NUTRIENT STATUS OF WISCONSIN CRANBERRIES

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Many fertilization programs over the years in an effort to increase cranberry yields. Some have resulted in increased yields in some years and some marshes. Others have not, Many factors are at play in producing a high yield including soil type, site, water availability, temperature, sunlight, management practices, and general vigor of the vines. What works well for your neighbor won't necessarily work for you. Mineral nutrition is only one piece of the total yield puzzle.

Plant analysis is the quantitative determination of the essential elements in plant tissue. Elements included by the University of Wisconsin Soil and Plant Analysis Lab include: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), and boron (B). Sodium (Na) and aluminum (AI) are also included though they are not essential. Sodium improves the quality of some crops and aluminum can be toxic in some low pH soils.

If properly used, results of plant analysis and a soil test can be a guide for efficient crop production. Soil tests provide estimates of nutrient needs but not all pieces of the production puzzle are supplied by just a soil test. Plant analysis allows you to evaluate your fertilizer and management practices by providing a nutritional "photograph" of the crop. These "photographs" can be used to help identify nutritional disorders, evaluate fertilizer efficiency, and determine availability of elements for which no reliable soil test exists.

Between 1981 and 1989 the Soil and Plant Analysis Lab at the University of Wisconsin-Madison analyzed about 400 cranberry plant and soil samples. While this is not a great number it may be representative of the cranberry marshes in the state as a whole. We have plotted some test results for the major nutrients for cranberry plants and soil in figures l-9. In each figure the proposed critical tissue level has been identified at the top. Below this number the tissue sample would be considered deficient in that nutrient. Additions of nutrients to deficient vines should result in a positive response. Samples containing more than the critical level are considered to have sufficient nutrition for good yield. Addition of nutrients above yearly maintenance doses probably will not result in a yield response.

First lets look at nitrogen (N) (Fig 1). Over the past several years, 75% of the samples were sufficient in nitrogen. These levels are reasonable as too 'much nitrogen can cause rank vine growth and lead to decreased yields. This suggests that most marshes have enough nitrogen and adding large quantities of nitrogen may be counterproductive. However, the 25% of samples that are below 0.9% N may profit by having more N added. In these beds it likely won t matter what form of N is provided (liquid, granular, organic, or foliar). These vines should show improvement given any N. However, during hot days beds established on peat may release enough nitrogen from mineralization processes to supply significant amounts of usable nitrogen.

Phosphorus (P) is also important to cranberry production (Fig. 2). About 75% of the samples were in the sufficient range (0.14% or higher). A few samples were in the high range (above 0.19%). Adding large amounts of phosphate fertilizer to these vines already having sufficient tissue P levels will probably not increase yields. However, the vines represented by the 25% deficient samples may profit by additions of phosphate fertilizer. Phosphate is relatively immobile in soils because it is fixed very tightly to specific soil adsorption sites. Availability of fixed phosphate to plants is affected by soil pH and soil potash content. Plants should have adequate levels of available P if soil test levels are maintained at 25 ppm (50 lbs/acre) with a pH less than 6.5.

The other major element of interest is potassium (K) (Fig 3). Ninety four percent of the samples had tissue potassium at or above the critical level of 0.5%. Only 6% of samples had tissue K levels below critical. Although potassium deficiency may occur in Wisconsin cranberries, the likelihood is extremely low because beds have adequate natural K reserves.

Magnesium (Mg) is an important element for plant growth. The vast majority of our samples (88%) were sufficient for Mg (Fig. 4). Only 12% of the beds would profit from remedial applications of Mg. A good source of magnesium is dolomitic lime. If a change in soil pH is not desirable, Epsom salts (MgS04) may be applied. Magnesium deficiency symptoms in Wisconsin cranberries should be rare.

Levels of micronutrients are of concern to many growers. These elements are required in very small amounts (parts per million) yet are critical to normal plant growth. Our understanding of the critical levels of micronutrients is limited, and in some instances is based on greenhouse work which may not apply well to field conditions.

With the exception of zinc, virtually all the plant samples analyzed were sufficient in all microelements. Roughly 10% of the samples were below the critical level for zinc (Fig. 5). However, as soil pH decreases, zinc availability increases. So, if a bed has zinc deficiency it may be solved be applying a small amount of sulfur to reduce the soil pH.

