Acidifying the Soil

The management of soil pH is important throughout the life of a blueberry planting. Blueberry plants are more vigorous, have more uniform color, and are more productive when growing in acid soil conditions - below pH 5.0. Since pH is frequently between 7 and 8, or even higher in many potential California blueberry growing areas, careful attention to soil pH management is important. In those instances where soil pH is above 8.4, excess sodium may also be a problem, and these soils require additional special management. Poor drainage also limits soil acidification, and the installation of special drainage measures will be needed before soil acidification should be attempted.

To lower the soil pH, acid - usually sulfuric acid - may be applied directly to the soil. Sulfuric acid application is a rapid and effective way to lower the pH but requires specialized equipment and applicators specially trained to handle the potentially hazardous acid. Other acids, such as nitric, phosphoric, etc., can also be used, but they should be used sparingly and paying close attention to the potential for over-application of nitrogen and phosphorus that could result.

More often, elemental sulfur is applied and incorporated in the soil. When elemental sulfur is mixed with moist soil, soil bacteria convert the sulfur to sulfuric acid.

Sulfur is oxidized by bacteria to form sulfuric acid

$$S + O_2 + H_2O \dashrightarrow H_2SO_4$$

(elemental S + oxygen + water + thiobacillus + time $\dashrightarrow$ sulfuric acid)

Soil pH in fields can be quite variable initially following application of sulfur to lower pH. The desired lower pH may not be completely uniform in the bed for several months. It is difficult to get the sulfur uniformly distributed in newly sulfured fields, and the reaction of the sulfur granules can be slow, depending upon the type of sulfur applied and the field conditions. Acidified soils will require continuing ph management for optimum blueberry growth and production throughout the life of the planting.

Apply the sulfur to the soil as early as possible prior to planting and use only finely ground sulfur as opposed to traditional "popcorn" sulfur. The sulfur products that have shown good results in California are Tiger Sulfur 90 and Dispersul, both of which are finely ground sulfurs formed into pellets with bentonite clay for ease of application. The clay expands as it absorbs moisture and breaks apart to disperse the fine sulfur particles.

The amount of sulfur to apply can be determined in a soil laboratory by an analysis for the soil in question or can also be determined by using the current pH and the soil texture chart in Table 1. Normally 2 million pounds representing an acre slice to a depth of 6 inches is used as the basis for calculation of these rates. If beds are raised to 8-12 inches and additional soil volume is moved to establish the beds, this figure may actually be 50-100% higher than the values indicated. If the soil has high levels of bicarbonates and/or free limestone (calcareous) - also common in California - then the S-requirement may also be higher than that indicated by

the chart. Try to correct the figures with an accurate estimate of the total soil volume moved. The sulfur can just be applied to the 4-foot-wide band centered over each row to decrease the costs of acidification. The sulfur should be incorporated uniformly with the soil and any other added amendments.

Table 1. Amount of elemental sulfur to apply depending on soil textural class to lower the pH from the indicated pH to 5.0

	Soil Textural Class		
Initial pH	Sand	Loam	Clay
	(lb / 1000 ft^2)		
5.0	4.0	11.7	7.8
5.5	7.7	23.4	35.4
6.0	11.7	34.3	25.9
6.5	14.7	44.7	51.28
7.0	18.6	56.6	84.9
7.5	23.6	59.2	87.5

- these values are for amending a soil to 6 inches. For greater soil volumes as with bedding operations increase the S applied proportionately.

Correcting soil pH when sodium is present involves substituting the sodium with calcium and leaching away the excess sodium so drainage is critical.

This reaction is fairly rapid. One ton of elemental S is equivalent to 5 tons of gypsum.

$$H_2SO_4 + CaCO_3 \dashrightarrow CaSO_4 + CO_2 + H_2O$$

(sulfuric acid + lime $\dashrightarrow$ gypsum + carbon dioxide + water)

The management of soil pH is especially critical during the initial establishment period, and growers should pay close attention to the pH environment surrounding the roots of the young plants. If growing conditions are otherwise adequate, a young blueberry plant should begin to initiate new growth 30-60 days after planting, and the foliage overall should have a uniform green to blue-green color down the entire row. The application of sphagnum peat moss to the planting hole at planting provides an ideal environment for the young blueberry plant to establish. The peat moss has an acid pH and also improves moisture retention and aeration in the root zone.

In special circumstances, the plants can be established on a site where the pH is not yet in a desirable range if specific steps are taken to be certain the plants have the nutrients they need. The sphagnum peat is incorporated in the plant hole at planting and iron chelate is applied regularly to the plants as a drench or foliar spray. Blueberries growing where the root zone pH is above 5.5 can show pale green-yellow (chlorotic) new growth due to iron deficiency; the plant

is slow to initiate new growth and the growth is weak. Iron chelate will supply iron to allow chlorotic plants to green-up and begin vegetative growth while the pH of the surrounding soil is falling.

Continuing periodic surface application of more modest amounts of S - 200 to 300 lb per acre per year - will aid in maintaining the desired soil pH. Surface applied S will be most effective during rainy periods as the fine S particles are washed through the mulch and into contact with moist soil. Surface S applications will likely not be effective for as long as six to twelve months following application, so a continued periodic program of S application is the most effective. Application of sulfur to moist soil creates the conditions for soil microorganisms to produce sulfuric acid in the soil. Apply the finest grind of sulfur possible and apply it uniformly.

Test soil pH regularly, and as pH begins to rise, apply S. Acidified irrigation water is a key element of pH management, and it can allow plants to develop normally in many cases while the pH in the surrounding soil is in transition. Sulfuric acid, urea sulfuric acid, and other acids may also be used to acidify the water where the water is alkaline. If alkaline irrigation water is not acidified, the soil pH will increase more rapidly following acidification. The soil will slowly tend to return to its native pH if the acid pH is not regularly maintained with sulfur or acid additions and this trend is accelerated with a high pH irrigation water high in bicarbonates. A soils laboratory can test how much acid of a given type or strength is necessary to lower the pH to the desired level. Acidify the water to a pH of 5.0 or to the point where the total bicarbonates fall below 1.0 meq.