University of Idaho
College of Agriculture

Cooperative Extension Service
Agricultural Experiment Station

Current Information Series No. 655

Idaho Fertilizer Guide: Orchards

Steven E. Petrie, W. Michael Colt and Walter Kochan

Fruit trees require adequate supplies of all essential plant nutrients to produce optimum yields of quality, extra-fancy fruit. The following fertilizer guidelines assume good orchard management practices are followed.

Soil analysis has proven successful at predicting the fertilizer requirements of annual crops. However, it has long been recognized that soil analysis is less reliable for predicting fertilizer requirements of established orchards.

Leaf analysis has proven more successful than soil analysis at predicting fertilizer requirements of fruit trees. Leaf analysis results must be linked to visual observation of tree growth and performance throughout the growing season. The packout of the orchard or block determines whether the nutrient supply was adequate for that growing season. Nitrogen, zinc and iron are the nutrients that most commonly affect the percentage of extra-fancy fruit from Idaho orchards.

Leaf Analysis

Leaf analysis can serve as a useful index of fruit trees' nutritional status. Research trials have shown that nutrient concentration in leaves can be related to the deficiency, sufficiency or excess concentration of plant nutrients. Analysis of leaves collected from commercial orchards can be compared to standards developed in research trials only if the leaves are collected at the correct growth stage, are collected from the proper part of the tree and are handled properly.

Each sample should represent no more than 5 acres, and several trees should be included in each sample. Samples of at least 50 but less than 100 leaves should be collected in late July or August. All leaves should be collected at shoulder height around the tree's periphery from the middle of the current season's shoot. Only healthy leaves with no spray, insect or disease damage should be selected. The petiole should be included with the leaf sample. Leaves should be wiped with a damp cloth soon after collection to remove dust and other contamination and then air dried before being submitted for analysis. Mark the trees selected for sampling or note them on a map. Future samples should be collected from the same trees. When diagnosing trouble spots, collect leaves from five affected trees and five nearby non-affected trees.

Nitrogen (N)

The nitrogen fertilizer rate for young trees is based on tree age and growth rate of shoots. Table 1 gives the recommended application rate. The nitrogen application rates should be adjusted so that young, nonbearing trees grow 24 to 36 inches per year.

Fertilization of mature, heavy-bearing trees may be based in part on terminal growth. Apples, pears and cherries should grow 8 to 12 inches per year. Leaf nitrogen levels should be used in conjunction with terminal growth as a guide to nitrogen fertilization (Table 2).

Table 1. Nitrogen fertilizer recommendations for young trees.

N fertilizer	Nitrogen	Apply per year of tree age
	(%)	(lb)
Ammonium sulfate	21	0.20
Ammonium nitrate	34	0.12
Urea	45	0.09
Calcium nitrate	15	0.28
Uran	32	0.13

If the leaf nitrogen concentration is deficient, apply 1 to 2 pounds N/tree. Nitrogen may also be supplied to apples using foliar urea sprays. Urea sprays, though, are ineffective on pears and stone fruits. The recommended application rate is 2 to 5 pounds of urea/100 gallons of water based on a spray rate of 400 gallons/acre. Do not apply more than 10 pounds of urea/100 gallons of water or fruit russetting and poor color may result.

Nitrogen fertilizer applied in the fall is subject to leaching, especially on coarse textured soils. Leaching may be minimized by applying ammonium (NH_4+) forms of nitrogen after the soil temperature is below 40° F. If the soil is above 40° F, microorganisms convert the NH_4+ to nitrate (NO_3-) which is then subject to leaching. Leaching will also be minimized if half of the nitrogen is applied in the fall after the trees are dormant and the remainder applied in the spring.

Optimum fertilizer efficiency results when nitrogen is applied shortly before bud swell, an indication of increased root activity. Nitrogen fertilizer should be applied before mid-June. Later fertilization as well as excess fertilization can result in poor fruit color, delayed fruit maturity and increased possibility of winter injury. The nitrogen fertilizer should be broadcast over the entire soil surface.

Phosphorus (P)

Fruit trees have not responded to phosphorus fertilization, regardless of soil or leaf phosphorus concentrations. Phosphorus fertilization is not recommended.

Potassium (K)

Potassium responses are uncommon in Idaho but have been observed in other Western states. Table 2 shows deficient leaf potassium levels. Apply 4 to 8 pounds K tree in a concentrated band on the soil surface if a deficiency occurs. Sulfate of potash (K_2SO_4) is 44 percent potassium, and muriate of potash (KCl) is 50 percent potassium. To avoid Cl toxicity, use sulfate of potash instead of muriate of potash in low rainfall areas.

Calcium (Ca)

Bitter pit of apples is a physiological disorder related to poor calcium nutrition. Spray applications of 5 pounds of calcium nitrate in 100 gallons of water have reduced the incidence of bitter pit. Three sprays are recommended: one each in mid-June, mid-July and mid-August. More sprays may be necessary on young, vigorous trees with a history of bitter pit. Sprays should not be applied after mid-August. Both the leaves and fruit must be uniformly covered since calcium is immobile within the tree.

Table 2. Nitrogen and potassium concentration in fruit tree leaves in August.

