A Summary of Strawberry Research Data with Magnet®

Summary

Recent data from a trial conducted by UC Davis comparing 13 different nutritional products/treatments showed that Magnet dramatically increased yield and nutritional content in strawberries. Of the 13 treatments (including a standard control and proprietary grower control, which included a fungicide dip), Magnet produced the most marketable berries, beating out applications of humic acids, calcium, boron, worm extracts, seaweeds, silicas, plant extracts, microbial extracts (including *Azobacter spp.*, *Bacillus spp.*, *Paenicbacillus spp.*, *Pseudomonas spp.*, *Trichoderma spp.*, *Streptomyces spp.*, etc.), and other unnamed biostimulants. Beyond this though, Magnet increased the nutritional content of the strawberries compared to the grower standard. The following is a discussion about why this occurred, and how strawberry growers could implement Magnet to increase yields on their own respective farms.

Soil Chemistry Discussion

In the trial with UC Davis, the treatment with Magnet yielded dramatic increases in the nutritional content of the strawberries (figure 1). To enter plants, nutrients have to be in a specific form. Nitrogen can either be taken up as ammonium (NH_4^+), or nitrate (NO_3^-). Often, nitrogen is applied as ammonium or urea (which converts to ammonium via the urease enzyme). Magnet, as an anionic (negatively–charged) polymer, adsorbs the cationic (positively charged) ammonium, keeping it in the ammonium form longer, and helping it remain in the upper part of the soil profile whereby it can be more readily taken up by the strawberries. This also prevents the displacement of potassium from the soil colloids, which often leads to an increase in uptake of potassium as well.

	% N	% P	% K	% Mg	% Ca	% S
Grower Standard	0.595	0.23	1.51	0.2	1.295	0.095
Magnet + Standard	0.76	0.255	1.84	0.255	1.435	0.105
% Change from GS	**27.70**	**10.87**	**21.85**	**27.50**	**10.38**	**10.52**

Figure 1. *Berry Nutrient Analysis*

Much like nitrogen, the form of phosphorus is important to plants as well. Phosphorus must be in the form of phosphate (PO_4^{3-}, either as HPO_4^{2-} or HPO_4^-) to enter into the plant. This is why discussions as to whether the phosphorus is in the form of ortho phosphate (plant–available form) or polyphosphate (not plant–available form) is important. With the bulk of phosphorus in the soil occurring as insoluble compounds with calcium (Ca), magnesium (Mg), iron (Fe), and aluminum (Al), any applied phosphorus to the soil readily precipitates with these minerals and is not available to the plant. When phosphorus is applied with Magnet, the anionic polymer adsorbs the calcium, magnesium, iron, and aluminum cations, which allows the phosphorus to remain in its available form longer, leading to an increase in uptake in the plant.

With over 90% of potassium existing in the soil in the form of insoluble minerals (feldspars and micas), helping to guard against the precipitation of potassium in the soil is important. Magnet adsorbs potassium that is applied via fertility programs—helping it remain in the solution longer, and therefore available for uptake into plants. In addition to this, as soil–based potassium becomes momentarily soluble from the biochemistry processes in the soil, the anionic Magnet polymer can adsorb it, and increase the time it remains in solution. This explains why trials with Magnet typically show a statistically significant increase in the uptake of potassium.

This same story rings true for calcium, magnesium, and sulfur. Calcium and magnesium are typically found in the soil as precipitates as phosphates or carbonates. Sulfur is typically adsorbed to aluminum, iron, or calcium. These secondary nutrients are typically only retained by relatively weak outer–sphere complexes, and are therefore released by mineral weathering. This process of weathering and adsorption repeats in a cycle until the nutrients are taken up into the plant. With Magnet present, as the nutrients are weathered, and enter into solution, they remain adsorbed to the anionic sites of the polymer momentarily, helping to increase the chances of their uptake into plants.

