ 20 g per plant  
T₃ : Foliar application of ZnSO₄ 1.0 per cent  
T₄ : Foliar application of ZnSO₄ 1.5 per cent  
T₅ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent  
T₆ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
4.2 Leaf chlorophyll content

The results of leaf chlorophyll content (SCM Reading) in Poona fig are presented in Table 4. Zinc nutrition significantly affected chlorophyll content in leaf. Soil application of 20 g ZnSO₄ per plant (T₂) recorded higher chlorophyll content in leaf (53.05 spad unit) which was on par with the treatment T₆ (51.32 spad unit), T₅ (50.09 spad unit) and T₃ (48.61 spad unit). However, the minimum chlorophyll content in leaf was recorded in the control treatment (37.29 spad unit).

Also, the variation in leaf total chlorophyll, chlorophyll ‘a’ and chlorophyll ‘b’ fractions was influenced by different levels of ZnSO₄ (Table 4).

4.2.1 Chlorophyll ‘a’ content (mg/g)

Significant differences in leaf chlorophyll ‘a’ content due to zinc nutrition was observed among the treatments and all the treatments were significantly superior over the control. The maximum leaf chlorophyll ‘a’ content was observed (Table 4) in soil application of 20 g ZnSO₄ per plant (1.98 mg/g) followed by soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (1.90 mg/g).

However, the minimum leaf chlorophyll ‘a’ content was recorded in control (1.61 mg/g).

4.2.2 Chlorophyll ‘b’ content (mg/g)

The leaf chlorophyll ‘b’ content as influenced by ZnSO₄ application in Poona fig is presented in Table 4. The chlorophyll ‘b’ content varied significantly among the treatments. The maximum chlorophyll ‘b’ content (0.97 mg/g) was recorded in soil application of 20 g ZnSO₄ per plant (T₂) followed by (T₆) soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (0.87 mg/g). The minimum chlorophyll ‘b’ content was recorded in control treatment (0.55 mg/g).
Table 4. Effect of zinc on leaf chlorophyll content in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>SCMR (spad unit)</th>
<th>Chlorophyll ‘a’ (mg/g leaf)</th>
<th>Chlorophyll ‘b’ (mg/g leaf)</th>
<th>Total Chlorophyll (mg/g leaf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>37.29 c</td>
<td>1.61 f</td>
<td>0.55 f</td>
<td>2.34 c</td>
</tr>
<tr>
<td>T2</td>
<td>53.05 a</td>
<td>1.98 a</td>
<td>0.97 a</td>
<td>2.62 a</td>
</tr>
<tr>
<td>T3</td>
<td>48.61 ab</td>
<td>1.85 c</td>
<td>0.71 d</td>
<td>2.47 b</td>
</tr>
<tr>
<td>T4</td>
<td>47.08 b</td>
<td>1.71 e</td>
<td>0.63 e</td>
<td>2.37 cb</td>
</tr>
<tr>
<td>T5</td>
<td>50.09 ab</td>
<td>1.79 d</td>
<td>0.79 c</td>
<td>2.52 ab</td>
</tr>
<tr>
<td>T6</td>
<td>51.32 ab</td>
<td>1.90 b</td>
<td>0.87 b</td>
<td>2.54 ab</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SEM±</td>
<td>1.76</td>
<td>0.01</td>
<td>0.01</td>
<td>0.06</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>5.18</td>
<td>0.03</td>
<td>0.04</td>
<td>0.17</td>
</tr>
</tbody>
</table>

*: Significant at 5 %

Note: Means with the same superscript are not statistically significant

T1 : Control (No application of ZnSO₄)
T2 : Soil application of ZnSO₄ 20 g per plant
T3 : Foliar application of ZnSO₄ 1.0 per cent
T4 : Foliar application of ZnSO₄ 1.5 per cent
T5 : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent
T6 : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
4.2.3 Total chlorophyll content (mg/g)

The leaf total chlorophyll content varied significantly among different treatments and was superior over the control. Soil application of 20 g ZnSO₄ per plant recorded the maximum total leaf chlorophyll content (2.62 mg/g) followed by soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (2.54 mg/g) which is on par with T₅. Whereas the minimum leaf total chlorophyll content was recorded in the control (2.34 mg/g).

4.3 Yield parameters

4.3.1 Number of fruits per plant

The soil and foliar applied ZnSO₄ had significant influence on the number of fruits per plant among different treatments in Poona fig (Table 5). The maximum number of fruits (32.60) per plant was observed in soil application of 20 g ZnSO₄ per plant (T₂) whereas minimum number of fruits (11.00) per plant was recorded in control (T₁).

4.3.2 Average fruit weight (g)

The influence of ZnSO₄ on average fruit weight was not significant among the treatments with soil and foliar application in Poona fig and is presented in Table 5. The maximum average fruit weight (27.55 g) was observed in soil application of 20 g ZnSO₄ per plant (T₂). However, the minimum average fruit weight (17.23 g) was observed in the treatment T₁ (control).

4.3.3 Yield per plant (kg)

Significant differences were noticed in yield per plant among all the treatments in soil and foliar applied ZnSO₄ in Poona fig (Table 5 and Fig. 2).
Table 5. Effect of zinc on yield characters of Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of fruits per plant</th>
<th>Average fruit weight (g)</th>
<th>Yield per plant (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>11.00 b</td>
<td>17.23</td>
<td>1.75 e</td>
</tr>
<tr>
<td>T₂</td>
<td>32.60 a</td>
<td>27.55</td>
<td>5.86 a</td>
</tr>
<tr>
<td>T₃</td>
<td>19.00 ab</td>
<td>24.75</td>
<td>4.64 c</td>
</tr>
<tr>
<td>T₄</td>
<td>17.80 ab</td>
<td>23.17</td>
<td>4.57 d</td>
</tr>
<tr>
<td>T₅</td>
<td>16.00 ab</td>
<td>21.95</td>
<td>4.53 d</td>
</tr>
<tr>
<td>T₆</td>
<td>21.80 ab</td>
<td>25.93</td>
<td>5.76 b</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>NS</td>
<td>*</td>
</tr>
<tr>
<td>SEM±</td>
<td>5.76</td>
<td>1.99</td>
<td>0.01</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>16.99</td>
<td>-</td>
<td>0.04</td>
</tr>
</tbody>
</table>

*: Significant at 5 %; NS: Non-significant

Note: Means with the same superscript are not statistically significant

T₁ : Control (No application of ZnSO₄)
T₂ : Soil application of ZnSO₄ 20 g per plant
T₃ : Foliar application of ZnSO₄ 1.0 per cent
T₄ : Foliar application of ZnSO₄ 1.5 per cent
T₅ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent
T₆ : Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
Fig. 2: Effect of zinc sulphate on yield of 'Poona' fig

- T1 - Control
- T2 - 20 g ZnSO₄/pl
- T3 - 1.0 % ZnSO₄
- T4 - 1.5 % ZnSO₄
- T5 - 20 g ZnSO₄/pl + 1.0 % ZnSO₄
- T6 - 20 g ZnSO₄/pl + 1.5 % ZnSO₄
The highest yield per plant (5.86 kg) was recorded in soil application of 20 g ZnSO₄ per plant which was followed by soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (5.76 kg). The minimum yield per plant (1.75 kg) was observed in control (T1).

