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# Role of zinc, copper and boron in fruit crops: A review

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**Abstract**
Micronutrients provide special lubricants required for variety of energy transfer mechanism within the plants. They are usually found in association with larger molecules such as cytochromes, chlorophyll and proteins (enzymes). About 40-55% of Indian soils are moderately deficient in Zinc and 25-30% are deficient in Boron. Deficiency of other micronutrients occurs under 15% of soils. Micronutrients happens to improve quality, size, colour, taste and earliness of fruits thereby enhancing their market appeal, improve input use efficiency of NPK fertilizers and water, provide disease resistance, thereby reducing dependence on plant protection chemicals, increase the post-harvest life of horticultural produce thereby avoiding wastage prevent physiological disorders and increase marketable yield. Fruits like citrus, banana, mango, guava, papaya etc. are highly susceptible to various disorders caused by deficiency of micronutrients. Hence judicial application of micronutrients specially zinc, copper and boron may prove to be an effective tool for sustainable fruit production.

**Keywords:** Micronutrient, boron, copper, zinc, fruit, deficiency

## Introduction
Micronutrients are key elements in plants growth and development. These elements play very important role in various enzymatic activities and synthesis. Their acute deficiencies some time poses the problem of incurable nature (Kumar, 2002) [24]. These micronutrients also help in the uptake of major nutrients and play an active role in the plant metabolism process starting from cell wall development to respiration, photosynthesis, chlorophyll formation, enzyme activity hormone synthesis, nitrogen fixation and reduction (Das, 2003) [14]. Moreover, elements like nitrogen, phosphorus and potash play a vital role in promoting the plant vigour and production and the micronutrients like Zn, Cu and B are not only essential but they are equally important like other macro nutrients, in spite of their requirement in micro quantities. Deficiency of micronutrient has become a major constraint to the productivity, stability and sustainability of crops in many Indian soils and may further deteriorate due to global warming (Kumar *et al.,* 2011) [23]. The unavailability of organic manure due to limited land resources and higher use of NPK fertilizers leads to unproductive orchards and various disorders hence micronutrients are essential for efficient use and balance soil status of major nutrients, therefore application of micronutrients is obvious. This paper is an attempt made to present a brief review of some previous researches related to role of micronutrients in quantitative characters of tropical and subtropical fruit crops.

### Effect of Zinc on Growth and Yield Attributing Characters of Fruit Crops
Fruit yield in many tropical and subtropical fruits are often limited by low soil levels of mineral micronutrients such as zinc (Zn). Zinc is an essential mineral nutrient and a cofactor of over 300 enzymes and proteins involved in cell division, nucleic acid metabolism and protein synthesis (Marschner 1986) [32]. Cakmak (2000) [12] has speculated that zinc deficiency stress may inhibit the activities of a number of antioxidant enzymes, resulting in extensive oxidative damage to membrane lipids, proteins, chlorophyll and nucleic acids. Zinc deficiency symptoms include, i.e. small leaves, shortened internodes giving the plant a stunted appearance means poor fodder qualities. Availability of zinc in soils and its absorption and translocation in plants is influenced by all other plant nutrients. Zinc in general interacts negatively with phosphorus which depends upon a number of physico-chemical properties of soils.

