Mosaic
AgriSight®
TRUSTED CROP NUTRITION EXPERTISE℠
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Corn Rootworm-Resistant Traits and Nutrient Removal

Rapid adoption of rootworm-resistant corn hybrids in the past five years has helped many farmers take corn yields to the next level. While corn varieties with insect resistance traits have eased insect control, it's important to remember that the investment in high-tech seed must be paired with other state-of-the-art agronomic practices, including a strong soil fertility program and balanced crop nutrition.

A recent study by Dr. Fred Below, University of Illinois, found that rootworm-resistant corn hybrids require more fertilizer to maintain soil fertility than conventional seed, indicating that fertility plans must be revised to meet the demands of new hybrids to achieve higher yields, maximize seed investment and maintain soil fertility.

The study examined six different hybrid pairs (same genetics with and without corn rootworm protection) at two locations over two years. The nutrient contents of N, P, K, S and Zn were determined in the stalk, leaf, reproductive tissue (tassel, cob and husk) and grain separately. As anticipated, the study demonstrated a yield increase of 10% in corn rootworm-protected hybrids compared to those without protection, as well as an increase in nutrient removal of both macro and micronutrients. Importantly, study results also showed that the increased yield did not affect nutrient removal equally.

Table 1.
Grain Nutrient Concentration Comparison in Corn Hybrids

Nutrient	No Protection	Corn Rootworm Protection	Change (%)
	lbs/bu		
N	0.742	0.726	-2
P	0.135	0.139	2
K	0.158	0.158	0
S	0.058	0.058	0
	oz/bu		
Zn	0.017	0.058	4
B	0.0013	0.0014	7
Yield (bu/ac)	155	171	10

Grain Nutrient Removal Comparison in Corn Hybrids

Nutrient	No Protection	Corn Rootworm Protection	Change (%)
	lbs/ac		
N	110	121	9
P_2O_5	47	53	13
K_2O	31	34	10
S	10	11	9
	oz/ac		
Zn	2.26	2.91	14
B	0.20	0.23	13

Source: Bender, Ross. 2012. Nutrient Uptake and Partitioning in High-Yielding Corn. University of Illinois, Urbana-Champaign, Illinois.

Table 1.
Grain macronutrient and micronutrient concentrations, removal and percent increase in nutrient concentration, or removal associated with corn rootworm protection compared to non-protected varieties.

Zn removal
INCREASED 14%
in rootworm-resistant hybrids.

P removal
INCREASED 13%
in rootworm-resistant hybrids.

> FACT

Rootworm-resistant corn hybrids require more fertilizer to maintain soil fertility according to a study conducted by the University of IL led by Dr. Fred Below.

New Research Shows High Fertility Demand

Nutrient removal from the field is directly affected by both the grain nutrient concentration and the yield of the grain removed. Examining the grain nutrient concentration shows that the concentration of P and Zn increased in the grain by 2% and 4% respectively, where N decreased in concentration by 2%. K and S remained unchanged.

Increased yield results increase overall nutrient removal, but particularly in those cases where the concentration of nutrients in the seed were also increased. Zn removal was increased 14% while P removal increased 13%.

Roots and Mobilization

Roots are the primary route for nutrients to enter the plant. For the plant to take up soil nutrients, they must reach the roots by either interception (the root physically contacts the nutrient), mass flow (nutrients dissolved in water move toward the plant as it takes up water), or diffusion (nutrients move from areas where they are in high concentration in the soil to areas where there is a lower nutrient concentration in the root).

Evaluating the differences in nutrient removal observed in the study is complex, and the effects are likely the result of a number of factors. However, the behavior of specific nutrients in the soil can provide some insight into why differences occur in nutrient composition between hybrids with and without corn rootworm protection.

Nutrients such as P and Zn are relatively immobile in the soil and uptake is dominated by diffusion and root interception. S and N, however, are very mobile in the soil, moving freely with soil water, so uptake is dominated by mass flow.

Nutrients that require root interception during uptake are more sensitive to changes in root system health and size than those taken up by mass flow. Hybrids with Bt traits for corn rootworm resistance develop more intact, healthier roots and greater root mass than their non-resistant counterparts, suggesting an improved ability to access nutrients.

Implication for Fertility Needs

Fertility plans have typically assumed that a bushel of corn requires the same nutrients regardless of variety. The results of this study indicate that corn rootworm protected hybrids have a significantly different grain nutrient concentration than non-protected hybrids.

Especially evident in P and Zn levels, the effect of the resistant gene on corn nutrient uptake was significant, accounting for 13% and 14% in removal rates due to the combined effect of increased seed concentrations and increased yields.

Increased uptake and removal of immobile nutrients by rootworm-resistant hybrids found in this study proves the significance of re-evaluating fertilizer recommendations in order to maximize high-yield potential and maintain soil fertility.

Advances in biotechnology, including insect-resistant hybrids, are a major key to pushing the yield barrier to the next level. Understanding the importance of seed selection, formulating a proper fertility plan and maintaining balanced crop nutrition are vital to maximizing yield and success.

The Next Generation of Fertilizer

>FACT

Products such as MicroEssentials® are designed to ensure balanced crop nutrition and establish the correct ratios of both macro and micronutrients. MicroEssentials® SZ™ combines a balanced formulation of N, P, S and Zn into every granule. The patented Fusion™ technology driving MicroEssentials ensures a uniform distribution of nutrients across the field that enhances plant uptake, allowing plants to use nutrients more efficiently, resulting in higher yields and profitability.

Mosaic®

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