ISSN 2250-3153

Effect of foliar fertilization of boron, zinc and iron on fruit growth and yield of low-chill peach cv. Sharbati

Vikas Yadav, P.N. Singh and Prakash Yadav

Horticultural Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand, India

Abstract: This field experiment was carried out at Horticultural Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar (U.K.), India, during two consecutive years 2010 and 2011 on 7 years old peach trees cv. Sharbati. The experiment was designed in RBD to study the effect of foliar spraying of boron, zinc and iron and its combination on fruit growth pattern and yield attributing characters of the low-chill peach. Boric acid (0.1%), zinc sulphate (0.5%) and ferrous sulphate (0.5%) were used as a source of boron, zinc and iron, respectively. All the trees fertilized with recommended dose of NPK (300:500:300 as N, P_2O_5 and K_2O). The spraying was done twice; during last week of February at after petal fall stage and again at 15 days after the first spraying during both years in three replication. Result proved that foliar spraying of peach trees with 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ was the promising treatment for improvement of fruit growth, fruit length, fruit diameter, fruit volume, firmness and fruit yield. This treatment was also found best for maximum fruit retention, average fruit weight as well as the fruit yield.

***Index Terms*:** Micronutrient, fruit growth pattern, fruit yield, low-chill peach

I. INTRODUCTION

Peach [*Prunus persica* (L.) Batsch] is one of the most important temperate stone fruit of the world. This fruit belong to the family rosaceae and sub family prunoidae. China is widely held to be the native land of peaches. Peach attain best quality in area where summer warm to hot. A distinct group of cultivar which require low chilling hours for bud brust and growth is known as low chill peach. The cultivation of low-chill peaches confined to subtropical area of north India including U.P. (Meerut, Saharanpur, Muzzafarnagar and Bulandsahar), U.K (Udhamsingh nagar and Nanital), Punjab and Haryana (Pathak and Pathak, 2001). Presently, Sharbati, Saharanpur Prabhat, Florada prince, Pratap, Shan-e- Punjab and Early grand are popular cultivar in this area (Tiwari, 2004). Foliar fertilization of micronutrients has advantage of low application rates, uniform distribution of fertilizer materials and quick responses to applied nutrients (Umer *et al.,* 1999). Application of micro nutrients through foliage can be from 10 to 20 times as efficient as soil application (Zaman & Schumann, 2006). Micro-nutrients such as iron, zinc and boron are essential for different biological functions that might be attributed to tree yield and fruit quality (Shoeib, 2003). It is also increased resistance to disease and insect pests and improved drought tolerance *(Tariq et al., 2007).* The essentiality of boron in plants is discovered by Gauch and Dugger (1953). Reduction in fruit set, fruit growth and yield in B deficient plant is reported in pear (Rease, 1989). Boron deficiency in peaches is characterized by a die-back of branches in spring (Woodbridge, 1955). Zn deficiency symptoms such as little leaf or rosette were described for peach (*Prunus percia*). Soil applications are not very effective because the roots of fruit crops occupy deep soil layers and zinc does not easily move in the soil therefore, foliar sprays are more effective (Chandler *et al.,* 1931). Iron plays an important role in chlorophyll biosynthesis pathway. Thus deficiency of this element reduced the net photosynthesis which causes huge reduction in fruit yield (Chandler *et al.,* 1931). Many reports have been published on effect of micronutrient in case of high-chill peaches. However, there is limited work done on effect of micronutrient spray on subtropical low-chill cultivars. Peaches have the ability to catch the market when there was no fruit availability in market. Therefore, it is necessary to evaluate the response of micronutrient application on subtropical peach under sub tropical condition.

II. MATERIALS AND METHODS

The study was conducted at Horticultural Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar (U.K.), India, during two consecutive years 2010 and 2011 on 7 years old peach trees cv. Sharbati. The plants having uniform vigour and size were selected for the study. The NPK (300:500:300 as N, P_2O_5 and K_2O) were supplied to the trees as per recommendation given by Tiwari *et al.* (2004). Three micronutrients i.e., boron as H_3BO_3, zinc as $ZnSO_4$,$7H_2O$ and iron as $FeSO_4$,$7H_2O$ were sprayed alone and in combinations during last week of February, every year i.e., after petal fall stage and again 15 days after the first spraying. The details of the treatment composition were as

T_1= 0.1 % H_3BO_3,

T_2= 0.5 % $ZnSO_4$, $7H_2O$,

T_3= 0.5 % $FeSO_4$, $7H_2O$,

T_4= 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$,

T_5= 0.1 % H_3BO_3 + 0.5% $FeSO_4$, $7H_2O$,

T_6= 0.5 % $ZnSO_4$, $7H_2O$ + 0.5% $FeSO_4$, $7H_2O$,

T_7= 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$,

T_8= Water spray (Control).