4.3.4 Length of fruit (cm)

The data on length of fruit in Poona fig are depicted in Table 6 and Fig. 3. The length of fruit varied significantly among the treatments due to zinc nutrition. The maximum length of fruit (4.24 cm) was recorded in soil application (Plate 5) of 20 g ZnSO₄ per plant (T2) followed by the treatment T6 (4.15 cm). The minimum length (Plate 4) of fruit (3.64 cm) was recorded in the control treatment (T1).

4.3.5 Breadth of fruit (cm)

The breadth of fruit in Poona fig as influenced by soil and foliar applied ZnSO₄ at different concentration was differed significantly among the treatments (Table 6 and Fig. 3).

The maximum breadth of fruit (2.88 cm) was recorded in soil application of 20 g ZnSO₄ per plant (T2) followed by the treatment T6 (2.83 cm) of soil application 20 g ZnSO₄ per plant with foliar application 1.5 per cent ZnSO₄ and on par with T3 (2.82 cm). The minimum breadth of fruit (2.51 cm) was recorded in the control treatment (T1).

4.3.6 Fruit shape index (cm²)

Fruit shape index was significantly influenced by the zinc sulphate application in Poona fig (Table 6 and Fig. 3). The maximum fruit shape index (12.21 cm²) was observed in soil application of 20 g ZnSO₄ per plant (T2) followed by (11.75 cm²) soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (T6). However, the minimum fruit shape index (9.14 cm²) was observed in control (T1).
Table 6. Effect of zinc on fruit characters of Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Length of fruit (cm)</th>
<th>Breadth of fruit (cm)</th>
<th>Fruit shape index (cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;</td>
<td>3.64&lt;sup&gt;f&lt;/sup&gt;</td>
<td>2.51&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.14&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;</td>
<td>4.24&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.88&lt;sup&gt;a&lt;/sup&gt;</td>
<td>12.21&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;</td>
<td>4.03&lt;sup&gt;c&lt;/sup&gt;</td>
<td>2.82&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11.36&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;</td>
<td>3.84&lt;sup&gt;e&lt;/sup&gt;</td>
<td>2.69&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>10.33&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;</td>
<td>3.92&lt;sup&gt;d&lt;/sup&gt;</td>
<td>2.54&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>9.96&lt;sup&gt;e&lt;/sup&gt;</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;</td>
<td>4.15&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.83&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>11.74&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.02</td>
<td>0.10</td>
<td>0.02</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>0.06</td>
<td>0.30</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*: Significant at 5 %

Note: Means with the same superscript are not statistically significant

T<sub>1</sub>: Control (No application of ZnSO₄)
T<sub>2</sub>: Soil application of ZnSO₄ 20 g per plant
T<sub>3</sub>: Foliar application of ZnSO₄ 1.0 per cent
T<sub>4</sub>: Foliar application of ZnSO₄ 1.5 per cent
T<sub>5</sub>: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent
T<sub>6</sub>: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
Fig. 3: Effect of zinc sulphate on fruit characters in 'Poona' Fig

- T1: Control
- T2: 20 g ZnSO\(_4\)/pl
- T3: 1% ZnSO\(_4\)
- T4: 1.5% ZnSO\(_4\)
- T5: 20 g ZnSO\(_4\)/pl+1% ZnSO\(_4\)
- T6: 20 g ZnSO\(_4\)/pl+1.5% ZnSO\(_4\)
Plate 4: Fruit of ‘Poona’ fig in control and treated with 20 g zinc sulphate per plant as soil application

Plate 5: Fruits of ‘Poona’ fig as influenced by soil application of 20 g zinc sulphate per plant
4.4 Quality parameters

4.4.1 Total soluble solids (°Brix)

Total soluble solids content of the fruit was significantly influenced by the soil and foliar applied ZnSO₄ in Poona fig (Table 7 and Fig. 4). The maximum total soluble solids content (16.40 °Brix) was recorded in soil application of 20 g ZnSO₄ per plant (T₂) followed by (T₆) soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (16.20 °Brix). The minimum total soluble solids (12.20 °Brix) was recorded in control (T₁).

4.4.2 Titratable acidity (%)

Titratable acidity of juice extracted has shown significant difference among the soil and foliar applied ZnSO₄ and is presented in Table 7 and Fig. 4. The minimum titratable acidity (0.34%) was observed in soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (T₆) followed by the treatment T₂ (0.56%). The maximum titratable acidity (0.65%) was observed in the control (T₁).

4.4.3 Total sugars (%)

Total sugar content of the fruit was significantly influenced by the soil and foliar applied ZnSO₄ in Poona fig (Table 7 and Fig. 4). The maximum total sugar (17.29%) was recorded in soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (T₆) followed by the treatment T₃ (16.98%). The minimum total sugar was recorded in the treatment T₁ (14.70%) in control.

4.4.4 Reducing sugars (%)

The reducing sugar differed significantly among the treatments and it was more in soil with foliar application treatment compared to soil application alone or foliar application alone of ZnSO₄ in Poona fig (Table 7 and Fig. 4).
Table 7. Effect of zinc on quality parameters of Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>TSS (°Brix)</th>
<th>Acidity (%)</th>
<th>Total sugars (%)</th>
<th>Reducing sugars (%)</th>
<th>Non-reducing sugars (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>12.20 f</td>
<td>0.65 c</td>
<td>14.70 d</td>
<td>12.75 d</td>
<td>1.95 c</td>
</tr>
<tr>
<td>T₂</td>
<td>16.40 a</td>
<td>0.56 b</td>
<td>16.92 bc</td>
<td>14.10 ab</td>
<td>2.82 b</td>
</tr>
<tr>
<td>T₃</td>
<td>14.20 d</td>
<td>0.63 bc</td>
<td>16.98 bc</td>
<td>13.83 b</td>
<td>3.15 a</td>
</tr>
<tr>
<td>T₄</td>
<td>13.20 e</td>
<td>0.63 bc</td>
<td>16.84 c</td>
<td>13.63 c</td>
<td>3.21 a</td>
</tr>
<tr>
<td>T₅</td>
<td>14.60 c</td>
<td>0.57 b</td>
<td>16.84 c</td>
<td>13.56 c</td>
<td>2.98 ab</td>
</tr>
<tr>
<td>T₆</td>
<td>16.20 b</td>
<td>0.34 a</td>
<td>17.29 a</td>
<td>14.31 a</td>
<td>3.28 a</td>
</tr>
</tbody>
</table>