Boron is known to be an important micronutrient for flower formation and function. The mechanics of the function of B are not known. Boron is quite immobile in plants and may not be in sufficient concentration in rapidly growing tissues such as floral meristems. Our data show that virtually all of the tissue samples had adequate boron (Fig. 6). Boron application has been shown to be beneficial when applied to other fruit crops. No definitive data are yet available for cranberries, however. We are suggesting a tentative critical level of 10 ppm. At this time there is no scientific data to suggest cranberries will benefit from further boron application. Because plants have a very fine line between enough and too much micronutrient, potential toxicities can occur with indiscriminate applications.

Soil pH is another important factor for cranberry production. The optimum cranberry growth is between 4.0 and 5.5. The bulk of the samples tested (80 %) were in that range Fig. 7). The beds represented by the remaining 20% of samples could benefit from soil pH adjustment. Caution should be taken to not overadjust. Decreasing high pH will increase availability of phosphorus and most micronutrients. Having soil very acidic (pH < 4.0) may create increases in the soluble forms of aluminum and cause toxicity.

There is also some confusion in the relationship between soil element concentration and tissue element concentration. We like to think that if more fertilizer is applied to the soil that the tissue content of the applied elements will also increase. However, when we plot the relationship between available soil nutrient and tissue nutrient analysis the result is not definitive.

The plots for available soil P and K and leaf potassium and phosphorus (Figs. 8 & 9) illustrate the point. For both elements there is a broad range of soil concentrations, yet the tissue concentrations are very narrow. This suggests that other factors beyond soil availability control the content of the elements in tissues. Apparently, having enough of an element in the soil is important, but adding more will not necessarily increase the tissue concentration of that element. Furthermore, higher tissue nutrient levels do not necessarily result in a corresponding yield increase.

The cranberry industry in Wisconsin has followed many individual fertilizer programs on the quest for the holy Grail of high yields. Some programs have called for frequent applications of small amounts of fertilizer at great expense. In some instances the cost of application was higher than the cost of materials. These data suggest that other factors may be at work in determining yields and tissue nutrient content; and that tissue sampling for sufficiency of mineral elements is a good way to help choose the specific elements your beds may need.

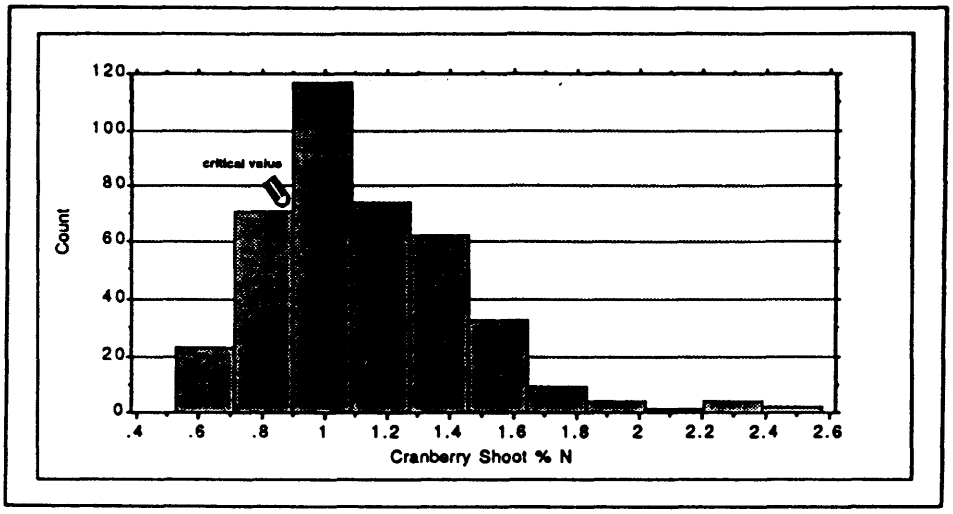

Figure 1. Above, cranberry tissue nitrogen levels from Wisconsin between 1981 and 1989. The critical level for tissue nitrogen is 0.9%.

