

BUILDING POTATO QUALITY AND PROFITS WITH MAGNESIUM

by

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Turning a good potato fertility program into a great one can mean big increases in profitability! Meeting potato requirements with most nutrients can place increasing importance on elements that may only be adequate for good yields...not great ones.

The same limitation can affect potato quality. Extensive information from the northwestern U.S. emphasizes how supplying adequate nutrients...nitrogen (N), phosphorus (P), potassium (K), sulfur (S) plus magnesium (Mg)...can increase yields and have tremendous effects on potato quality...and on net returns.

High Nutrient Requirements

Potatoes have high nutrient requirement, particularly for high yielding, high profit crops. Table 1 indicates how nutrient requirements increase as yields increase.

Table 1. Potato Nutrient Requirements

Yield Tons/A	N	P ₂ O ₅	K ₂ O lb/A	Mg	S
25	269	90	546	50	22
30	322	108	655	60	26
45	484	162	982	90	39

Magnesium

Changes in plant nutrient management programs over the years have placed more emphasis on the secondary nutrients, S, Mg and calcium (Ca) as high yielding crop needs for N, P and K have been met by better fertilizer management. Increased rates of K application over the past 10 to 15 years combined with split applications of N have possibly increased crop needs for supplemental Mg even when soil test Mg levels seem to be adequate.

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Potassium and the ammonium form of N interact with Mg uptake by plants. Potassium and ammonium-N tend to depress plants' abilities to absorb Mg leading to nutritional problems in some species and effects on crop quality in others. Higher rates of K for potatoes combined with multiple applications of N materials, which contain or produce ammonium-N in the soil should at least raise growers' attention to possible needs for supplemental Mg.

Magnesium has unique roles in plant physiology including a key role as the central atom in the chlorophyll molecule. Consequently, Mg affects plant chlorophyll content and the production and utilization of carbohydrates. Magnesium is also important in the activity of a large number of enzyme systems in plants, enzyme systems which are particularly important in the metabolism of carbohydrates. Magnesium is mobile in the plant, moving to areas of new growth when Mg uptake is insufficient. That means that Mg deficiency symptoms appear first near the base of the plant and are characterized by interveinal chlorosis and sometimes by the accumulation of reddish pigments (anthocyanins) at the leaf margins.

Sources of supplemental Mg are limited. Where liming is required and where Mg-containing limestone (dolomite) is available, it can serve as an acceptable Mg source although the solubility of the material is low. A more readily available and highly soluble Mg source is potassium-magnesium sulfate which is commercially available and contains nominally 22% K_2O , 11% Mg and 22% S. Magnesium sulfate is also available in some areas but not as easily obtained as potassium-magnesium sulfate.

Field Studies Emphasize Benefits of Good Fertility

The effects of an improved potato nutritional program including available Mg application supplied as potassium-magnesium sulfate were evaluated on Russet Burbank potatoes in the Columbia Basin from data collected over a 9-year period on over a thousand center pivot irrigated fields producing over 100,000 data points. Soil types ranged from sands to silty loams.

Yields were determined by weight. Quality samples were collected at the processor's facilities by routine blind sampling on each load of potatoes delivered. Quality grading was based on USDA standards. Potatoes were delivered both directly from the field and from storage.

The Benefits of Quality

Comparisons of results indicate that Mg applications of 20 or more pounds per acre largely as broadcast preplant applications increased potato quality and value through increased specific gravity, percentage over 6 oz. and percent US #1s (Table 2). Negative quality factors including hollow heart, brown center and internal discoloration both declined numerically but did not affect value of the crop.

Overall, yields increased from 31.43 to 33.2 tons/A. Based on local 1998 contracts, specific gravity increases from 1.0784 up to 1.0824 added \$5.00/ton.

Percentage over 6 oz. increased from 57.16 to 62.15 for an increased value of \$3.00/ton. Percent US #1s increased from 51.79 to 70.55 adding an additional \$5/ton for a total quality effect of \$13/ton from Mg applications.

While total yields increased, percent usables rose from 80.46 to 85.35 resulting in a net useable ton yield of 28.34 compared to 25.29 for the controls.

Table 2. Magnesium Builds Potato Yield, Quality and Profits

	0-2.5	Mg rate lb/A 20+	Value \$/ton
Quality:			
Specific gravity	1.0784	1.0824	\$5.00
%>6 oz.	57.16	62.15	\$3.00
% US #1s	51.79	70.55	\$5.00
% Internal discoloration (IBS)	2.39	1.76	\$0.00
% Hollow heart/brown center	1.73	1.57	\$0.00
Total Premium Per Ton on Useable Tons			\$13.00
Yield:			
Yield, tons/A	31.43	33.20	
% Usables	80.46	85.35	
Useable tons/A	25.29	28.34	
Increase in Useable Tons Per Acre 3.05			
Profits:			
3.05 ton/A increase in useable potatoes x \$90.00/ton base =			\$274.50 increase/A
Premium per acre (\$13.00 x 28.34 tons/A)			= \$368.42 increase/A
Cost of add-on Mg application/A			<u>(\$ 38.85)</u>
Net \$ Increase Per Acre			\$604.07

The Bottom Line

Results of the study emphasize the value of a complete nutritional program for potatoes. Magnesium applications produced a 3.05 ton/A increase in usables. At \$90 per ton, a mid-range value, that added \$274.50 in returns/A. Quality premiums added \$13/ton on all 28.34 tons/A usables for an increased return of \$368.42/A. Figuring the cost of the Mg as an add-on to the fertility program at \$38.85/A...there was actually substitution in the fertilizer program and a lower cost of \$10 to \$13/A....increased net/A was a whopping \$604.07.

Increased yield was important but increased quality premiums added even more to the bottom line. This study provides voluminous evidence that proper and complete fertilization programs increase profits...substantially.

Obviously, not every situation will generate an identical Mg benefit. Even if the Mg effects were only a sixth of that recorded from this study, the story is still the same. Providing adequate Mg affects both potato yield and very importantly...potato quality. Other varieties were included in this study but the numbers of data points were much smaller than Russet Burbank and were not included. Possible varietal interactions with such responses are possible and bear further examination.

These results indicate that including supplemental Mg in potato fertility management can add quality, increase yields, increase crop value, cut production costs/ton and increase profitability.