F-test * * * * *

SEm± 0.06 0.02 0.14 0.16 0.14

CD at 5 % 0.18 0.07 0.42 0.46 0.41

*: Significant at 5 %

Note: Means with the same superscript are not statistically significant

T₁ : Control (No application of ZnSO₄)
T₂ : Soil application of ZnSO₄ 20 g per plant
T₃ : Foliar application of ZnSO₄ 1.0 per cent
T₄ : Foliar application of ZnSO₄ 1.5 per cent
T₅ : Soil application of ZnSO₄ 20 g per plant along with foliar
     application of ZnSO₄ 1.0 per cent
T₆ : Soil application of ZnSO₄ 20 g per plant along with foliar
     application of ZnSO₄ 1.5 per cent
Fig. 4: Effect of zinc sulphate on quality parameters of 'Poona' fig

Legend:
- **TSS (0Brix)**
- **Acidity (%)**
- **Total sugars (%)**
- **Reducing sugars (%)**
- **Non-reducing sugars (%)**

Treatments:
- T₁ - Control
- T₂ - 20 g ZnSO₄/pl
- T₃ - 1.0 % ZnSO₄
- T₄ - 1.5 % ZnSO₄
- T₅ - 20 g ZnSO₄/pl+1.0 % ZnSO₄
- T₆ - 20 g ZnSO₄/pl+1.5 % ZnSO₄
The highest percentage of reducing sugar (14.31%) was observed in soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application which was on par with treatment T₂ (14.10%). The lowest reducing sugar was observed in treatment T₁ (12.75%) in control.

4.4.5 Non-reducing sugars (%)

The content of non-reducing sugar had shown significant differences among the different treatments tried in Poona fig with soil and foliar applied ZnSO₄ (Table 7 and Fig. 4). The highest non-reducing sugar (3.28%) was found in soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (T₆) which was on par with T₄ (3.21%) and T₃ (3.15%). However, the minimum non-reducing sugar was recorded in the treatment T₁ (1.95%) in control.

4.5 Post-harvest parameters

4.5.1 Weight loss (g)

Significant differences were noticed in weight loss of fruit among all the treatments in soil and foliar applied ZnSO₄ in Poona fig (Table 8). The minimum weight loss of fruit on 4th day (9 g) was observed in the treatment (T₆) of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (Plate 7) which was followed by the treatment T₃ (10 g) and T₂ (11.5 g). The maximum weight loss of fruit on 4th day (15.5 g) was observed in control treatment (Plate 6).

4.5.2 Physiological loss in weight (PLW %)

Physiological loss in weight of the fruit was significantly influenced by the zinc sulphate application in Poona fig (Table 8). The minimum physiological loss in weight of fruit on 4th day was recorded in the treatment T₆ (28.85 %) of 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays followed by soil application 20 g ZnSO₄ per plant (T₂).
Table 8. Effect of zinc on weight loss (WL) and physiological loss in weight (PLW) of Poona fig fruits during storage.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>0 day (IFW)</th>
<th>1st day</th>
<th>2nd day</th>
<th>3rd day</th>
<th>4th day</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WL (g)</td>
<td>PLW (%)</td>
<td>WL (g)</td>
<td>PLW (%)</td>
<td>WL (g)</td>
</tr>
<tr>
<td>T1</td>
<td>21.0</td>
<td>6.0&lt;sup&gt;d&lt;/sup&gt;</td>
<td>28.57&lt;sup&gt;c&lt;/sup&gt;</td>
<td>11.0&lt;sup&gt;d&lt;/sup&gt;</td>
<td>52.38&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>T2</td>
<td>38.5</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.79&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.48&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>T3</td>
<td>32.7</td>
<td>2.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.64&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>21.41&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>T4</td>
<td>35.0</td>
<td>4.0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>11.43&lt;sup&gt;b&lt;/sup&gt;</td>
<td>6.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>17.14&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>T5</td>
<td>30.5</td>
<td>5.0&lt;sup&gt;c&lt;/sup&gt;</td>
<td>16.39&lt;sup&gt;c&lt;/sup&gt;</td>
<td>9.5&lt;sup&gt;c&lt;/sup&gt;</td>
<td>31.15&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td>T6</td>
<td>31.2</td>
<td>3.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>9.62&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>22.44&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>SEM±</td>
<td>0.77</td>
<td>0.41</td>
<td>1.03</td>
<td>0.50</td>
<td>1.18</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>2.26</td>
<td>1.20</td>
<td>3.05</td>
<td>1.49</td>
<td>3.48</td>
</tr>
</tbody>
</table>

*: Significant at 5 %  
IFW: Initial Fresh Weight

Note: Means with the same superscript are not statistically significant

T1: Control (No application of ZnSO₄)
T2: Soil application of ZnSO₄ 20 g per plant
T3: Foliar application of ZnSO₄ 1.0 per cent
T4: Foliar application of ZnSO₄ 1.5 per cent
T5: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.0 per cent
T6: Soil application of ZnSO₄ 20 g per plant along with foliar application of ZnSO₄ 1.5 per cent
Plate 6: Control

Plate 7: 20 g zinc sulphate per plant soil application in combination with 1.5 per cent zinc sulphate foliar spray

Poona fig fruits on 4th day during storage
The maximum physiological loss in weight of fruit on 4th day (78.81 %) was recorded in control treatment (T₁).

4.6 Sensory evaluation

The data on shape, skin colour, flavour, taste, aroma, pulp colour, sweetness, texture and overall acceptability of Poona fig fruit are given in Table 9. Differences in pulp colour (Plate 8 and 9), texture and overall acceptability due to zinc nutrition are not statistically significant. However, shape, skin colour, flavour, taste, aroma and sweetness of fruit were significantly influenced by zinc nutrition.

The highest score of shape, skin colour and flavour of fruit was observed in (T₆) wherein, soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (4.78, 5.00, and 4.78, respectively) whereas, the lowest score (3.50, 3.56 and 3.55, respectively) was observed in the control treatment (T₁).