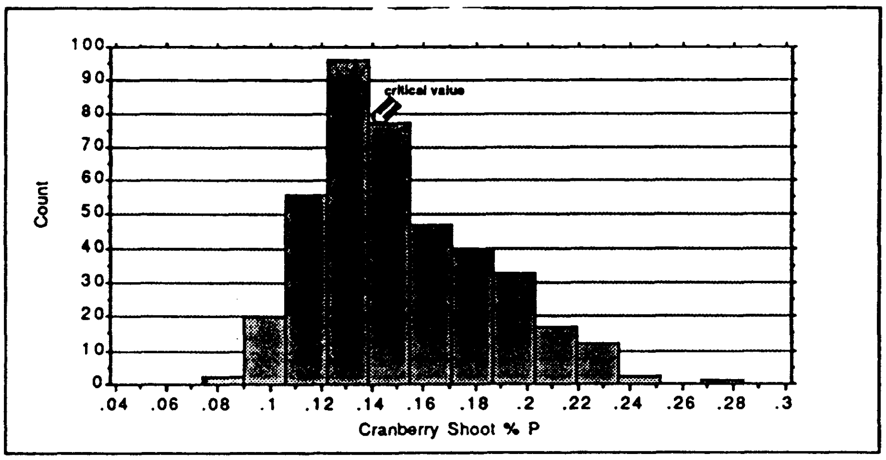

Figure 2. Above, cranberry tissue phosphorus levels from Wisconsin between 1981 and 1989. The critical level for tissue potassium is 0.5%.

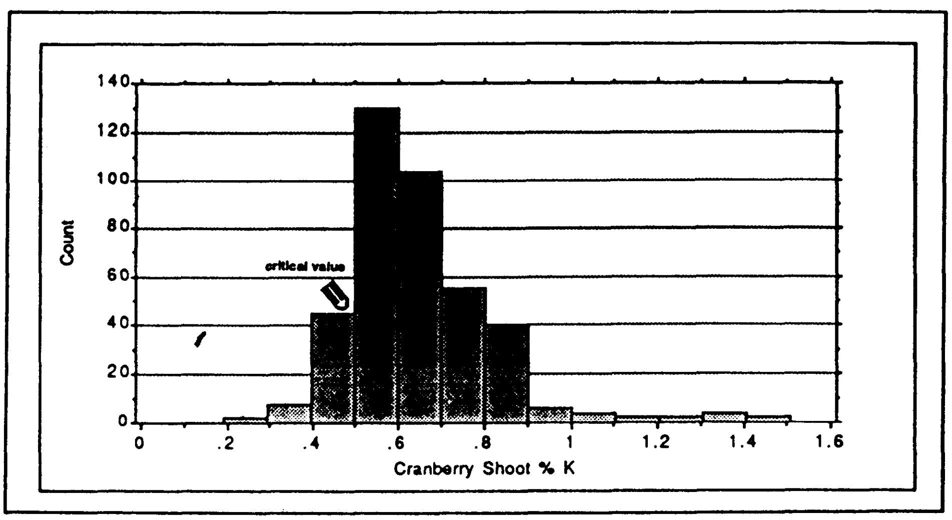

Figure 3. Above, cranberry tissue potassium levels from Wisconsin between 1981 and 1989. The critical level for tissue potassium is 0.5%.

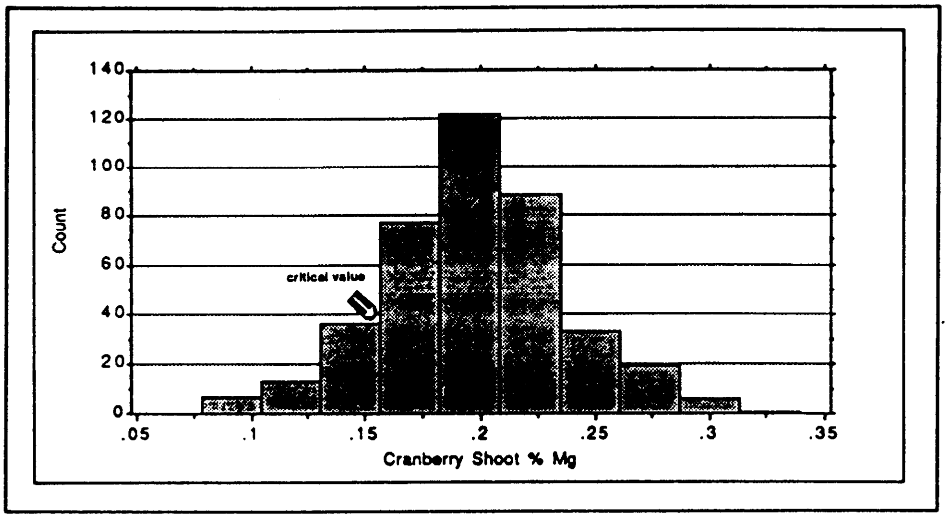

Figure 4. Above, cranberry tissue magnesium levels from Wisconsin between 1981 and 1989. The critical level for tissue magnesium is 0.15%.