Awasthy *et al.* (1975) [7] reported that zinc sulphate spray significantly reduced fruit drop in litchi. The reduction was due to increased biosynthesis of IAA in zinc treated plants. And reported that foliar application of zinc sulphate at 0.5, 1.0 and 1.5 per cent concentrations, considerably increased number of fruits, pulp weight and volume. According to Singh and Rajput (1976) [48] the foliar application of 0.2, 0.4, 0.6 and 0.8 per cent zinc sulphate increased the fruit set in Chausa cultivar of mango, fruit weight increased with the increase in concentrations and found to be the maximum (251.32 g) under 0.8 per cent. While studying the effects of pre-blossom foliar sprays of zinc sulphate with 0.1-0.4 per cent concentration on the fruit size of guava cultivar Allahabad Safeda, Rajput and Chand (1976) [48] found that fruit size was enhanced by all treatments, however the best results were obtained under 0.3 per cent zinc sulphate. Daulta *et al*. (1983) [49] reported that all the concentrations (0.2, 0.4 and 0.6%) of zinc sulphate significantly improved the berry weight over the control in Beauty Seedless grape. $ZnSO_4$ with 0.4 and 0.6 per cent significantly increased the length and breadth of berry over control, whereas the maximum berry weight was obtained with $ZnSO_4$ (0.6%), while boron could not affect berry weight. Similarly Mansour and El-Sied (1985) [30] reported that the foliar application of Zn at 0.5 or 1.0 per cent applied at full bloom in guava trees increased fruit set, reduced pre-harvest fruit drop and boost the yield (160-373 fruits/ tree) when compared to control. Mann *et al*. (1985) [29] reported the highest fruit weight (167.0 g), width (7.05 cm) and yield (344 fruits/ tree) with $ZnSO_4$ sprays (0.5%) in sweet orange cultivar Blood Red. Pandey *et al.* (1988) [36] noted that the size of Sardar guava fruits with respect to both length and breadth was significantly increased by foliar application of chemicals and they reported that the maximum value (6.21 cm length and 5.68 cm breadth) of both the characters was recorded under urea + $ZnSO_4$ + ethrel + NAA (2.0%, 0.4%, 250 ppm and 10 ppm, respectively). Zinc alone at 0.4 per cent gave fruits of 5.28 cm length, 5.30 cm diameter, 83.63 g weight and 51.91 kg/tree, which superseded such effects of control. Plants of guava cultivar Allahabad Safeda sprayed with 0.4 per cent $ZnSO_4$ before flowering at fruit setting and 3 weeks after fruit setting produced fruits with 4.96 cm length, 5.28 cm width, 78.67 g fruit weight and 18.17 kg fruit yield per plant. When trees were sprayed with 0.4 per cent $ZnSO_4$ in combination with urea at 2.0 per cent produced fruits with 4.79 cm length, 5.02 cm width, 70.00 g fruit weight and 18.67 kg fruit yield per tree (Ali *et al*., 1991) [3]. In a study conducted in guava Sharma *et al*. (1991) [43] found the highest fruit set (71.96%), fruit retention (53.86%), fruit weight (165.8 g) and fruit yield (498.6 fruits weighing 82.39 kg/plant) with 0.6 per cent zinc sulphate treatment, when foliar sprays of aqueous solutions of zinc sulphate (0.2, 0.4 or 0.6%) were applied to guava cultivar Allahabad Safeda at flower initiation (mid March) and after >50% fruit set (mid May). Ali *et al*. (1992) [2] in their experiment found that when four -year-old highly chlorotic Blood Red Orange trees growing on alkaline clay soil (pH 8.24) were given foliar sprays in April and July containing 39 g $FeSO_4$, 98 g $ZnSO_4$ and 39 g $MnSO_4$ in 20 lit. of water separately or in all possible combinations, had the greatest effect on tree growth. While, Langthasa *et al*. (1993) [28] noted that the application of chelated zinc @ 0.4 per cent gave the highest