Treatments were replicated thrice in a randomized block design (RBD), each replicate consisted of two trees. The observations were recorded on size of fruit (fruit length and diameter) at weekly intervals starting from 1st week of March and 1st week of June every year. The data on average fruit length, diameter, fruit volume, fruit firmness and fruit weight were taken from ten fruits per replication. The statistical analyses of pooled data of both the years were carried out as per the method prescribed by Panse and Sukhatme (1985).

III. RESULTS AND DISCUSSION

Fruit growth pattern

The fruit growth pattern of the peach cv. Sharbati on the basis of length and diameter is represented as Fig. 1. Initially, the length of the fruit was increased at an increasing rate upto 4th week of March during both the years. Then the rate of increase in fruit length was quite low upto 3rd week of April. Again the rate of increase in fruit length was recorded at increasing rate after the 3rd week of April to 1st week of June. The increase in diameter followed the same trend as in case of fruit length during both the years. The treatment 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ recorded maximum increase in fruit length and diameter in every week intervals over control. These findings clearly established that the growth pattern of peach followed the double sigmoid growth curve. Double sigmoid growth of low-chill peach was also reported in low-chill peach cv. Shan-e-Punjab (Babu and Yadav, 2002).

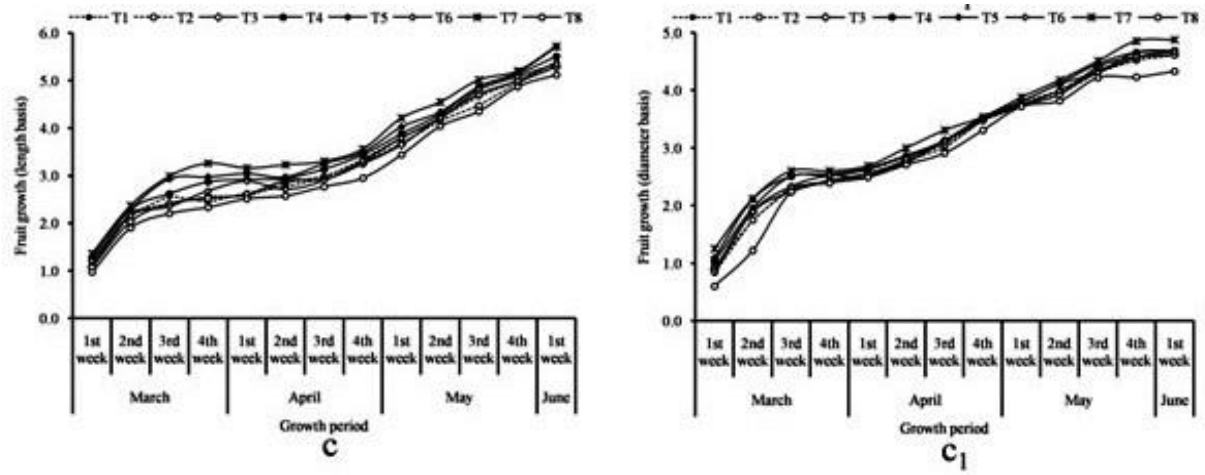

Figure1: Response of foliar fertilization of different micronutrients in growth pattern of low- chill peach cv. Sharbati [fruit length basis c and diameter basis c_1

Final Fruit length and fruit diameter

A perusal of data in table:1 clearly indicate that size of fruit (on fruit length and diameter) was significantly influenced by the use of micronutrients spray. Pooled mean value indicated that application of 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ produced maximum fruit length (5.59cm) and fruit diameter (5.08cm) during both years. All other treatments were also significantly increased fruit length and fruit diameter over control. Role of zinc and boron in increasing the fruit length and diameter is reported in mango cv. dashehari (Singh *et al*., 1989). The increase in size of fruit as a result of foliar application of micronutrients in present investigation might be because it improved the internal physiology of developing fruit in terms of better supply of water, nutrients, and other compounds vital for their proper growth and development (Dutta and Banik, 2007).

Fruit weight, volume and fruit firmness

The maximum fruit weight (51.60g, Table 2), volume (44.57ml) and firmness (12.37lb/inch) recorded in the plants which were sprayed with 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ (Table 1) and the minimum fruit weight and volume was observed in control plants. The increase in fruit weight and volume might be due to increase in cell size and intercellular space (Basker and Davis, 1951). Zinc has been identified as component of almost 60 enzymes and it has a role in synthesis of growth promoter hormone (auxin). Which is directly associated with improvement of Fresh weight of fruits (Shivanandam *et al.*, 2007). A favorable effect of foliar application of boron might be due to its role in cell division, cell elongation, sugar metabolism and accumulation of carbohydrates (Sourour, 2000). Rana and Sharma (1979) obtained increased berry volume with the application of 0.5% ferrous sulphate in grape. It might be increased chlorophyll content in leaf which is associated with high production of photosythate in plant.