Fruit	N concentration			K concentration
	deficient	sufficient	excessive	deficient
	(%)	(%)	(%)	(%)
Apples				< 1.1
Golden delicious	< 1.6	1.6-2.2	> 2.2	
Non-spur delicious and others	< 1.8	1.8-2.3	> 2.3	
Pears				< 0.7
Bartlett	< 1.9	1.9-2.8	> 2.8	
Anjou	< 1.5	1.5-2.4	> 2.4	
Other	< 1.7	1.7-2.6	> 2.6	
Sweet cherries	< 2.3	2.3-2.6	> 2.6	< 1.5
Prunes	< 1.8	1.8-2.5	> 2.5	< 1.5
Peaches	< 2.0	2.0-3.5	> 3.5	< 1.2

Boron (B)

Boron deficiencies are uncommon in Idaho but have been reported in other Western states. Boron deficiency occurs primarily on calcareous soils. Leaf boron concentrations less than 15 ppm indicate a boron deficiency and 3 to 5 pounds of B/acre should be applied. Apply 1 to 3 pounds of B/acre to young, nonbearing trees because these are more easily injured by boron toxicity. A soil application should last 3 to 5 years. Foliar application of 1 pound of B/acre per year is also effective at correcting boron deficiency.

Zinc (Zn)

Zinc should be applied if the leaf tissue zinc is less than 15 ppm or if zinc deficiency symptoms are observed. Zinc deficiency is characterized by small, terminal leaves clustered on a short stem (rosette). The leaves are also chlorotic with the large veins greener than the surrounding tissue creating a Christmas tree-like appearance.

Foliar application of zinc is preferred because soil application is ineffective in correcting zinc deficiency. If a deficiency is observed, apply 15 pounds of Zn/acre before the buds open. Or, apply 7½ pounds of Zn/acre after harvest while the leaves are still green. Low concentrations of zinc may also be applied in the first and second cover sprays. When using zinc sulfate, be sure all crystals are dissolved before spraying. Do not apply zinc nitrate in the fall. After correcting the deficiency, a maintenance application of 2 pounds of Zn/acre in the cover sprays is recommended.

Iron (Fe)

Iron deficiency is characterized by yellow leaves with a network of green veins throughout the leaf. The chlorosis pattern of faulty iron nutrition in fruit trees differs from that of zinc deficiency in that most veins remain green, producing a network of thin green lines on a yellow background. As the iron deficiency worsens, the leaf margins turn brown and die. Entire leaves then die starting at the branch tip and proceeding down the branch.

Iron deficiencies occur primarily on alkaline soils because the iron is "tied up" in a form unavailable to the plants. Thus, special fertilizer materials and application methods are required to prevent "tie-up" of the applied iron.

Certain organic chelates, iron-EDDHA and iron-DTPA, have been found to increase the availability of iron on alkaline soils. Applications of ¼ pound of iron-chelate per tree in 4 gallons of water have proven successful at correcting iron chlorosis. Four injections of 1 gallon each per tree should be made to a depth of 12 inches. The injections should be equally spaced inside the dripline.

Table 3. Phosphorus fertilizer rates for cover crops based on soil test values.

Soil test P (0 to 12 inches)	Apply P_2O_5	Apply P
(ppm)	(lb/acre)	
0 to 3	160	70
4 to 7	120	55
8 to 10	60	25
over 10	0	0

Table 4. Potassium fertilizer rates for cover crops based on soil test values.

Soil test K (0 to 12 inches)	Apply K_2O	Apply K
(ppm)	(lb/acre)	
0 to 38	200	165
39 to 75	140	115
76 to 112	80	65
over 112	0	0

Cover Crops

Establishment of a good cover crop or sod is usually essential if spraying and other cultural practices are to be performed in a timely manner. A good cover crop or sod cover also helps control weeds and prevent erosion. The increased organic matter from the cover crop improves soil tilth and increases water-holding capacity. However, the cover crop or sod should be limited to alleyways. The area within the dripline of the tree should be clean cultivated.

The cover crop or sod should be grass and not legumes because the nitrogen "fixed" by legumes will be released in the late summer and early fall. This could result in poor fruit color, delayed fruit maturity and increased possibility of winter injury. Recommended grasses for a cover crop include orchardgrass and fescue.

Cover Crop Fertilization

Soil tests for nitrogen do not correlate well with cover crop or sod growth; nitrogen fertilization is usually determined by grass growth. Grasses can utilize 50 to 150 pounds of N / acre per year based on the actual acreage of grass. Nitrogen fertilizer should be applied in late fall after the trees are dormant and before mid-June. Adequate fertilization insures a vigorously-growing cover crop or sod that is more capable of withstanding vehicle equipment and that helps prevent soil erosion.

Cover crops and sod respond to phosphorus and potassium fertilization if the soil tests low in these nutrients. Tables 3 and 4 give fertilizer recommendations based on soil test values.

General Comments

1. Overirrigation and subsequent nitrogen leaching are hazards, particularly on sandy soils.
2. Irrigation, soil type and previous fertilizer application can influence fertilization results.
3. Fertilizer application rates should be adjusted to reflect the results obtained from fertilization in previous years.
4. "Shotgun" applications of micronutrient mixtures have not resulted in yield increases and are not suggested.
5. Contact your University of Idaho Extension county agent if you have any questions on the information presented here.

The Authors

Steven E. Petrie is an Extension soil fertility specialist at Twin Falls. W. Michael Colt is an Extension horticulturist, and Walter Kochan is a professor of plant science, both in the University of Idaho Research and Extension Center at Parma.

Two other College of Agriculture publications on fertilization you will want to get are:

CIS 608 Essential Plant Micronutrients — Boron in Idaho ..... 15 cents

CIS 617 Essential Plant Micronutrients — Zinc in Idaho ..... 15 cents

You can get copies of these publications from your University of Idaho Cooperative Extension county office. Or, you can order directly from:

Agricultural Information
College of Agriculture
University of Idaho
Moscow, Idaho 83843

Please list publications by title and number on your order. Make your check payable to University of Idaho, Agricultural Information.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U. S. Department of Agriculture, H. R. Guenthner, Director of Cooperative Extension Service, University of Idaho, Moscow, Idaho 83843. We offer our programs and facilities to all people without regard to race, creed, color, sex or national origin.

1500 5-82

10 cents per copy