number of flowers (289.33), fruit set (78.17%) and yield/tree (20.88 kg) in Blood Red Orange. Bacha *et al*. (1995) [8] investigated the effect of foliar application of chelated iron, zinc and manganese on yield and berry quality of Thompson Seedless and Roumy Red cultivars of grape and revealed that with a mixture of Fe, Zn and Mn caused non-significant and significant increase in the yield of Thompson Seedless and Roumy Red as compared to control. Chaitanya *et al*. (1997) [13] recorded the maximum fruit yield of 133.82 kg per tree, fruit weight of 108.9 g, length and diameter (5.52 & 4.51 cm) when L-49 guava trees were sprayed thrice with 0.3 per cent zinc sulphate in comparison of 0.5 per cent. Bahadur *et al*. (1998) applied zinc sulphate as foliar sprays (0.25, 0.50 and 1.0%) or to the soil (0.5, 1.0 and 2.0 kg/tree) during 2nd week of October at flower bud differentiation to 26-year-old mango trees cultivar Dashehari and found that uptake of zinc under foliar application was more rapid than that of soil applied zinc and there was a significant increase among zinc sulphate treatments with respect to fruit size, weight and yield. Lal *et al*. (2000) reported that the foliar spray of $ZnSO_4$ at 4 g per plant per year significantly increased the yield and Zn content of leaves in guava cv. Allahabad Safeda however, it reduced significantly the Mn content of leaves. Bhatia *et al*. (2001) [11] pointed out that the fruit weight and yield of guava cultivar L-49 increased with foliar application of $ZnSO_4$ at 0.5, 0.75 and 1.0 per cent, during winter season and revealed that maximum increase in fruit weight and yield (133.0 g and 68.0 kg/tree, respectively) were recorded with 1.0 per cent $ZnSO_4$. Lal and Sen (2002) [26] observed that the earliest fruit maturity (131.33 days) and the highest number of fruits (327.00 fruits/tree) were significantly affected by foliar spray of $ZnSO_4$ and $MnSO_4$ and soil application of urea in cultivar Allahabad Safeda in a field experiment conducted in Rajasthan and they reported that the highest yield (76.97 kg/tree) was recorded at treatment combination of 600 g N + 4 g Zn + 4 g Mn/tree, while the latest fruit maturity (172.67 days) and the lowest number of fruits (243.33 fruits/tree) and yield (41.18 kg/tree) were recorded under the control. Yadav *et al.* (2007) [57] reported that plant height increment (10.71%) was maximum and fruit drop (60.30%) was minimum with soil application of 250 g $ZnSO_4$ per plant in sweet orange cv. Jaffa, however foliar application of 0.75% $ZnSO_4$ gave best result in term of plant growth (9.08%) and fruit drop (64.26%). Awasthi and Lal (2009) found that application of 2% $ZnSO_4$ in guava resulted in highest number of fruits per tree (182.2 and 186.1) and fruit yield (23.50 and 24.30 kg/plant) and 1.5% $ZnSO_4$ resulted in maximum fruit length (7.85 and 8.11 cm), fruit diameter (7.05 and 7.15 cm), fruit volume (162.00 and 164.5 ml) and fruit weight (146.2 and 147.6 g in the year 2004-05 and 2005-06 respectively). Waskela *et al*. (2013) reported that foliar application of zinc sulphate @ 0.75% on guava (*Psidium guajava* L.) cv. Dharidar, significantly increased the shoot length (13.44 cm), leaves per shoot (11.65), shoot diameter (0.52 cm), leaf area (71.60 $cm^2$), fruit length (7.06 cm), fruit width (7.09 cm), number of fruit/plant (164.80), fruit weight (187.18 g), yield per plant (30.90 kg) and yield per hectare (85.89 q/h). Kaur *et al.* (2015) reported that foliar application of 1000 ppm Zn + 1000 ppm Mn on Kinnow mandarin during the end of April and mid of August gave maximum fruit yield (862 fruits / tree) and good quality fruits (Higher TSS/Acid: 14.23).

