

# NEWS & VIEWS

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## Fertilizing for Quality

A **CAREFULLY PLANNED** and managed fertilizer program has many benefits. Response to applied nutrients that lead to high(er) yields and more profit is an obvious one. Tools and information available to help growers reach yield and profit goals include soil and tissue testing, field history, and recently emerging site-specific management techniques.

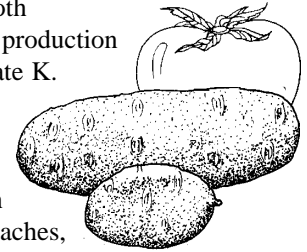
Crop quality is also enhanced through fertilization. Nutrient programs that provide balanced nutrition...and minimize stress as the crop develops and matures... support high yield and quality, resulting in improved profit potential.

Crop quality is affected directly and indirectly by fertilization. Direct benefits relate to the function of essential nutrients in the plant itself and how they affect crop growth. Indirect effects include factors beyond direct nutritional benefits such as how a plant resists disease and insect pressures. Both direct and indirect effects can have major impacts on ultimate crop quality.

**Direct nutritional benefits** of fertilizer vary according to the specific nutrient. For example:

- Nitrogen (N) is a component of protein. Therefore, forages and grain must be adequately fertilized with N or protein content will be low. Nitrogen is also part of the chlorophyll molecule that gives plants green color. Deficient N results in pale (yellowish) leafy vegetables.
- Phosphorus (P) is important to seed quality, playing a direct role in genetic transfer. Phytin, an organic compound which contains P, stores important dietary minerals such as calcium (Ca), zinc (Zn), and iron (Fe).

- Potassium (K) is involved in many processes within the plant as a catalyst. It does not become part of any compound, but plays a role in carbohydrate formation and translocation. Both carbohydrate and protein production are enhanced with adequate K. Carbohydrates are especially important in producing high quality fruits and vegetables such as grapes, stone fruits (peaches, etc.), tomatoes, and potatoes.



- Sulfur (S) is a component of two amino acids, cysteine and methionine. It, therefore, directly affects the amount and quality of protein produced. It also is a constituent of certain aromatic compounds giving plants such as garlic and onions their distinctive odors.
- Magnesium (Mg) is part of the chlorophyll molecule. So, as with N, Mg deficiency produces chlorotic vegetation, reducing quality of any crop where green color is a measure of quality.
- Calcium (Ca) plays a role in cell wall structure and stability. Deficiency symptoms such as bitter pit of apples and brown center and hollow heart of potatoes are related to Ca deficiency.
- Micronutrients serve a variety of functions in the plant, mostly related to catalyzing metabolic reactions. Deficiencies, therefore, can interrupt numerous processes and result in abnormal growth and development, leading to poor quality.



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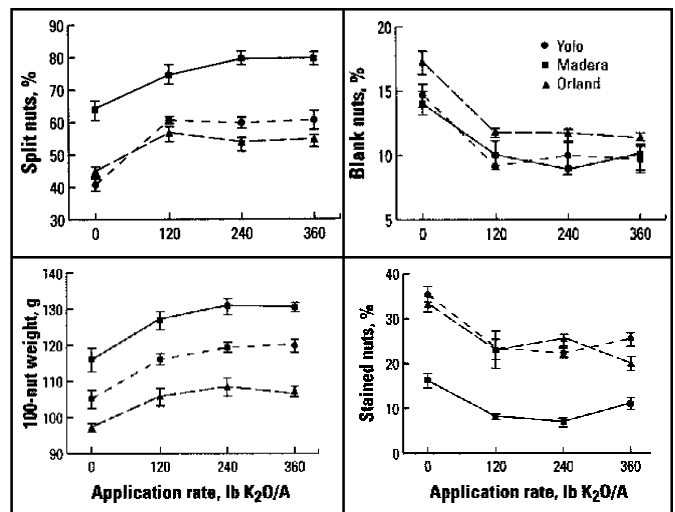
Direct nutritional benefits of fertilization are generally well documented and frequently obvious. When deficient, many nutrients produce characteristic plant symptoms that are quite diagnostic. There are exceptions. Deficiencies of P are often not as clear-cut as N and K. Alfalfa, for example, can be seriously P deficient (ie., greater than 10 percent yield loss) and appear relatively normal. The leaves may be a bit small and overall color tending towards dark green or blue-green. The most obvious symptom of a problem may be thinning stand and weed encroachment. Weeds are an indirect effect of P deficiency, leading to lower quality hay.