Table 1: Response of foliar fertilization of micronutrients on final fruit length (cm), final fruit diameter (cm), fruit volume (ml) and fruit firmness (lb $inch^{-2}$) of low-chill peach cv. Sharbati

Treatments	Final fruit length (cm)	Final fruit diameter (cm)	Fruit volume (ml)	Fruit firmness (lb $inch^{-2}$)
T_1	5.38	4.61	41.68	10.97
T_2	5.18	4.62	42.50	10.94

T_3	5.30	4.62	41.74	10.96
T_4	5.48	4.69	43.17	11.71
T_5	5.57	4.68	43.83	11.99
T_6	5.25	4.68	42.53	11.29
T_7	5.59	5.08	44.57	12.37
T_8	5.12	4.33	39.76	10.35
CD at 5%	0.09	0.02	0.20	0.52

Fruit retention

It is clear from the data presented in Table 2 that the percentage of fruit retention found maximum (74.14%) with treatments 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$. Boron plays important role in pollen germination and pollen tube growth which is associate with better pollination, fertilization and fruit setting (Thompson and Batjer, 1950). Application of zinc could be promoted the auxin synthesis in the plant system which might delayed the formation of abscission layer during early stages of fruit development (Nason and McElroy, 1963). The increase in the fruit retention by application of micronutrient has also been reported in fruits like almond (Sotomayor and Castro, 1997) and aonla (Shukla, 2011).

Number of fruits per tree and yield

Number of fruits per tree and fruit yield during both the year was significantly affected by foliar treatments (Table 2). The maximum number of fruits per tree (492) and fruit yield per tree (25.39kg) were recorded by application of 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ and the minimum found in control. The combination of all the applied micronutrients significantly increase the number of fruits per tree and yield of the plants might be due to the beneficial roles of boron in pollination (Lee and Kim, 1991), zinc in growth promoting substances (Shivanandam *et al.*, 2007) and iron in electron transport chain (Meshcheryakov and Alekhina (1971)). Chaturvedi *et al*. (2005) also suggested application of 0.2 per cent ferrous sulphate and 0.4 per cent zinc sulphate for increasing the fruit yield in strawberry.

Table 2: Response of foliar fertilization of micronutrients on fruit retention (%), average fruit weight (g), number of fruits/tree and fruit yield (kg/tree) of low-chill peach cv. Sharbati

Treatments	Fruit retention (%)	Average fruit weight (g)	Number of fruit/ tree	Fruit yield (kg /tree)
T_1	57.19	45.19	396.98	17.93
T_2	57.32	45.45	414.42	18.83
T_3	60.03	47.25	412.25	19.49
T_4	65.96	48.89	477.53	23.54
T_5	71.80	49.59	485.45	24.07
T_6	50.84	45.02	468.02	21.07

T_7	74.14	51.60	492.00	25.39
T_8	42.02	43.49	385.08	16.74
CD at 5%	5.33	0.42	6.84	0.07

IV. Conclusion

On the basis of results summarized above, it can be concluded that there were a significant variation in growth of fruit and yield of the low-chill peach plants with different micronutrient treatments. Thus, from this study it may be concluded that NPK + 0.1 % H_3BO_3 + 0.5 % $ZnSO_4$, $7H_2O$ + 0.5 % $FeSO_4$, $7H_2O$ could be considered as a best treatment in low-chill peach cv. Sharbati to improve the yield and quality of the fruits.