**Effect of Copper on Growth and Yield Attributing Characters of Fruit Crops**

Copper is an activator of several enzyme systems in plants and functions in electron transport and energy capture by oxidative proteins and enzymes. It may play a role in vitamin-A production. A deficiency interferes with protein synthesis. Native copper supply has been recognized only rarely as needing supplementation. Some tree crops grown on organic soils or sands may need supplementation. Copper can be toxic at low levels so a need should be firmly established prior to supplementation. Deficiency symptoms vary greatly among species. Symptoms of copper deficiency include: Leaves may be chlorotic or deep blue-green with margins rolled up, the bark of trees is often rough and blistered and gum may exude from fissures in the bark, young shoots die back, flowering and fruiting may fail to develop in annual plants and they may die in the seedling stage, stunted growth, formation of gum pockets around central pith in oranges.

While studying the growth characters in litchi with foliar spray of copper, Dutt (1962) [16] reported that spraying of Cu (3.05 g/lit.) increased fruit set, fruit size and yield. Arora and Singh (1971) [4] found that 0.4 per cent copper sulphate spray on guava trees improved yield and hastened fruit maturity by 10 days, also spray at 0.2 and 0.4 per cent showed significant improvement in Allahabad Safeda with the maximum increase in length (3.5%), diameter (3.2%), fruit weight (12.4%) was recorded under 0.4 per cent spray, whereas 2.1, 2.2, 9.7 and 92.3 per cent increase in length, diameter, fruit weight and yield, respectively, was obtained with 0.2 per cent spray. Similarly, Sarkar *et al*. (1984) [42] found that 0.4 per cent Cu spraying improved weight and diameter of litchi fruits and reported that copper at 0.2 per cent spray reduced fruit drop and hence increased fruit yield of Rose Scented litchi. Spraying of $CuSO_4$ (0.25 or 0.5%) in combination with 20 ppm 2, 4 -D on Kinnow mandarins, reduce fruit drop significantly and improved fruit size (Singh and Mishra, 1986) [50]. Singh and Rethy (1996) [45] observed greatest fruit weight in Kagzi lime with the spraying of 0.5 per cent copper sulphate and 20 ppm NAA. In an investigation conducted on guava cultivar Allahabad Safeda trees, Singh and Singh (2002) [51] reported that copper sulphate at 0.4 per cent increased fruit set and fruit retention. They also found that copper sprays at 0.4 per cent gave significantly higher values for fruit length (5.19 cm), diameter (5.02 cm) and weight (168.7 g) than the other treatments. The foliar application of 0.1, 0.2, 0.3 and 0.4 per cent copper significantly increased the fruit yield over the control, with highest yield of 62.63 kg/tree at 0.4 per cent copper spray. Similarly Shekhar and Singh (2010) [44] reported significant increase in papaya plant growth, yield and fruit quality characters *viz.*, plant height, plant girth, fruiting height, fruiting depth, number of fruit per plant, fruit yield (kg/plant and q/ha) and fruit size (fruit length and width) were recorded with the foliar application of copper sulphate. Al-Atrushy and Al-Bamarny (2013) [1] reported that spraying of copper in sub tropical peach at high concentration (0.04%) had a positive effect on leaf area, leaf fresh weight, leaf dry weight, total chlorophyll, fruit weight, fruit number and yield per tree as well as fruit diameter, pith thick, pulp weight, seed weight and total soluble solid.

**Effect of Boron on Growth and Yield Attributing Characters of Fruit Crops**

Boron is an essential element for higher plants, but its toxicity is observed when the element is present in higher concentration. Boron is an essential micronutrient for higher plants and a deficiency causes inhibition of plant growth. It is generally up-taken by roots of a tree from soils containing boric acid solutions. Research findings revealed that the lowest level of boron concentration was in sandy and loamy soils, but the highest concentration was reported for lateritic and calcareous soils (Pendias, 2001) [37] Boron content in soil is also affected due to rainfall for prolonged leaching loss of B in soils.