**Indirect nutrient effects** can impact crop quality in a number of ways. The importance of balanced nutrition to increasing resistance to pests and their resultant damage is widely recognized: "A healthy, well-nourished crop resists pest damage better than one that lacks some essential elements." (Source: *Integrated Pest Management for Alfalfa Hay*. 1981. Univ. of California Publication 3312). It is important to recognize the fertilizers will not cure a disease or prevent insect attacks, but, as stated, properly managed fertilizers can help increase a plant's resistance to these pests.

An example of how fertilizer can directly impact insects (producing an indirect nutrient benefit) is provided in the continuing research of Drs. Larry Godfrey and Robert Hutchmacher (1999 Annual Report to the Fertilizer Research and Education Program, CDFA) in their study of aphid pressure versus N and K fertilization of cotton in the San Joaquin Valley. The researchers report: "Aphids from the treatment that had the 'balanced' fertilization (200 N lb/A + 100 K<sub>2</sub>O lb/A) had a lower fecundity (offspring/female) and longer generation time than individuals from the two highest N treatments (200 and 250 N lb/A)." Balanced nutrition with N and K in this case directly reduced the aphid population.

Potassium is frequently called the "quality nutrient" because of the benefits, both direct and indirect, that it has on crop quality. Research on pistachios, for example, showed K improved four quality parameters (**Figure 1**). Direct quality improvements were increased split nuts, increased nut size, and reduced blank nuts. Indirect quality improvement was the result of less stained nuts caused by fungal organisms (Zeng, D.Q. and P.H. Brown. 1999. Potassium fertilization and diagnostic criteria for pistachio trees. *Better Crops with Plant Food* (No. 3), Potash & Phosphate Institute).

The overall relationship of N and K with a spectrum of diseases is illustrated in **Table 1**. Both obligate and facultative diseases are reduced with high K fertilization. In the case of N, obligates (rusts and powdery mildew) are encouraged with high N rates, while the facultative group (leaf spot, wilt, etc.) are discouraged by high N rates. Diseases affect crop quality in a number of ways. They cause blemishes, increase culls and reduce shelf life of



**Figure 1. Potassium fertilization improves quality of pistachio nuts.**

fresh market products, produce shriveled and discolored grain, create off-flavors, and in extreme cases, introduce toxins into food and feed crops.

**Table 1. Summary: Effect of N and K levels on the severity of diseases.**

Pathogen and disease	Nitrogen		Potassium	
	Low	High	Low	High
<b>Obligate parasites</b>				
<i>Puccinia</i> spp. (rust diseases)	+	+++	++++	+
<i>Erysiphe Graminis</i> (powdery mildew)	+	+++	++++	+
<b>Facultative parasites</b>				
<i>Alternaria</i> spp. (leaf spot diseases)	+++	+	++++	+
<i>Fusarium oxysporum</i> (wilt and rot disease)	+++	+	++++	+
<i>Xanthomonas</i> spp. (bacterial spots and wilt)	+++	+	++++	+

Increasing disease + → ++++ Mineral Nutrition of Higher Plants, 2<sup>nd</sup> ed. (1997) Academic Press

**Fertilizing for quality is consistent with high-yield management systems. Avoiding nutrient stress is a key step. As observed, nutrient programs that provide balanced nutrition...and minimize stress as the crop develops and matures...support both high yield and quality. ■**

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**www.ppi-far.org or www.ppi-ppic.org**

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