The maximum score of taste (5.33), aroma (4.16) and sweetness (5.33) of fruit was recorded in (T₂) soil application of 20 g ZnSO₄ per plant while minimum score was recorded in control treatment (T₁).

4.7 Leaf zinc content

Leaf zinc content varied significantly in different treatments with soil and foliar applied ZnSO₄ and is presented in Table 10 and Fig. 5. The leaf zinc content was recorded highest (68.50 ppm) on soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ as foliar sprays (T₆) followed by the treatment T₂ (58.40 ppm) of soil applied ZnSO₄ at 20 g per plant. The least content of zinc in leaf was recorded in control treatment (54.60 ppm).
Table 9. Effect of zinc on sensory evaluation of fruit in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Shape</th>
<th>Skin colour</th>
<th>Flavour</th>
<th>Taste</th>
<th>Aroma</th>
<th>Pulp colour</th>
<th>Sweetness</th>
<th>Texture</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>3.50</td>
<td>3.56</td>
<td>3.55</td>
<td>3.33</td>
<td>3.14</td>
<td>4.00</td>
<td>3.71</td>
<td>3.50</td>
<td>3.44</td>
</tr>
<tr>
<td>T2</td>
<td>4.71</td>
<td>4.67</td>
<td>4.71</td>
<td>5.33</td>
<td>4.16</td>
<td>4.78</td>
<td>5.33</td>
<td>4.50</td>
<td>5.22</td>
</tr>
<tr>
<td>T3</td>
<td>4.13</td>
<td>4.67</td>
<td>4.00</td>
<td>5.00</td>
<td>4.14</td>
<td>4.71</td>
<td>4.37</td>
<td>4.43</td>
<td>4.13</td>
</tr>
<tr>
<td>T4</td>
<td>3.52</td>
<td>4.44</td>
<td>3.88</td>
<td>3.44</td>
<td>3.14</td>
<td>4.11</td>
<td>3.89</td>
<td>3.57</td>
<td>3.62</td>
</tr>
<tr>
<td>T5</td>
<td>4.00</td>
<td>4.11</td>
<td>3.71</td>
<td>3.75</td>
<td>3.83</td>
<td>4.33</td>
<td>3.89</td>
<td>3.80</td>
<td>3.67</td>
</tr>
<tr>
<td>T6</td>
<td>4.78</td>
<td>5.00</td>
<td>4.78</td>
<td>4.25</td>
<td>3.86</td>
<td>4.95</td>
<td>4.55</td>
<td>3.87</td>
<td>4.37</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>NS</td>
<td>*</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.08</td>
<td>0.23</td>
<td>0.33</td>
<td>0.33</td>
<td>0.28</td>
<td>0.44</td>
<td>0.39</td>
<td>0.42</td>
<td>0.50</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>0.23</td>
<td>0.69</td>
<td>0.98</td>
<td>0.97</td>
<td>0.84</td>
<td>-</td>
<td>1.15</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*: Significant at 5 %

Hedonic scale (6):
Dislike extremely - 1  Dislike very much - 2  Dislike moderately - 3
Like moderately - 4  Like very much - 5  Like extremely - 6

Note: Means with the same superscript are not statistically significant
T1: Control (No application of ZnSO4)
T2: Soil application of ZnSO4 20 g per plant
T3: Foliar application of ZnSO4 1.0 per cent
T4: Foliar application of ZnSO4 1.5 per cent
T5: Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.0 per cent
T6: Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.5 per cent
Plate 8: Control

Plate 9: 20 g zinc sulphate per plant as soil application

Cross section of ‘Poona’ fig fruits
4.8 Fruit zinc content

Zinc content in the fruit varied significantly among the treatments in soil and foliar applied ZnSO₄ (Table 10 and Fig. 5). The maximum zinc content (101.50 ppm) in the fruit was due to treatment (T₆) soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ as foliar sprays followed by the treatment T₂ (83.50 ppm) of soil applied ZnSO₄ at 20 g per plant. The minimum zinc content (47.33 ppm) was recorded in control (T₁).

4.9 Soil zinc content

The soil zinc content in the experimental plot was differed significantly among the treatments (Table 10 and Fig. 5). The soil zinc content was significantly higher in soil applied ZnSO₄ treatment than the foliar treatments. The highest zinc content was recorded in the treatment (T₂) of 20 g ZnSO₄ per plant soil application (3.16 and 2.86 ppm) in 0-15 cm and 15-30 cm depths which was followed by treatment T₆ (2.34 and 1.71 ppm). The minimum zinc content (0.67 and 0.63 ppm) was observed in the control treatment (T₁).

4.10 Cost economics

The data on cost economics of Poona fig treated with ZnSO₄ is presented in Table 11. The highest cost benefit ratio of (1:1.03) was recorded in the treatment (T₂) of 20 g ZnSO₄ per plant soil application. Also, maximum net returns (35632 Rs/ha) was observed in the same treatment. The next best cost benefit and net returns were found in the treatment T₆ (1:0.95 and 33603 Rs/ha). However, the minimum cost benefit ratio (1:0.01) and net returns (443 Rs/ha) were observed in control treatment (T₁).
Table 10. Zinc content of leaf, fruit and soil as influenced by zinc sulphate application in Poona fig.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Zinc content (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Leaf</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>54.60 f</td>
</tr>
<tr>
<td>T2</td>
<td>58.40 b</td>
</tr>
<tr>
<td>T3</td>
<td>54.70 e</td>
</tr>
<tr>
<td>T4</td>
<td>55.67 d</td>
</tr>
<tr>
<td>T5</td>
<td>56.25 c</td>
</tr>
<tr>
<td>T6</td>
<td>68.50 a</td>
</tr>
<tr>
<td>F-test</td>
<td>*</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.02</td>
</tr>
<tr>
<td>CD at 5 %</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*: Significant at 5%