Spraying guava trees with 0.1 and 0.2 per cent B as boric acid increased the extension of the terminal shoot, the number of leaves and the leaf-area/shoot and also hastened fruit ripening by 7 and 11 days and increased the yield by 82 and 73 per cent, respectively. 0.1 per cent boric acid improved the size of the fruits (Arora and Singh, 1972) [5]. The effects of the boron sprays were particularly marked when pre- flowering sprays of boric acid at 0.1, 0.2, 0.3 or 0.4 per cent concentrations were applied to Allahabad Safeda (Rajput and Chand, 1975) [38]. They found that all the treatments, especially with two higher concentrations, led to significant improvements in growth, flowering and fruiting. Rana and Sharma (1979) [40] found increase in weight and volume of individual grape berries as well as each cluster when grape vines were sprayed with boron at 0.025 per cent and 0.05 per cent concentrations. The results obtained by Singh *et al*. (1983) [49] from the foliar spray of urea and boric acid at different concentrations singly as well as in combinations have good effects on physical characters of guava fruits cultivar L-49. The largest fruits, sizing 6.68 x 7.12 cm with 125.8 g fruit weight were produced on trees with 3.0 per cent urea + 0.3 per cent boric acid. Spraying of borax (0.2%) proved effective in increasing the size of Sardar guava fruits, weight and yield as 5.93 cm length and 5.63 cm width, 95.25 g and 63.49 kg/tree, respectively, (Pandey *et al.*, 1988) [36]. The fruit yield was the highest (69.45 kg/tree) with the combined application of borax + ethrel + NAA (0.2%, 250 ppm and 10 ppm, respectively), however the spraying of urea or borax proved equally effective in this respect. Spray of borax at 0.2 per cent in combination with urea at 2 per cent thrice at pre flowering, fruit setting and 3 weeks after fruit setting in guava cultivar Allahabad Safeda produced fruits with 4.84 cm length, 5.00 cm width, 72.67 g weight and 19.08 kg fruit yield per tree (Ali *et al*., 1991). [3] They also recorded higher fruit weight of 80.67 g and yield of 20.17 kg/plant with foliar feeding of borax at 0.2 per cent alone on guava cultivar Allahabad Safeda. Upreti and Kumar (1996) [53] found that borax was most effective in reducing fruit drop in Rose Scented litchi. They reported a fruit drop of 75 -76 per cent only by using borax (0.5% and 1.0%) as foliar sprays as against 92.4 per cent fruit drop in control. Yadav (1998) [56] found the best yield of quality fruits, fruit yield (67.7 kg per tree), number of fruits (686 per tree), volume of fruit (107.5 cc) after foliar application of urea (3.0%) + borax (0.15%) + NAA (10 ppm) in guava trees. Pre-harvest spray of borax with 0.2, 0.4, 0.6, 0.8, 1.0 and 1.2 per cent concentrations twice in October improved the quality of guava fruits in cultivar Sardar in terms of size and weight. Foliar application of $H_3BO_3$ at 0.3, 0.5 and 1.0 per cent on guava cultivar L-49 during winter season (Bhatia *et al*., 2001) [11] increased the fruit weight and yield showing the maximum value of 141.0 g and 73.0 kg/tree, respectively with 1.0 per cent. Sotomayor *et al*. (2010) [52] reported that the weight of kiwifruits growing from shoots with boron-treated leaves were 14.1% higher than the control, while the weight of fruits derived from boron-treated flowers was 17% higher than that of fruits from untreated flowers. Regarding fruit length, significant differences between boron treatments and the control were observed. Haq and Rab (2012) [20] reported that foliar application of $CaCl_2$ and borax in litchi has significantly increased the mean fruit skin calcium content (4.79 mg/100 g DW), boron content (0.109 mg/100 g DW) and skin strength (2.43 kg $cm^{-2}$) from the least in the control to the highest 8.88

