Himachal Journal of Agricultural Research 35 (2):241-243, 2009

Short Note

Performance of potassium, zinc and boron on growth, yield and quality of apple (*Malus domestica* Borkh)

Ashwani Sud, P. S. Chauhan, M. S. Mankotia and Gopal Singh
Dr Y. S. Parmar University of Horticulture and Forestry
Regional Horticultural Research Station, Mashobra, Shimla-171 007, India.

Abstract

The present studies were carried out at Regional Horticultural Research Station Mashobra, District Shimla, Himachal Pradesh during 2002-2004 on 20 years old plants of apple cv. Red Delicious. The results of the study revealed that combined application of $N:P_2O_5:K_2O$ at 700:350:700 g and 100 kg FYM/tree basin supplemented with Zn (0.5%) and B (0.1%) as foliar spray at pink bud and fruit development stages was most effective in improving annual shoot extension growth, yield, fruit surface colouration, fruit length, fruit diameter and total soluble solids.

Key words: Potassium, zinc, boron, apple, growth, yield.

Apple is the dominant fruit crop of Himalayan region of northern India. Himachal Pradesh has emerged as leading hilly state of India for quality apple production during past three decades. However, apple production in the state has been decreasing consistently during the past few years. Imbalanced nutrition, moisture stress, poor orchards management practices, inadequate pollinizer proportion, incidence of pests and diseases and inclement climatic conditions are the major factors responsible for the reduction in productivity. The normal annual growth of the plants is mandatory for the production of optimal yield and good quality fruit in apple. Besides favourable climatic conditions, the optimal plant growth can be achieved to a great extent by judicious use of fertilizers. Although, there is known evidence of the role of potassium in improving the productivity and quality of apple (Kaith and Awasthi, 1998) but the information on the effect of potassium in relation to other nutrients is not adequate. Therefore, the present studies were undertaken to work out the effect of potassium, zinc and boron on growth, yield and quality of apple.

The present studies were carried out at Regional Horticultural Research Station Mashobra, District Shimla, Himachal Pradesh during 2002-2004 on 20 years old plants of apple cv. Red Delicious. All the trees received uniform dose of 350g P_2O_5/tree as single super phosphate and 100 Kg FYM/plant. Potassium was applied as muriate of potash (60% K_2O) during March every year. The nitrogen was applied as CAN (25%) in two split doses, half 2-3 weeks before flowering and the remaining half one month after the first application. During pink bud and fruit development stages, zinc sulphate (0.5%) and boric acid (0.1%) were given as foliar sprays. In the treatment combinations $N_1$and K_1 represents 700g application each of CAN and potash, whereas N_0 and K_0 indicate no CAN and potash application in the treatment. In all there were 13 treatment combinations of nitrogen, potassium, zinc and boron replicated thrice under RBD. Six shoots were randomly selected from the periphery of the tree and its length was measured at the end of the growing season in October during both the years. The crop load removed from experimental trees during harvesting season August-September was recorded in Kg/tree. The average weight of the fruit was calculated on the basis of eight representative fruits. Total soluble solid contents were determined with the help of hand refractometer, per cent acidity by titrating the juice with standard N/10 NaOH solution, expressed in terms of malic acid and firmness with hand-held pressure tester. The data recorded for two seasons was pooled and statistically analysed.

The perusal of the data (Table 1) indicate significant differences among different treatments with respect to annual extension growth and fruit parameters except fruit acidity which was observed to be non significant. The maximum extension shoot growth (27.90 cm) was recorded with N_1PK_1+Zn+B (T_3), which was statistically at par with N_1PK_1+Zn (T_1), N_1PK_1+B (T_2), and NPK (T_{13}). Similarly, yield was significantly increased by N_1PK_1+Zn+B (T_3) treatment. Yield increased from 10.34 kg/tree in $N_0P\ K_0$ +B (T_{11}) to 39.42 kg/tree with basal N_1PK_1 + Zn + B (T_3). The resultant increase in yield was due to balanced NPK supplemented with foliar Zn and B, increased fruit set and improved K level of the tree. These

results are in concurrence with the observations of Wojcik *et al.* (1997) who also reported significant increase in fruit weight and yield of apple with foliar application of boron. The lower yield in other treatments attributed to the poor flowering and fruit set. Wallace *et al.* (1951) had also demonstrated that N, K and Ca were utilized almost in the same magnitude in the production of flowers. In the present study high yield with N_1PK_1+Zn+B (T_3) combination treatment is the cumulative effect of balanced nutrition. Yogaratanam and Greenhem (1982) also reported a similar increase in apple fruit set by foliar sprays containing N, Mg, Zn and B. In mango, Banik and Sen (1997) also observed that zinc sulphate at 0.2% with boron at 0.1% increased flowering percentage.