Note: Means with the same superscript are not statistically significant

T1 : Control (No application of ZnSO4)
T2 : Soil application of ZnSO4 20 g per plant
T3 : Foliar application of ZnSO4 1.0 per cent
T4 : Foliar application of ZnSO4 1.5 per cent
T5 : Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.0 per cent
T6 : Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.5 per cent
Fig. 5: Zinc status in leaf, fruit and soil due to zinc sulphate application in 'Poona' fig at harvest
<table>
<thead>
<tr>
<th>Treatments</th>
<th>Total yield (t/ha)</th>
<th>Total cost of cultivation (Rs/ha)</th>
<th>Gross returns (Rs/ha)</th>
<th>Net returns (Rs/ha)</th>
<th>Cost benefit ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>1.1 d</td>
<td>32557 d</td>
<td>33000 d</td>
<td>443 f</td>
<td>1:0.01 d</td>
</tr>
<tr>
<td>T2</td>
<td>2.34 a</td>
<td>34568 b</td>
<td>70200 a</td>
<td>35632 a</td>
<td>1:1.03 a</td>
</tr>
<tr>
<td>T3</td>
<td>1.86 b</td>
<td>33464 c</td>
<td>55800 b</td>
<td>22336 c</td>
<td>1:0.67 b</td>
</tr>
<tr>
<td>T4</td>
<td>1.83 bc</td>
<td>33477 c</td>
<td>54900 bc</td>
<td>21423 d</td>
<td>1:0.64 b</td>
</tr>
<tr>
<td>T5</td>
<td>1.81 c</td>
<td>35384 a</td>
<td>54300 bc</td>
<td>18916 e</td>
<td>1:0.53 c</td>
</tr>
<tr>
<td>T6</td>
<td>2.30 a</td>
<td>35397 a</td>
<td>69000 a</td>
<td>33603 b</td>
<td>1:0.95 a</td>
</tr>
</tbody>
</table>

| F-test     | *                  | *                                | *                    | *                 | *                 |
| SEm±       | 0.02               | 48.44                            | 1334.06              | 65.89             | 0.03              |
| CD at 5 %  | 0.04               | 142.90                           | 3935.56              | 194.41            | 0.09              |

*: Significant at 5 %; NS: Non-significant

Note: Price per kg of fruit is Rs. 30

Means with the same superscript are not statistically significant

T1 : Control (No application of ZnSO4)
T2 : Soil application of ZnSO4 20 g per plant
T3 : Foliar application of ZnSO4 1.0 per cent
T4 : Foliar application of ZnSO4 1.5 per cent
T5 : Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.0 per cent
T6 : Soil application of ZnSO4 20 g per plant along with foliar application of ZnSO4 1.5 per cent
application. The results are in conformity with those of Smith (1967) in Valencia orange and Bakhshi et al. (1990) in Trifoliate orange.

Among the treatments, the plants treated with 20 g ZnSO₄ per plant soil application recorded higher leaf area (357.90 cm²) followed by 1.0 per cent ZnSO₄ foliar spray at 90 days after treatment. The increase in leaf area may be due to foliar spraying of nutrients that might have translocated to the leaves and due to quick absorption which have resulted in high photosynthetic activity causing more active cell division and cell differentiation and expansion of leaf. The enhancing effect of nutrient sprays was supported by the results of Sindhu et al. (2000) in Perlette grapes. Similar results concerning the effect of spraying ZnSO₄ was reported by Surender Singh and Ahlawat (1996) in ber.

The leaf chlorophyll content was significantly influenced by soil application and foliar sprays of ZnSO₄. The maximum total chlorophyll content (2.62 mg/g), chlorophyll ‘a’ content (1.98 mg/g) and chlorophyll ‘b’ content (0.97 mg/g) were recorded in 20 g ZnSO₄ per plant soil application (T₂) followed by the treatment (T₆) 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprayed treatment. This might be due to the role of zinc in chlorophyll synthesis. These observations are in conformity with those of Bakhshi et al. (1990) in Trifoliate orange, Kavitha et al. (2000) in papaya and Sindhu et al. (2000) in Perlette grapes.

The soil application of ZnSO₄ was better than the foliar application in improving the growth characteristics which revealed that 20 g ZnSO₄ per plant through soil application was most ideal to have better plant growth in Poona fig.
Discussion
V. DISCUSSION

The investigation on growth, yield and quality parameters as influenced by soil and foliar application of ZnSO$_4$ on Poona fig was carried out at the Horticultural Research Station, Gandhi Krishi Vignana Kendra, University of Agricultural Sciences, Bangalore. The significant effects of soil and foliar applied ZnSO$_4$ are discussed here under based on the available information and scientific reasoning.

5.1 Growth parameters

The plant height, plant spread, number of branches and number of leaves of Poona fig was found to be significantly more due to soil treated ZnSO$_4$ rather than the foliar application of ZnSO$_4$. Similar results were observed by Saraswathy et al. (2004) in sapota cv. PKM-1. The increase in growth parameters may be due to rapid uptake, translocation and assimilation of zinc which in turn resulted in higher vegetative growth.

The maximum plant height was observed in the treatment 20 g ZnSO$_4$ per plant soil application. The least was observed in the treatment without ZnSO$_4$ application. The ZnSO$_4$ increased the plant height due to increase in auxin synthesis which resulted in availability of photosynthates. The present results are in conformity with the findings of Singh and Rajput (1976) in mango.

The treatment 20 g ZnSO$_4$ per plant soil application recorded the maximum plant spread and the least was in control treatment. Similar results were also obtained by Singh et al. (2001) in aonla. Also the plants treated with 20 g ZnSO$_4$ per plant soil application significantly influenced the number of leaves and number of branches in Poona fig. The treatment with 1.0 per cent ZnSO$_4$ foliar application was on par as soil
5.2 Yield parameters

5.2.1 Yield per plant (kg)

Significant differences among the treatments were observed with respect to number of fruits per plant and yield per plant. The number of fruits per plant and yield per plant was found maximum in treatment (T2) 20 g ZnSO₄ per plant soil application, however minimum was observed in control treatment (T1). This may be due to rapid uptake, translocation and assimilation of zinc in leaves, increase number of leaves, number of branches and leaf area resulting in effective formation and translocation of photosynthates to sink (fruit). Since, zinc is regulating the semi permeability of cell walls, thus mobilizes more water and metabolites into fruit which in turn has increased the yield. Similar observations were made by Prabu and Singaram (2001) in Muscat grapes, Bhatia et al. (2001) in guava cv. L-49, Saraswathy et al. (2004) in sapota and Dhinesh Babu and Yadav (2005) in Khasi mandarin.

Application of (T₂) 20 g ZnSO₄ per plant resulted in better growth and fruit characters, which has lead to overall increase in the yield of Poona fig.

5.2.2 Fruit characters

The fruit characters viz., fruit shape index, length of fruit and breadth of fruit were significantly influenced by soil application and foliar sprays of ZnSO₄. The maximum fruit shape index (12.21 cm²), length of fruit (4.24 cm) and breadth of fruit (2.88 cm) were found in soil application of 20 g ZnSO₄ per plant (T₂) which was on par with the treatment T₆ (11.74 cm², 4.15 cm and 2.83 cm) and treatment T₃ (11.36 cm², 4.03 cm and 2.82 cm). This may be due to beneficial effect of zinc nutrients which leads to cell expansion. Zinc regulates the semi permeability of cell walls by which mobilized more water into fruits.
thereby increasing the diameter of fruit (Leonard et al., 1956). Zinc also act as a catalyst in the oxidation and reduction process and is of great importance in the sugar metabolism which might have improved the fruit length and breadth (Rath et al., 1980). The results are in conformity with those of Babu and Singh (1994) in litchi and Veena Pant and Lavania (1998) in papaya.