mg/100 g DW, 0.247 mg/100 g DW and 3.01 kg $cm^{-2}$ with $CaCl_2$ 3% + boron 1.5% treatment respectively, while ion leakage (35.17%) and fruit cracking (25.40%) in the control decreased to 16.17 and 11.14% respectively with $CaCl_2$ 3% + boron 1.5% treatment. Mao *et al.* (2014) [31] reported that both single and mixed spraying of calcium and boron increased the fruit size and number of fruits per plant and so improved fruit yield per plant in Dongzao (ber). The best treatment for improving fruit yield was the mixed spray of boron and calcium at the concentration of 0.4% respectively. Mollah *et al*. (2016) [34] carried out an experiment at Rangpur, Bangladesh during 2002-03 in papaya cv. Shahi and revealed that the highest fruit yield (49.01 t/ha) was obtained using 1.0 kg B/ha as foliar application. From the economic point of view, the best results were obtained in 1 and 2 kg B/ha as foliar and basal application, respectively.

**Effect of combined application of zinc, copper and boron on growth and yield attributing characters of fruit crops**

Borax in combination with zinc sulphate and magnesium sulphate increased the average fruit weight by about 9.0 per cent compared to control in guava cultivar L-49 (Ghosh, 1986) [17]. It also increased the number of fruits (150.0) and fruit yield (26.1 kg) per plant. Singh *et al*. (1990) [46] conducted a trial to study the effect of Zn, B and Cu on 15 year old trees of Kagzi lime which were sprayed twice a year in middle of August and beginning of September with $ZnSO_4$, $CuSO_4$ and borax at 0.3 per cent alone and mixture of all three micronutrients. The results revealed that highest number of fruits per twig (7.0), weight of fruit (55.26 g), length (5.40 cm), width (4.81 cm) and volume (248 $cm^3$) with the mixture of zinc, boron and copper treatment. Foliar spray of 0.25 per cent each of $ZnSO_4$, $FeSO_4$ and $MnSO_4$ combined with 0.15 per cent boric acid significantly increased the yield from 18.5 kg/plant under control to 26.37 kg/plant in pomegranate cultivar Ganesh (Balakrishan *et al*., 1996) [10]. An increase in the fruit length and diameter (6.02 & 5.30 cm), yield (144.22 kg/plant) and weight (120.0 g) in L-49 guava trees were recorded the maximum when zinc sulphate and borax spray made combined thrice each at 0.3 per cent as compared to Zinc sulphate + Borax at 0.5 + 0.5, 0.5 + 0.3, and 0.3 + 0.5 per cent (Chaitanya *et al*., 1997) [13]. Effect of foliar application of nutrients on fruits of guava cultivar L-49 was studied by Kundu and Mitra (1999) [25] and reported that the maximum increase in weight and size (length & diameter) of fruits was recorded under the combined spraying of $CuSO_4$ + Boric acid + $ZnSO_4$ (0.3+0.1+0.3%). A combination of these micronutrients was also found effective in increasing the yield (54.65 kg), fruit weight (149.20 g) and size (6.30 x 6.75 cm). Saraswathy *et al.* (2004) reported that the application of borax or ZnSO4, single or in combination in sapota cv. PKM-1, resulted in remarkable improvement in growth, yield and quality over the control, with $ZnSO_4$ at 50 g + borax at 25 g/tree + borax at 0.3% + $ZnSO_4$ at 0.05% being identified as the best treatment. Singh and Maurya (2004) [47] studied the effect of foliar spraying of micronutrients, i.e. $ZnSO_4$ (0.4%), $FeSO_4$ (0.4%), $MnSO_4$ (0.2%) and $H_3BO_3$ (0.2%), alone and in combinations, on flowering, fruiting and yield of mango cv. Mallika, micronutrients were sprayed 3 times, i.e. at the time of panicle emergence, pea stage and fruit development stage and revealed that spray of micronutrients was found responsive in increasing the flowering, fruiting and yield of mango. Nehete *et al.* (2011) [35] found that the lower level of $ZnSO_4$, $FeSO_4$ and borax in combination in mango cv. Kesar had influenced flowering and treatment $ZnSO_4$ 1% + $FeSO_4$ 1% + borax 0.5% significantly increased the number of fruits per tree (168), average fruit weight (0.295 kg) and yield per tree (49.54 kg). Similarly, Modi *et al*. (2012) studied the effect of foliar spray of various micronutrients on growth, yield and quality of papaya (*Carica papaya* L.) cv. Madhu Bindu and revealed that the yield characters i.e. average weight of fruit (0.702, 0.739 kg), number of fruit (38.14, 41.64) and yield of fruits (27.15, 30.76 kg) per plant with maximum yield per hectare (74.87, 84.90 tonnes) was also recorded maximum with $ZnSO_4$ 0.5% and borax 0.3%. Hada *et al*. (2014) [19] reported that $ZnSO_4$ 0.8% + borax 0.4% spray on guava cv. L-49 resulted in maximum shoot length (38.12 cm), number of leaves (26.23), leaf area (628.21 $cm^2$), fruit set (78.57%), fruit retention (60.23%) and number of fruits per tree (241.84) and also shows minimum fruit drop (39.77%), number of days taken for first flowering (35.00) and number of days taken for 50% flowering (44%). Yadav *et al*. (2014) reported that application of $ZnSO_4$ 0.4% + boric acid 0.4% + $FeSO_4$ 0.4% in pomegranate cv. Sindhuri resulted in increased canopy volume (28.93%), chlorophyll content (0.61 mg/g), fruit weight (213.00 g), fruit volume (204 cc), number of arils per fruit (457.67), fruit set per cent (54.17%), number of fruits per plant (23.67) and yield (5 kg/plant). Similar studies on acid lime (Venu *et al*, 2014) [54] revealed that the interaction effect of zinc, boron and iron (0.5% + 0.4% + 0.4%) resulted in increased flowers per shoot (22.37), fruit set (49.33%), number of fruits per shoot (8.53), number of fruits per plant (925.00), fruit weight (42.67 g), fruit yield per plant (27.07 kg) and per hectare (7.49 ton) with minimum fruit drop (24.33%). Kumar *et al*. (2015) [21] reported that the foliar fertilization of Pant Prabhat guava showed an increasing trend towards plant height (12.17% with 0.03% Zn two weeks after fruit set), fruit weight (150g with 0.03% B two weeks after fruit set), volume (147.67 with 0.03% B two weeks after fruit set) and yield (52.50 kg/tree with 0.01% Zn two weeks after fruit set) while it showed a trend towards decreasing per cent fruit drop (5.90% with 0.03% Zn two weeks after fruit set). While, Gurjar *et al*. (2015) [18] reported that foliar application of 1% $ZnSO_4$, 1% $FeSO_4$ and 0.5% borax in combination in Alphonso mango had significantly increased the fruit set at pea stage (14.00) and marble stage (7.50), number of fruits per tree (1.73), average fruit weight (314.69 g) and yield per tree (185.09 kg) and decreased the fruit drop (87.66%).

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