How Much Boron Do Flowers Need?

By Eric Hanson

Meeting the boron (B) requirements of crops has been a continuing challenge for farmers and scientists. Some tree crops appear to require more B than previously thought.

BORON, long known as an essential plant nutrient, is recognized for its critical role in the flowering process and seed set. Yet, answers pertaining to its specific influence on flowering and subsequent fruit and nut set or how much tree crops need for optimum production are not clear.

Fruit and nut tree growers typically judge the nutritional health of their tree crops based on the nutrient levels in leaves. Recent investigations have shown that some tree crops respond to applied B even though tissue analysis and tree appearance indicated adequate B nutrition. In these cases, foliar B sprays improved yields by increasing the percentage of flowers which set fruit.

Photo credit: Dave Burkhart

MOST temperate tree crops show B deficiency symptoms as shoot dieback and leaf distortion when leaf tissue B levels fall below 15 or 20 parts per million (ppm). Corrective applications are usually made when leaf B is low or deficiency symptoms are evident.

The B nutrition–fruit set relationship was first observed in apple and pear orchard trials. A detailed study of B nutrition of 'Italian' plum, grown in the Pacific Northwest for prune production, showed that foliar B sprays often increased fruit set, even when growth was normal and leaf tissue B level of 30 to 40 parts per million (ppm) was considered adequate. Similar work in the 1980s on filberts or hazelnuts was even more surprising. Trees having up to 80 ppm B in the leaf tissue usually increased the percentage of flowers which set and matured nuts when supplied with additional B. Deficient levels in filbert leaves were previously thought to be less than 11 ppm. More intensive production systems require that the B needs of tree crops be re-evaluated.

Research found that sour cherry trees respond well to B nutrition. Low fruit set percentages frequently limit yields under Michigan conditions. Foliar B sprays,

Table 1. Boron sprays affect fruit set and production of sour cherries.

B in control leaves, ppm	Response (% increase)		
	Fruit set	Yield/ tree	Yield/unit trunk cross sectional area
19	+110	ns	+100
20	ns	ns	+34
22	+30	ns	+14
23	ns	ns	+13
25	ns	ns	ns
27	ns	+13	ns
28	ns	—	—
32	+34	ns	ns
32	ns	ns	ns

(ns) no significant effect. (—) data not available.

Dr. Hanson is Associate Professor, Department of Horticulture, Michigan State University, East Lansing, MI 48824.

applied in the autumn while leaves are still functional and before leaves begin to abscise, are an effective method and time for supplying B to flowers and increasing fruit set the following spring. Absorbed B moves out of leaves and into adjacent spurs and twigs during a 2 to 4 week period in the autumn, remains in the wood during the winter, and becomes available to the developing flowers in spring. Fall sprays usually increase B concentrations in the flowers by 50 to 100 percent.

Foliar B sprays enhanced fruit set and increased fruit production (**Table 1**). The greatest responses, where B doubled fruit set and production, were observed in those orchards having relatively low leaf tissue B levels. Additional trials have clearly illustrated that orchards with low leaf B levels respond the most to B treatments. Trees containing 30 ppm B or higher were less likely to show a benefit. Spray concentrations were 500 ppm B, applied at rates of 0.5 to 1.0 lb B/A. In these trials, no apparent deficiency symptoms existed and leaf B levels were 19 to 32 ppm, well above the previously considered deficiency levels of 15 ppm.

Fruit set is a complex process, involving a series of steps including pollination, pollen germination, pollen tube growth, fertilization, etc. Deficiency or stress at any point can limit fruit set and yield. Although the mechanism by which B operates to improve fruit set is unclear, studies show that when fruit tree pollen grains are cultured in low B sugar solutions, pollen germination and the growth of pollen tubes are reduced.

Boron benefits the flowering process most when weather during the bloom period is wet and cold, conditions which lower fruit set and yield potentials. Under adverse conditions, slow pollen tube growth limits fruit set because flowers deteriorate before fertilization is completed. Boron may enhance fruit set by accelerating this process.

Complicating our understanding of B nutrition is the fact that fruit set and yields are not always increased by B sprays. Numerous questions remain unanswered. We need to better understand how B influences fruit set in order to predict accurately when sprays are likely to be beneficial. Further, several tree crops and cultivars have not been adequately tested. For example, little work has been done on sweet cherries. Undoubtedly, more research is needed to determine the role of B in flowering and fruit set. ■

BORON recommendations for the sour cherry or pie-cherry industry in North America should be relatively easy to improve since only one cultivar, "Montmorency", is used.