The average fruit weight does not differ significantly among the treatments due to zinc nutrition. This may be due to difference in zinc dosage among different treatments which may not be sufficient to improve the fruit weight. However, the maximum average fruit weight (27.55 g) was recorded on soil application of 20 g ZnSO₄ per plant (T₂) followed by the treatment (T₆) consisting of 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays whereas, the minimum average fruit weight (17.23 g) was recorded in control treatment (T₁). These findings are in confirmation of the results of Babu and Singh (1994) in litchi and Sandhu et al. (2000) in pear.

### 5.2.3 Post-harvest

The weight loss and physiological loss in weight of fruit were significantly influenced by the soil and foliar application of ZnSO₄ in Poona fig. The minimum weight loss (9 g) and physiological loss in weight (28.85%) on the 4th day during storage was observed in soil application of 20 g ZnSO₄ per plant with 1.5 per cent ZnSO₄ foliar application (T₆) followed by soil application of 20 g ZnSO₄ per plant (T₂). The maximum weight loss (15.5g) and physiological loss in weight (78.81 %) on the 4th day during storage was observed in control treatment without zinc application. This may be due to increase in auxin biosynthesis which in turn delay senescence of fruit. The enhanced effect of nutrient spray was supported by the result of Sharma et al. (1991).
5.2.4 Sensory evaluation

The sensory evaluation parameters viz., fruit shape, skin colour, flavour, taste, aroma and sweetness were significantly influenced by zinc sulphate nutrition in Poona fig. The maximum score of fruit shape, skin colour, flavour, taste, aroma and sweetness (4.78, 5.00, 4.78, 4.16 and 5.33, respectively) was observed in soil application of 20 g ZnSO$_4$ per plant (T$_2$). The lowest score (3.50, 3.56, 3.55, 3.53, 3.14 and 3.71, respectively) was observed in control treatment (T$_1$). However, fruit pulp colour, texture and overall acceptability were not significantly influenced by zinc sulphate nutrition. The results are in conformity with those of Bhatia et al. (2001) in guava cv. L-49.

5.3 Quality parameters

The quality parameters viz., total soluble solids, acidity, total sugar, reducing sugar and non-reducing sugar were significantly influenced by the method and concentration of ZnSO$_4$ application. The total soluble solids was significantly higher in ZnSO$_4$ soil application alone than control and other treatments. The titratable acidity was also less in soil applied ZnSO$_4$ than control and other treatments. However, total sugar, reducing sugar and non-reducing sugar were significantly higher in ZnSO$_4$ soil application with ZnSO$_4$ foliar application than the control treatment. Similar observations were made by Bhatia et al. (2001) in guava and Dhinesh Babu and Yadav (2005) in Khasi mandarin. The maximum total soluble solids (16.40 oBrix) was recorded in soil application of 20 g ZnSO$_4$ per plant (T$_2$) followed by 20 g ZnSO$_4$ per plant soil application with 1.5 per cent ZnSO$_4$ foliar sprays (T$_6$). Zinc helps in the synthesis of carbonic anhydrase enzyme and also in the process of photosynthesis which ultimately led to the accumulation of carbohydrates and helped to increase the total soluble solids (Vinod Kumar et al., 2005). Similar observations were also reported by Sharma

The acidity was less (0.34 %) in the treatment (T6) 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays which was followed by the treatment (T2) soil application of 20 g ZnSO₄ per plant. The decrease in acidity may be due to increase in the total soluble solids and it is also because of zinc which might have involved in fast conversion of metabolites into sugars and their derivatives by the reactions involving reversal of glycolytic pathway (Ruffner et al., 1975). Similar reports on the influence of ZnSO₄ was reported by Lal and Sen (2001) in guava, Rani and Brahmachari (2001) in litchi, Kar et al. (2002) in pineapple, Sharma et al. (2002) in Kagzi lime and Dhinesh Babu and Yadav (2005) in Khasi mandarin.

The highest total sugar (17.29 %) was recorded in the treatment (T6) 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays followed by the treatment (T3) 1 per cent ZnSO₄ foliar application. The higher percentage of zinc might have resulted in movement of sugars. The reducing sugar content (14.31 %) was more in the treatment (T6) 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays which was followed by 20 g ZnSO₄ per plant soil application treatment (T2). Maximum non-reducing sugar (3.28 %) was recorded in the treatment (T6) 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar sprays while minimum non-reducing sugar (1.95 %) was noticed in control (T1). These increased in chemical constituents of fruits mainly due to zinc application, which might have helped in the process of photosynthesis and which ultimately led to the accumulation of carbohydrates and finally increase in sugars and total soluble solids. The

Thus the quality parameters were found to be increased with the soil application in combination with foliar application of ZnSO$_4$. This reveals that soil application of 20 g ZnSO$_4$ per plant with 1.5 per cent ZnSO$_4$ foliar sprays proved to be better in improving the quality parameters.

### 5.4 Zinc uptake

The uptake and accumulation of zinc in leaf was found to be more in soil along with foliar application of ZnSO$_4$ than applied to soil as well as foliar alone and control treatments. However, zinc accumulation in soil is more in soil applied zinc treatments than the foliar applied treatments. Similar observations were made by Labanauskas (1971) in Valencia orange and Littlemore et al. (2005) in mango cv. Kensington Pride.

Zinc content in leaf and fruit was significantly more in soil with foliar applied zinc sulphate treatment than control treatment. This may be due to continuous maintenance of zinc concentration in the root zone by soil application and in the leaves by foliar application. Hence, to increase zinc concentration in edible parts, soil along with foliar application is found to be better than the foliar application alone or soil application alone.
5.5 **Leaf zinc content**

Leaf zinc content was significantly influenced by ZnSO₄ application and was observed among the treatments. The zinc content in the leaf was maximum (68.50 ppm) in 20 g ZnSO₄ per plant soil application with 1.5 per cent of ZnSO₄ foliar spray (T₆) followed by the soil application of 20 g ZnSO₄ per plant (T₂). However, the leaf zinc content (54.60 ppm) was found minimum in the control treatment (T₁). The results are in conformity with those of Manchanda (1974) in Sweet orange, Bakhshi *et al.* (1990) in Trifoliate orange, Durga *et al.* (1997) in Sathgudi orange and Littlemore *et al.* (2005) in mango cv. Kensington Pride.