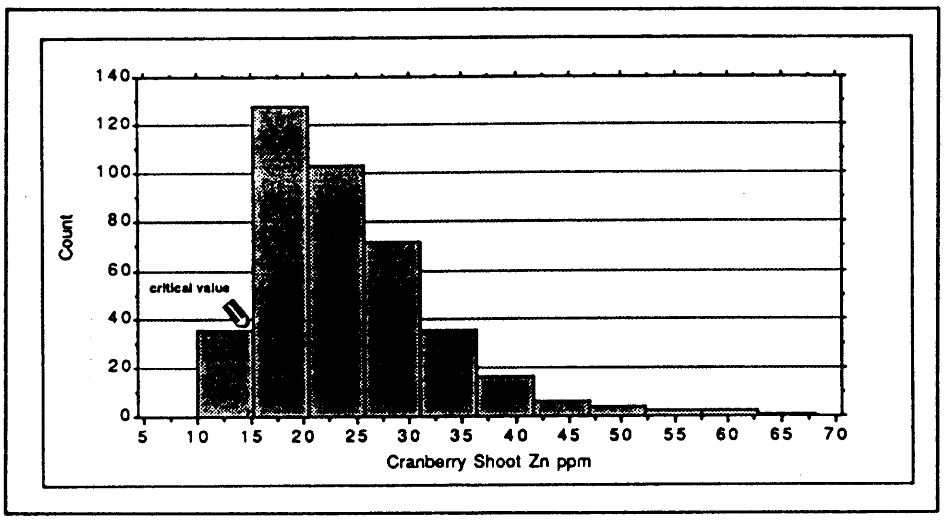

Figure 5. Above, cranberry tissue zinc levels from Wisconsin between 1981 and 1989. The critical level for tissue zinc is 15 ppm.

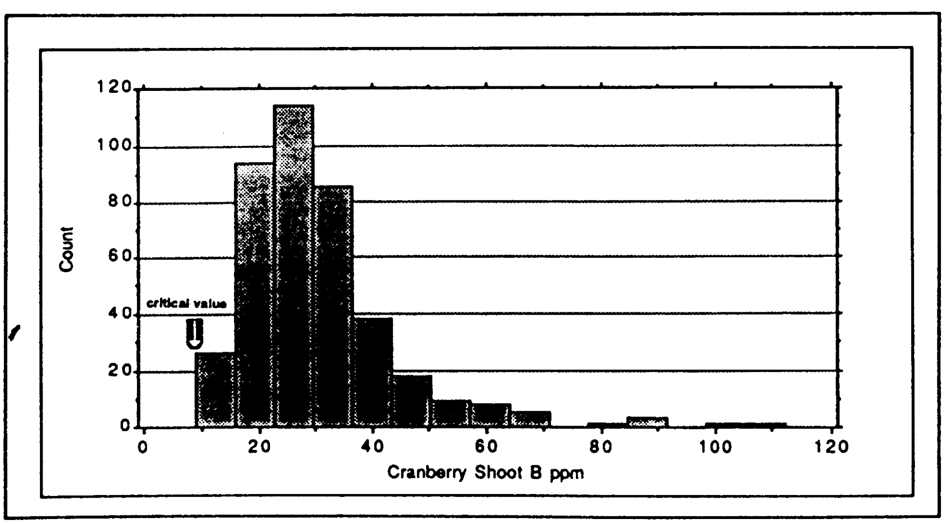

Figure 6. Above, cranberry tissue boron levels from Wisconsin between 1981 and 1989. The critical level for tissue boron is 10 ppm.