REFERNCES

1) Babu, KD and Yadav, DS (2002) Fruit growth and development of peach cv. Shan-e-Punjab under edaphic and environmental condition of Meghalaya. Indian J. Hort. 59(1): 44-48.
2) Baker, GA and Davis, ID (1951) Growth of the cheek diameter of peaches, Proc. Amer. Soc. Hort. Sci. 57: 104-110.
3) Chandler, WH, Hoagland, DR and Hibbard, PL (1931) Little leaf or rosette of fruit trees. *Proc. Amer. Soc. Hort. Sci*. 28: 556-560.
4) Chaturvedi, OP, Singh, AK, Tripathi, VK and Dixit, AK (2005) Effect of zinc and iron on growth, yield and quality of strawberry cv. Chandler. Acta Hortic. 696: 237-240.
5) Dutta, P and Banik, AK (2007) effect of foliar feeding of nutrients and plant growth regulators on physico-chemical quality of sardar guava grown in red and lateritic tract of West Bengal. *Acta Hortic.*735
6) Gauch, HG and Dugger, WM (1953) The role of boron in the translocation of sucrose. *plant physiol.* 28:457-467.
7) Lee, S.S. and Kim, K.R. 1991. Studies on the internal browing of apple fruits, caused by excessive boron application and mineral and some organic contents of fruit accordind to excessive B application, *J. Korean Soc. Hort. Sci.* 32(2): 184-190.
8) Meshcheryakov, AM and Alekhina, LA (1971) The effect of iron sulphate and chelate on chlorosis and yields in irrigated grape vines grown on calcareous soil. *Trudy-Issledovaniya-Biologii-Agrotekhniki-i-Uslovii – Vyraschivaniya - Nekotorykh-Sel Skokhozyoi - stvennykh-Koltur-Tadzhikistapa*, 15: 90-104.
9) Nason, A and McElroy, WD (1963) Modes of action of the essential mineral elements in plant physiology: A Treatise. F.C. Steward. (Ed.) Vo. III, Academic Press. New York. 451-521.
10) Panse, VG and Sukhatme, PV (1985). Statistical method for agricultural PP.145-155.ICAR, New Delhi.
11) Pathak, RK and Pathak, RA (2001) Peaches. In: Temperate Fruits. S.K. Mitra, T.K. Bose and D.S. Rathore (eds.). Horticulture and Allied Publishers, 27/3 Chakraberia Lane, Kolkata. pp. 179-232.
12) Raese, JT (1989) Physiological disorders and maladies of pear fruit. Hort. Rev. 11: 357–411.
13) Rana, R S and Sharma, HC (1979) Effect of iron sprays on growth, yield and quality of grapes. Punjab Hort. J. 19(1-2): 31-34.
14) Shivanandam, VN, Pradeep, SL, Rajanna, KM and Shivappa. (2007) Effect of zinc sulphate on growth and yield of mango varieties and hybrids. *J. Soil Crops*, **17**: 225-229.
15) Shoeib, MM. and El sayed, A (2003) Response of "Thompson Seedless" grape vines to the spray of some nutrients and citric acid. *Minia J. Agric. Res. Dev.* 23(4): 681–698.
16) Shukla, AK (2011) Effect of foliar application of calcium and boron on growth, productivity and quality of Indian gooseberry *(Emblica officinalis*). Indian J. Agri. Sci. 81(7): 628–632.
17) Singh, YP, Tiwari, JP and Misra, KK (2003) Effect of micronutrients on fruit yield and physico-chemical characters of mango cv. Dashehari. Prog. Hort. 35(1): 34-37.
18) Sotomayor, C and Castro, J (1997) The influence of boron and zinc sprays at bloom time on almond fruit set. Acta Hortic. 470:402-405.
19) Sourour, MM (2000) Effect of foliar application of some micronutrient forms on growth, yield, fruit quality and leaf mineral composition of Valencia orange trees grown in North Sinai. Alexandria J. Agri. Res. 45(1): 269-285.
20) Tariq, M, Sharif, M, Shah, Z and Khan, R (2007) Effect of foliar application of micronutrients on the yield and quality of sweet orange (*Citrus sinensis* L.). *Pak. J. Biol. Sci*. 10(11): 1823-1828.
21) Thompson, AH and Batjer, LP (1950) The effect of boron in germinating medium on pollen germination and pollen tube growth for several deciduous fruit trees. Proc. Amer. Soc. Hort. Sci. 56: 227-230.
22) Tiwari, JP, Mishra, NK, Mishra, DS, Bisen, B Singh, YP and Rai, R (2004) Nutrient requirement for subtropical peaches and pear for Uttaranchal; An Overview. Acta Horic. 662: 199-204.
23) Umer, S, Bansal, S, Imas, KP. and Magen, H (1999) Effect of foliar fertilization of potassium on yield, nutrition. quality and nutrient uptake of groundnut. *J. Plant. Nutri.* 22: 1785-1795.
24) Woodbridge, CG (1955) The boron requirements of stone fruit trees. *Can. J. Agr. Sci.* 35: 282-286.
25) Zaman, Q and Schumann, AW (2006) Nutrient management zones for citrus based on variation in soil properties and tree performance. *Precision Agri.* 7: 45-63.

[1]First Author- Dr.Vikas Yadav, Subject Matter Specialist &its equivalent post, Krishi Vigyan Kendra, Navsari Agriculture University, Dediapada, Narmada District, Gujarat, India, vikas.yadav15@yahoo.com.

[2]First Author- Dr. P. N. Singh, professor, Department of Horticultural, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar, Uttarakhand, India, PIN: 263 145

[3]First Author- Prakash Yadav, Ph.D Scholar, Department of Agronomy, C.S.A. University of Agriculture and Technology, Kanpur, Uttar Pradesh, India,

Correspondence Author – Dr.Vikas Yadav, Subject Matter Specialist &its equivalent post, Krishi Vigyan Kendra, Navsari Agriculture University, Dediapada, Narmada District, Gujarat, India, vikas.yadav15@yahoo.com, Mob: 09889998483