5.6 **Fruit zinc content**

The zinc content in the fruit was significantly influenced by the soil and foliar applied ZnSO₄. The maximum zinc content (101.50 ppm) in the fruit was found in the treatment (T₆) of 20 g ZnSO₄ per plant soil application with 1.5 per cent of ZnSO₄ foliar spray which was followed by the soil application of 20 g ZnSO₄ per plant (T₂). The minimum fruit zinc content (47.33 ppm) was recorded in control treatment (T₁).

The higher accumulation of zinc content in the fruit may be due to continuous maintenance of higher zinc concentration in the root zone as well as in the leaves. The leaves are the principle site of metabolism, that changes in the nutrient supply and are reflected in the nutrient composition of fruit. The results are in conformity with that of Manchanda *et al.* (1972) in Sweet orange and Neilsen *et al.* (2005) in apple.

5.7 **Soil zinc content**

Soil zinc content was significantly influenced by the soil application of ZnSO₄ (15 and 30 cm depth). The zinc content in soil was found maximum (3.16 and 2.86) in the treatment (T₂) 20 g ZnSO₄ per
plant soil application both in 15 cm and 30 cm soil depths which was followed by the treatment \((T_6)\) of 20 g ZnSO\(_4\) per plant soil application with 1.0 per cent ZnSO\(_4\) foliar application. The soil zinc content increased with the soil applied treatment. However, the zinc content was recorded minimum in control and foliar applied treatments. Since the soil applied ZnSO\(_4\) is not fully taken up by the plants, the residual levels remaining in the soil which in turn reflected in soil analysis. These results are in conformity with those of Orphanos (1982) in apple.

5.8 Cost economics

The highest cost benefit ratio (1:1.03) and net returns (35632 Rs/ha) was recorded in the treatment \((T_2)\) receiving 20 g ZnSO\(_4\) per plant as soil application followed by \((T_6)\) soil application of 20 g ZnSO\(_4\) per plant with 1.5 per cent ZnSO\(_4\) foliar application (1:0.95 and 33603 Rs/ha). The minimum cost benefit ratio (1:0.01) and net returns (443 Rs/ha) was recorded in control \((T_1)\).

Practical application

In the nutrient management of Poona fig the soil application of 20 g ZnSO\(_4\) per plant can be recommended to increase the growth and yield while 20 g ZnSO\(_4\) per plant soil application with 1.5 per cent ZnSO\(_4\) foliar sprays can be recommended to increase the quality. However to increase the zinc content in the edible parts, soil application of 20 g ZnSO\(_4\) per plant with 1.5 per cent ZnSO\(_4\) foliar application can be recommended.

Future line of work

1. Studies on the effect of zinc nutrition in combination with other micronutrients on fig.

2. The effect of fertigation with different dosage of zinc sulphate on fig.

3. Influence of zinc nutrition on the shelf life of fig fruits.
Summary
VI. SUMMARY

A study conducted to investigate the efficacy of zinc on growth, productivity and quality of Poona fig at the Horticultural Research Station, University of Agricultural Sciences, Gandhi Krishi Vignana Kendra, Bangalore, during the year 2007-2008. The findings of the investigation were summarized hereunder.

6.1 Growth parameters

The highest plant height at 90 days after treatment (2.21 m), plant spread at 90 DAT (4.84 m²), number of leaves at 90 DAT (211.10), number of branches at 90 DAT (90.80), index leaf area (357.90 cm²), total chlorophyll (2.62 mg/g), chlorophyll ‘a’ (1.82 mg/g) and chlorophyll ‘b’ (0.97 mg/g) were observed in 20 g ZnSO₄ per plant soil application.

6.2 Fruit characters

The highest fruit shape index (12.21 cm²), length of fruit (4.24 cm) and breadth of fruit (2.88 cm) were recorded in 20 g ZnSO₄ per plant soil application.

6.3 Yield parameters

The highest number of fruits per plant (32.60) and yield per plant (5.86 kg) was recorded with 20 g ZnSO₄ per plant soil application. However, the average fruit weight was not significantly influenced by zinc nutrition.

6.4 Post-harvest and sensory evaluation

The lowest physiological loss in weight on 4th day (28.85 %) and weight loss on 4th day (9 g) was observed with 20 g ZnSO₄ per plant soil application with 1.5 per cent ZnSO₄ foliar application.
The highest score of fruit shape (4.78), skin colour (5.00), flavour (4.78), taste (5.33), aroma (4.16) and sweetness (5.33) were recorded with 20 g ZnSO$_4$ per plant soil application. However, fruit pulp colour, texture and overall acceptability were not significantly influenced by zinc nutrition.

6.5 Quality parameters

The maximum total soluble solids (16.40 °Brix) was observed with 20 g ZnSO$_4$ per plant soil application, while maximum total sugar (17.29 %), reducing sugar (14.31 %), non-reducing sugar (3.28 %) and minimum titratable acidity (0.34 %) were observed with 20 g ZnSO$_4$ per plant soil application with 1.5 per cent ZnSO$_4$ foliar application.

6.6 Zinc uptake

The maximum leaf zinc content and fruit zinc content was observed in 20 g ZnSO$_4$ per plant soil application with 1.5 per cent ZnSO$_4$ foliar application, while soil zinc content was recorded in soil application of 20 g ZnSO$_4$ per plant. In the soil applied zinc sulphate more left over of zinc in the soil has been found.

6.7 Cost economics

The highest cost benefit ratio of 1:1.03 was recorded in soil application of 20 g ZnSO$_4$ per plant with highest net returns of Rs. 35632 per hectare.
VII. REFERENCES


Manchanda, H.R., Shukla, V.C. and Randhawa, N.S., 1972, Effect of soil and foliar application of Zn and foliar application of Cu, Mn, Fe alone and in combination with Zn on the incidence of chlorosis, fruit quality, fruit fall and granulation in sweet orange variety Blood Red. *Indian J. Hort.*, **29**: 19-29.