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Summary of Yield Data

Transplants dipped in cyprodinil + fludioxonil (5 oz/100 gal); proprietary nutrient regimen followed.

Magnet applied first dip at 1 qt/acre after planting with successive 1 qt/acre applications made in early January (first bloom), mid–February, and mid–May.

Grams per Plot	
Standard	Treated
49,371.25	56,782.50

Calculated Lbs per Acre	
Standard	Treated
55,336.98	63,643.76

Yield Increase (% Change)	
Standard	Treated
***	15.12

Trays (10 Lbs) per Acre	
Standard	Treated
5,533.69	6,364.38

Canopy Size @ First Pick (cm^2)	
Standard	Treated
626.69	849.59

Fruit Firmness (kgf)	
Standard	Treated
0.86	0.87

As one can see from the data, Magnet not only dramatically increased the nutritional content in the berries, but also the total yield. It's clear that the anionic polymer helped increase the nutritional uptake of nutrients in the plants, which directly led to the increase in yield. How this occurs is explained through the knowledge of how nutrients become available and unavailable in soil ecological settings. What's particularly interesting in this trial though is that Magnet exceeded the performance of humic acids, seaweed extracts, microbial inputs, and other common biostimulants that are currently used across millions of acres today. With a statistically–significant increase in yield, along with being compatible with most nutrients and inputs, Magnet is likely to bring a significant return on investment to growers who incorporate it into their programs.

Nitrogen's Role In Plants

The essential role of nitrogen is as a constituent of amino acids in plants—also known as the building blocks of proteins. Amino acids are assembled into peptides (small chains of amino acids), and into proteins (large chains of amino acids). Proteins serve a wide range of functions including structure, movement, storage, and transport. Aside from peptides and proteins, nitrogen is found in a variety of compounds, including, but not limited to: purines, alkaloids, enzymes, vitamins, hormones, nucleic acids, and nucleotides.

Phosphorus's Role In Plants

Most of the phosphorus in plants is found in ATP (also ADP and AMP), nucleoproteins, and phospholipids. ATP is an organic compound that provides energy for many different metabolic processes in plants. Nucleoproteins are defined as any proteins that are structurally associated with nucleic acids––examples include ribosomes and nucleosomes. Finally, phospholipids (lipids that contain phosphorus) are a structural double–layer component of cell membranes.

Potassium's Role In Plants

Potassium's primary function in the plant centers around its role as an osmolyte—a substance that is loaded into the vacuole, thereby activating the regulation of osmotic pressure and maintaining the homeostasis of a cell's water content. This directly/indirectly affects enzyme activation, protein synthesis, stomatal pore opening and closing, photosynthesis, and transport of sugars, nutrients, and amino acids.

Magnesium's Role In Plants

Aside from being a constituent of chlorophyll, magnesium (like calcium) is also a component of the middle lamella. In addition to this, it's required for the preservation of ribosome structure and integrity (up to 90% or more of cellular magnesium is bound mainly in ribosomes). Magnesium also influences many different metabolic processes by complexing with anionic molecules and with negatively charged ligands.

Calcium's Role In Plants

Calcium is mostly used to stabilize phospholipid membranes by bridging phosphate and anion complexes located at the hydrophilic (water-loving) membrane surface. It also forms calcium pectate in the middle lamella (pectin layer that cements the cell walls of two adjoining cells together). Calcium is also involved in other processes such as cell division, callose synthesis in response to injuries (mechanical or pest), nitrogen metabolism, and root lubrication.

Sulfur's Role In Plants

Sulfur is a constituent of two amino acids: cysteine and methionine (both important to plant immune responses). It is also a constituent of several enzymes, including ferredoxin (assists in building chlorophyll and assimilating nitrogen), biotin (assists in the synthesis of fatty acids, amino acids, and the generation of glucose), and thiamine (breaks down sugars of amino acids). It is also a component of sulfolipids (specific plant membranes).

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