Maximum fruit firmness (14.67 psi) was recorded in N_1PK_0+Zn (T_4) and minimum (12.86 psi) in N_0PK_0+Zn+B (T_{12}). This might be due to imbalanced plant nutrition in the treatment T_{12}. Increase in fruit firmness in T_4 is due to the supplemental effect of N, as nitrogen is essential nutrient for the fruit development and structural integrity of the cell wall as well as for calcium translocation. The accumulation of calcium pectate in middle lamella is responsible for increase in fruit firmness. The sprays of zinc also increases the calcium levels of fruit as reported by Schmitz and Engel (1973). Fruit color and TSS contents increased up to 84% and 14.55% at N_1PK_1+Zn+B (T_3) treatment, respectively (Table 1). Ratan *et al.* (1978) reported 750 g K_2O/tree/ year as optimum level for obtaining high TSS contents and fruit colour on Starking Delicious apple. The higher soluble solids and intense colour was also reported by Wojcik (2005) in Jonagold apple with K application. The increase in fruit weight may be attributed to higher cell division and photosynthetic activities as a result of balanced fertilization.

The results of the study revealed that combined application of N:P_2O_5:K_2O at 700:350:700 g and 100 kg FYM/tree basin supplemented with Zn (0.5%) and B (0.1%) as foliar spray at pink bud and fruit development stages was most effective in improving annual shoot extension growth (27.90 cm), yield (39.42 kg/tree), fruit surface colouration (85%), fruit length (6.68 cm), fruit diameter (7.00 cm) and total soluble solids (14.55°B).

Table 1.Effect of Potassium, zinc and boron on growth, yield and quality of apple

Treatments	Annual extension growth (cm)	Yield (kg/tree)	Fruit length (cm)	Fruit breadth (cm)	Fruit Weight (g)	Fruit firmness (psi)	TSS (°B)	Acidity (%)	Fruit Colour (%)
N_1PK_1+Zn(T_1)	25.85	37.85	6.65	6.82	176.00	14.09	14.20	0.21	75.00
N_1PK_1+B (T_2)	25.95	36.41	6.36	6.62	163.35	13.92	14.30	0.19	80.50
N_1PK_1+Zn+B(T_3)	27.90	39.42	6.68	7.00	179.35	13.64	14.55	0.20	85.00
N_1PK_0+Zn (T_4)	21.55	28.38	5.92	6.33	143.35	14.67	13.40	0.19	57.00
N_1PK_0+B (T_5)	24.00	28.53	5.78	6.20	139.00	14.55	12.95	0.20	58.00
N_1PK_0+Zn+B(T_6)	24.75	26.98	6.12	6.63	155.85	14.50	13.20	0.20	54.50
N_0PK_1+Zn (T_7)	15.10	14.31	6.07	6.24	139.15	14.25	13.20	0.20	71.00
N_0PK_1+B (T_8)	15.00	14.00	5.80	6.09	124.00	14.13	13.10	0.19	72.00
N_0PK_1+Zn+B(T_9)	15.40	14.06	6.06	6.34	135.50	14.09	13.15	0.20	74.50
N_0PK_0+Zn (T_{10})	14.10	10.97	5.68	5.93	115.00	13.64	12.40	0.20	66.00
N_0PK_0+B (T_{11})	13.80	10.34	5.72	6.01	120.00	12.88	12.55	0.21	66.00
N_0PK_0+Zn+B(T_{12})	13.65	10.93	5.77	6.05	125.50	12.86	12.70	0.21	65.00
N.P.K(T_{13})	25.50	30.82	6.53	6.95	162.85	14.62	14.25	0.20	73.00
CD (P=0.05)	3.41	3.86	0.69	0.72	26.20	0.89	0.95	NS	8.25

References

Banik BC and Sen SK 1997. Effect of three levels of zinc, iron, boron and their interaction on growth,flowering and yield of mango cv. Fazli. Hort. J. **10** (1):232-29.

Kaith, NS and Awasthi, RP 1998. Effect of K on growth, yield, fruit quality and leaf nutrient status of apple Starking Delicious. Indian J. Hort. **55** (1):10-15.

Ratan SS , Pant PC, Singh MV and Adhikari WS 1978. Response of apple variety Royal Delicious to different ratios of NPK. Prog.Hort. **10**:29-38.

Schmitz KJ and Engel G 1973. Untersccchungen und Beobachtungen Zur Stippigkeit. Erwerbobstbau **15**:9-14.

Wallace A, Cameron SH and Mneller RT. 1951. Seasonal use and loss of nutrient and dry matter in orange trees. Proc. Amer. Soc. Hort. Sci. **60**:51-54.

Wojcik P 2005. Effect of foliar potassium sprays on apple tree yield and fruit quality under conditions of low soil potassium availability. Proc. Intl. Scientific Conf.: Environment- Friendly- Fruit growing-Polli-Estonia, 7-9 September 2005, p 44-50.

Wojcik P,Mika A and Civeslinski G.1997. Effect of boron fertilization of apple on yield and fruit quality. Acta Agrobotanica **50** (1-2):111-24.

Yogaratanam N and Greenham DWP 1982. The application of foliar sprays containing nitrogen, magnesium, zinc and boron to apple trees. 1. Effect on fruit set and cropping. J.Hortic. Sci. **57** (2):151-58.

VIR SOFTECH