* Original not seen
APPENDIX I

Climatological data for the period of study (2007-2008)

<table>
<thead>
<tr>
<th>Months</th>
<th>Rainfall (mm)</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
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<td>minimum</td>
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<td>March (2008)</td>
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APPENDIX II

Chemical properties of soil before treatment

<table>
<thead>
<tr>
<th>Treatments</th>
<th>pH</th>
<th>E.C. (mhos cm⁻¹)</th>
<th>O.C. (%)</th>
<th>Available K₂O (kg/ac)</th>
<th>Available P₂O₅ (kg/ac)</th>
<th>Zn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T₁ : Control (No application of ZnSO₄)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 cm</td>
<td>5.7</td>
<td>0.02</td>
<td>0.62</td>
<td>52</td>
<td>31</td>
<td>0.58</td>
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<tr>
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<td>56</td>
<td>39</td>
<td>0.49</td>
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<td></td>
<td></td>
</tr>
<tr>
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<td>5.4</td>
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<td>52</td>
<td>1.98</td>
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<tr>
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<td>5.5</td>
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<td>0.50</td>
<td>89</td>
<td>33</td>
<td>1.62</td>
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<td></td>
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<td>0.63</td>
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<td></td>
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<td></td>
</tr>
<tr>
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<tr>
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<tr>
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<tr>
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<td>0.03</td>
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<td>39</td>
<td>1.19</td>
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# APPENDIX III

## Chemical properties of soil after crop harvest

<table>
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<tr>
<th>Treatments</th>
<th>pH</th>
<th>E.C. (mhos cm(^{-1}))</th>
<th>O.C. (%)</th>
<th>Available K(_2)O (kg/ac)</th>
<th>Available P(_2)O(_5) (kg/ac)</th>
<th>Fe (ppm)</th>
<th>Cu (ppm)</th>
<th>Mn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>T(_1)</strong> : Control (No application of ZnSO(_4))**</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15 cm</td>
<td>5.9</td>
<td>0.15</td>
<td>0.68</td>
<td>62</td>
<td>38</td>
<td>66.7</td>
<td>3.6</td>
<td>38.4</td>
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<tr>
<td>30 cm</td>
<td>5.8</td>
<td>0.16</td>
<td>0.44</td>
<td>70</td>
<td>42</td>
<td>69.0</td>
<td>2.7</td>
<td>37.2</td>
</tr>
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<td><strong>T(_2)</strong> : Soil application of ZnSO(_4) 20 g per plant**</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>15 cm</td>
<td>6.7</td>
<td>0.11</td>
<td>0.72</td>
<td>110</td>
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<td>64.0</td>
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<tr>
<td>30 cm</td>
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<td>0.14</td>
<td>0.52</td>
<td>110</td>
<td>36</td>
<td>64.2</td>
<td>5.1</td>
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<tr>
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<td></td>
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</tr>
<tr>
<td>15 cm</td>
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<td>0.05</td>
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<td>37</td>
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<tr>
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<td>70</td>
<td>45</td>
<td>65.0</td>
<td>3.1</td>
<td>36.6</td>
</tr>
<tr>
<td><strong>T(_4)</strong> : Foliar application of ZnSO(_4) 1.5 per cent**</td>
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<td></td>
</tr>
<tr>
<td>15 cm</td>
<td>6.5</td>
<td>0.08</td>
<td>0.56</td>
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<td>35</td>
<td>64.5</td>
<td>2.5</td>
<td>37.9</td>
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<tr>
<td>30 cm</td>
<td>6.6</td>
<td>0.05</td>
<td>0.28</td>
<td>88</td>
<td>43</td>
<td>65.7</td>
<td>2.5</td>
<td>37.9</td>
</tr>
<tr>
<td><strong>T(_5)</strong> : Soil application of ZnSO(_4) 20 g per plant + foliar spray of ZnSO(_4) 1.0 per cent**</td>
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<td>66.7</td>
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<td>90</td>
<td>44</td>
<td>67.9</td>
<td>2.6</td>
<td>34.4</td>
</tr>
<tr>
<td><strong>T(_6)</strong> : Soil application of ZnSO(_4) 20 g per plant + foliar spray of ZnSO(_4) 1.5 per cent**</td>
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</tr>
<tr>
<td>15 cm</td>
<td>5.9</td>
<td>0.13</td>
<td>0.56</td>
<td>140</td>
<td>53</td>
<td>63.7</td>
<td>2.6</td>
<td>30.8</td>
</tr>
<tr>
<td>30 cm</td>
<td>5.4</td>
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<td>210</td>
<td>43</td>
<td>64.5</td>
<td>3.2</td>
<td>33.9</td>
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## APPENDIX IV

Details of input, labour and training materials required for cultivation of Poona fig.

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<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>Quantity required for one hectare</th>
<th>Rate/unit (Rupees)</th>
<th>Amount (Rs/ha)</th>
</tr>
</thead>
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<td><strong>Manures and fertilizers</strong></td>
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</tr>
<tr>
<td>1.</td>
<td>a. FYM</td>
<td>10 tones</td>
<td>250/tones</td>
<td>2500</td>
</tr>
<tr>
<td></td>
<td>b. Urea</td>
<td>140 kg</td>
<td>5/kg</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>c. Single super phosphate</td>
<td>240 kg</td>
<td>3.25/kg</td>
<td>780</td>
</tr>
<tr>
<td></td>
<td>d. Murate of potash</td>
<td>68 kg</td>
<td>4.6/kg</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td><strong>Total labour required</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>a. Fertilizer application</td>
<td>5</td>
<td>80/day</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>b. Weeding (thrice)</td>
<td>6</td>
<td>80/day</td>
<td>960</td>
</tr>
<tr>
<td></td>
<td>c. Spraying (twice)</td>
<td>5</td>
<td>80/day</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>d. Soil application zinc sulphate</td>
<td>5</td>
<td>80/day</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td>e. Harvesting</td>
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<td>80/day</td>
<td>640</td>
</tr>
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<td>3.</td>
<td>Tractor hire charge</td>
<td>3 hours</td>
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<td>750</td>
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<tr>
<td>4.</td>
<td><strong>Plant protection chemicals</strong></td>
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</tr>
<tr>
<td></td>
<td>a. Rogor</td>
<td>267 ml</td>
<td>222/lt</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>b. DM-45</td>
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<td>200/kg</td>
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<tr>
<td>5.</td>
<td>Zinc sulphate</td>
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<td>200/kg</td>
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<tr>
<td>6.</td>
<td>Irrigation charge</td>
<td>-</td>
<td>-</td>
<td>25400</td>
</tr>
</tbody>
</table>
Cost of cultivation incurred per hectare by using zinc sulphate as soil and foliar nutrient on Poona fig.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Particulars</th>
<th>T₁</th>
<th>T₂</th>
<th>T₃</th>
<th>T₄</th>
<th>T₅</th>
<th>T₆</th>
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<td>3200</td>
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<td>3</td>
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<td>750</td>
<td>750</td>
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