Nutrient Management for Onions in the Pacific Northwest

By D.A. Horneck

Both quality and yield of onions are essential attributes for profitability. Nutrient management makes a major contribution to this widely grown vegetable.

Onions represent the third-largest fresh vegetable industry in the U.S. The per capita consumption of onions is around 18 lb/year. They are a high-value crop, where both high yield and quality are important economic considerations. Successful onion production depends on careful nutrient management, as well as other management techniques, pest issues, and climatic factors. Onions are grown in many environments across the country, as shown in **Figure 1**. The management strategies recommended here are based on data gathered over many seasons and varieties in Oregon, Idaho, and Washington.

An onion bulb is different from other root crops (such as sugar beets) or a stem-produced potato. Each onion layer is called a "scale" in botanical terminology and is comprised of the base of an individual leaf. Hence, the number of leaves is important in determining bulb size. A premium price is paid for a large onion, so they are sorted and marketed according to size, ranging from *Super Colossal* (>4¼ in. diameter) to *Mediums* (2¼ to 3 in.). The market for smaller onions is limited and less valuable. Important quality factors for onions include bulb shape, scale color, scale thickness, scale retention, number of scales, bulb firmness, number of growing points, paper quality, and neck thickness.

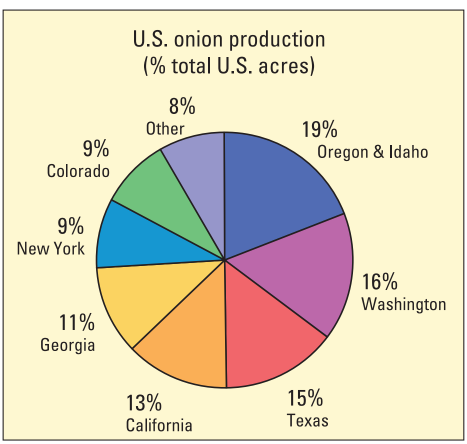

Figure 1. Percent of U.S. onion production acreage in top-producing states.

Onions have a small root system that limits their ability to acquire nutrients from the soil. Source: www.extento.hawaii.edu/IPM/onion/onion4.jpg

Onions have a sparsely branched root system, with most of the roots in the top foot of soil (**see photo**). This shallow rooting pattern has important implications for the limited availability of relatively immobile nutrients such as phosphorus (P), potassium (K), and some micronutrients. Mobile nutrients such as nitrate and sulfate can be easily lost from the shallow root zone by excessive irrigation.

Nitrogen. The nitrogen (N) concentration in harvested onion bulbs on a dry weight basis is similar among red, yellow, and white varieties. Total crop N uptake averages about 140 lb N/A, with between 70 to 90% of the N contained in the bulb at harvest. The N uptake rate during the early bulb growth period is from 1 to 3 lb N/A each day. Split applications of N fertilizer are commonly made during the growing season.

Phosphorus and Potassium. Onions are highly dependent on mycorrhizal fungi for P acquisition from soil. These fungi, living in close association with the roots, produce a network of threadlike hyphae that extends far into the soil, greatly increasing the absorptive surface area of the root system. The P fertilizer recommendation for onions following fumigation may be 25% greater than on non-fumigated soils.

Since P is essential for rapid root development, a deficiency typically reduces bulb size and delays maturation (**see photo**). Total P uptake for a bulb yield of 840 cwt/A was 20 to 25 lb P/A (45 to 55 lb P_2O_5/A) at the time of harvest (**Figure 2**). Specific P fertilizer recommendations are based on the soil test P concentration, the amount of calcium carbonate present in the soil, and the history of fumigation.

Incorporation of fertilizer P into the planting bed is always recommended. Banded P applications have been more effective than broadcast applications in western Oregon. However, in Idaho, no advantage was found for banded applications compared with broadcast. Placement of ammonium phosphate fertilizers next to the seed should be avoided due to potential danger of ammonia toxicity.

Onions respond to banded P applications with larger plants (on left) and earlier maturity than plants growing with broadcast P.

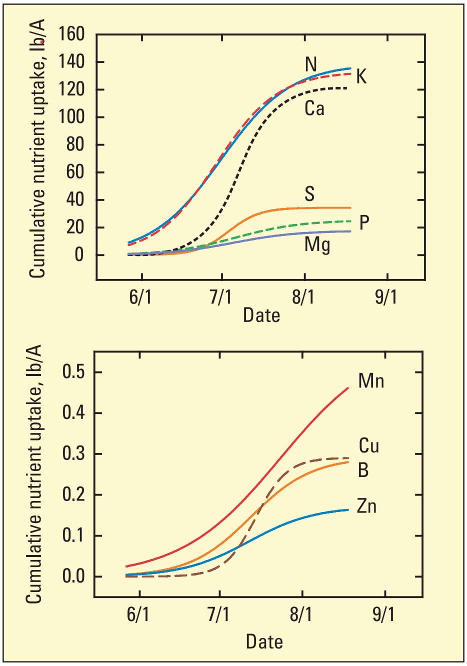

Figure 2. Cumulative nutrient uptake by onions (bulb and tops) for yellow onions grown near Connell, Washington. Fresh weight bulb yield was 840 cwt/A grown with furrow irrigation.

Nearly equal amounts of N and K are removed in harvested onions, ranging from 130 to 190 lb K_2O/A. While K deficiencies are rare in some areas, regular K fertilization is typically needed on many sandy soils with a low cation exchange capacity. Potassium application rates should be based on soil test results, with applications typically required when sodium bicarbonate-extractable K falls below 100 ppm.

Although less desirable, when reliable soil test information is not available, K fertilization can be based on crop removal rates to prevent soil depletion. Potassium is an important factor in plant water

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High Yields in 2003… a Product of Nature and Nurture

By P.E. Fixen

Those of us privileged to be part of crop production agriculture typically experience about 40 growing seasons in the core part of our professional careers. Certain seasons serve as benchmarks that we use to index all other seasons. For many corn growers, both producers and researchers, 2003 was such a benchmark because of the high yields experienced. These seasonal differences are products of nature…what nature provided in terms of growing season length, precipitation amount and distribution, solar radiation, day and nighttime temperatures, absence of "acute stress" such as hail or wind storms, etc. However, the impact of these products of nature can be greatly influenced by how we nurture the crop. What we reap is clearly a product of both nature and nurture.

On-going Midwest studies designed to learn how to produce the highest corn yields attainable in a specific environment generated interesting data under 2003 growing conditions. The following four brief accounts (on pages 17, 18, 19, and 20) feature some of these studies. Future issues of *Better Crops* will contain more information on individual research projects. In this section, we focus on specific lessons illustrated in the 2003 season and on an exciting development in the science of crop modeling that promises to markedly improve our ability to determine the attainable yield potential at specific sites. In other words, stay tuned to future issues because there is more to come. BC

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relations, cell wall formation, and energy reactions in the plant. When required, K should be applied pre-plant or after onions progress past the 4-leaf stage to avoid problems associated with excessive soluble salts, since onions are very sensitive to water stress during the seedling stage and during bulb growth.

Substantial amounts of other essential nutrients…especially calcium (Ca), sulfur (S), and magnesium (Mg)…are also rapidly accumulated during the growing season. They must be available in adequate quantities to supply the rapidly growing crop. Due to the shallow nature of the root system, these nutrients must be present in relatively large amounts in the surface soil. Soil testing is the best way to monitor the nutrient status of the root zone.

Conclusions

Onions are widely grown across North America. Research from the Pacific Northwest shows that onions are very responsive to nutrient applications. Proper nutrient management results in larger and more profitable onion yields. BC

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