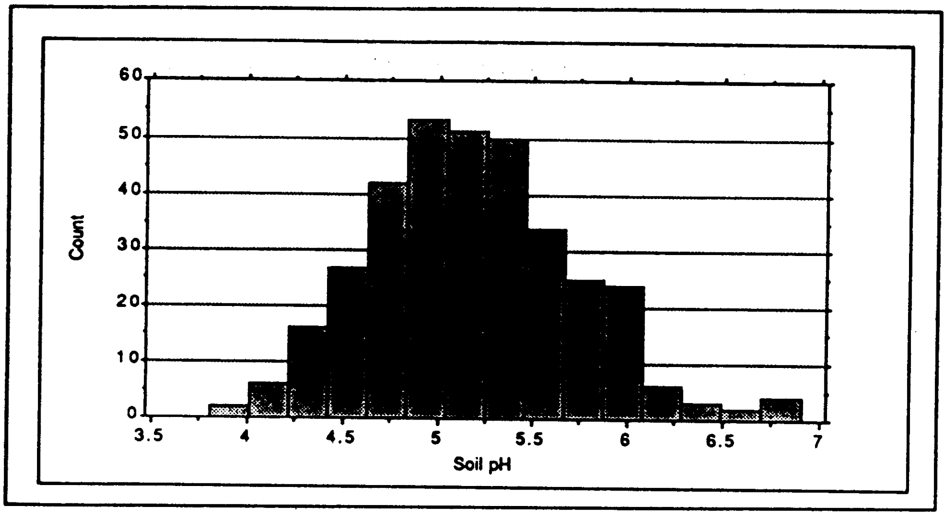

Figure 7. Above, soil pH for Wisconsin cranberry beds sampled 1981-1989. Optimum soil pH is 4.0 tp 5.5.

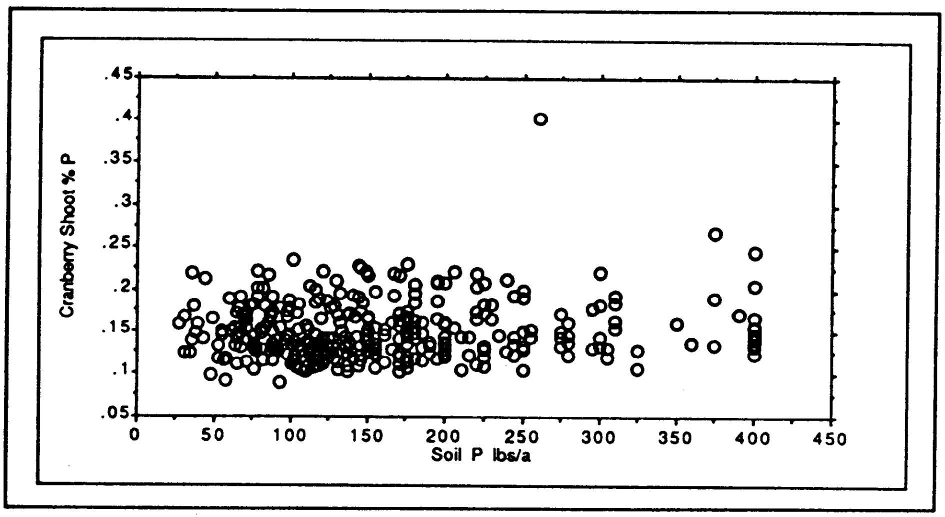

Figure 8. Above, the relationship between Wisconsin cranberry tissue phosphorus levels and available soil phosphate between 1981 and 1989.

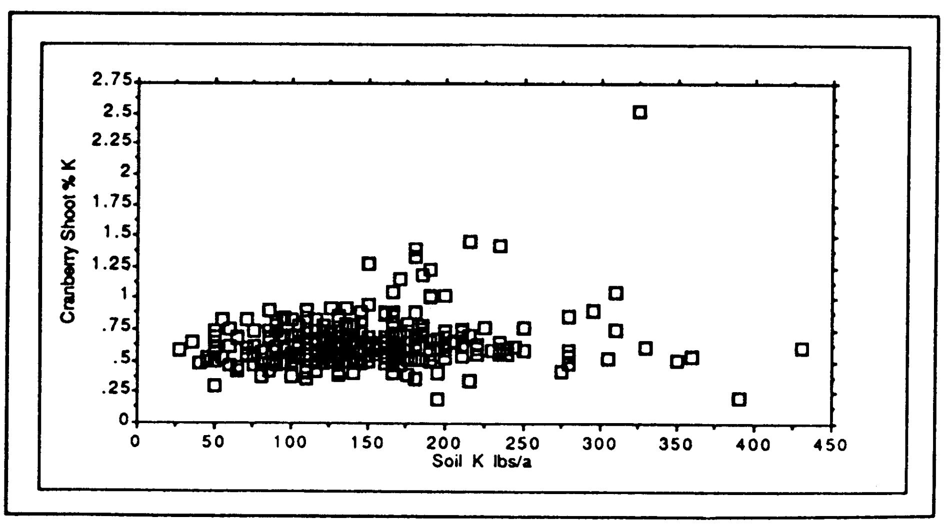

Figure 9. Above, the relationship between Wisconsin cranberry tissue potassium levels and available soil potash between 1981 and 1989.