



Maximizing Nutrient Release from Crop Residue

Enhancing Residue Breakdown,
Improving Nutrient Cycling and Optimizing
Yields with Biochemical Technology

Introduction

Nutrients in crop residue are a valuable asset to a grower's fertility program that are often overlooked and challenging to access. In today's higher-yield corn and soybean environments, additional volumes of crop residue are generated that will require additional time and energy before nutrients are released from crop residues in the field via the natural process of decomposition.

The primary limiting factor for residue decomposition is cooler soil temperatures (below 50° F). Such temperatures significantly slow down the microbial activity that decomposes residue. In instances where harvest may occur later than ideal, the rate of natural decomposition will be minimized prior to spring planting. The opportunity to utilize a large portion of the valuable nutrients locked in the stover will be delayed, potentially compromising early season nutrient availability. Not only can this impact growers' fertilizer costs, it can also affect the performance of their plants and their yields at harvest.

One way that growers are addressing these challenges is through the use of agricultural biologicals that deliver concentrated, microbial-derived biochemistry. Such products can enhance natural residue decomposition and nutrient release processes. Extract Powered by Accomplish® (Extract PBA), available from Loveland Products through Nutrien Ag Solutions, is a biochemical additive that can be used to maximize residue decomposition, nutrient release and nutrient mineralization to optimize yields in a range of crops. Unlike many biological technologies, the performance of Extract PBA is not impacted by colder temperatures.

Residue Breakdown and Ugly Corn Syndrome

Corn residue from a 200 bushel crop contains approximately 100 units of nitrogen (N), 50 units of phosphorous (P) and 210 units of potassium (K) (a sample nutrient removal chart is shown in Table 1). Nutrients in the residue, which are not in a plant-available form, must be mineralized by soil microorganisms prior to plant utilization. When soil temperatures drop below 50° F, these microbial processes slow down significantly.

When there are high levels of residue and/or little time before cooler temperatures arrive, natural decomposition processes are not sufficient to release adequate amounts of nutrients from the stover for the benefit of crops grown the next season. This translates to a lost opportunity to improve the efficiency of both applied nutrients and those found in the prior year's crop residue. Further, once warmer temperatures come and microbial activity increases, the digestion process (during which microbes use N as a food source) can tie up applied N, making it unavailable for plant growth. This creates the conditions for a phenomenon known as "ugly corn syndrome" to occur.



Nutrient Values from Residue

Must access “bound” nutrients to increase productivity

Crop	Bu/Acre	N	P ₂ O ₅	K ₂ O	Total/Acre
Corn	200	200	70	50	320
Stover		100	50	210	360
Total Corn		300	120	260	680
Soybeans	70	266	59	91	416
Stover		77	17	70	164
Total Bean		343	76	161	570
Wheat	80	120	48	27	195
Straw		56	13	96	165
Total Wheat		176	61	123	360

Table 1. Nutrient removal chart for 200-bushel crop residue (University of Michigan). Note: Nutrient values are estimates and will vary according to factors including location, season, growing practices, and time of harvest.

Ugly corn syndrome—in which a lack of plant-available N causes corn seedlings (emergence to V3-V4) to turn yellow—is familiar to many corn growers, especially for those with continuous corn operations. Due to the buildup of organic matter from multiple years of corn-on-corn rotations, the carbon-to-nitrogen (C:N) ratio can be more than double the optimal ratio¹ for crop residue decomposition on continuous corn acres. Even if a grower has applied N during the previous fall or at spring planting, soil microbes are able to out-compete seedling corn plants for N whenever excess carbon is present.

One effective way to prevent ugly corn syndrome on high residue fields is to lower soil C:N ratios by baling corn stalks for winter cow feed. Unfortunately, this is not a feasible option for most farm operations. In addition, complete removal of corn residue takes away significant amounts of the N, P and K that comprises corn stover and could be used to benefit the next season’s crop.

A second option for making sure seedling corn has enough N is to apply more N to meet the needs of both the soil-microbe system and the seedling corn. A common approach in the Corn Belt has been to broadcast 10-15 gallons of 28% UAN on corn residue after harvest, with the idea that the extra N will facilitate rapid microbial activity and decomposition of the corn residue. However, because the greatest limiting factor for residue decomposition is temperature, and not available N, applying more N may not always lead to a reduction in N immobilization or ensure that the plants will have optimal levels of N in the spring.

¹A C:N ratio of 20-30:1 is optimal.

Using Biochemical Technology to Maximize Residue Breakdown, Nutrient Release and Nutrient Mineralization

To enhance residue breakdown, nutrient release and nutrient mineralization across a range of tillage practices, growers can use Extract PBA in their operations. Extract PBA is a concentrated biochemical product that isn't dependent on soil microbial activity to function. Applied in concert with spring liquid nitrogen and/or PRE herbicide, Extract PBA can hasten residue decomposition, effectively releasing nutrients tied up in the stover and improving the mineralization and uptake of soil and applied nutrients.

The concentrated biochemistry in Extract PBA is not temperature sensitive and will continue to decompose corn and other crop residues, even in colder soil temperatures. The effects are often rapid, with visible deterioration seen only a few weeks after application.



Untreated

Treated with

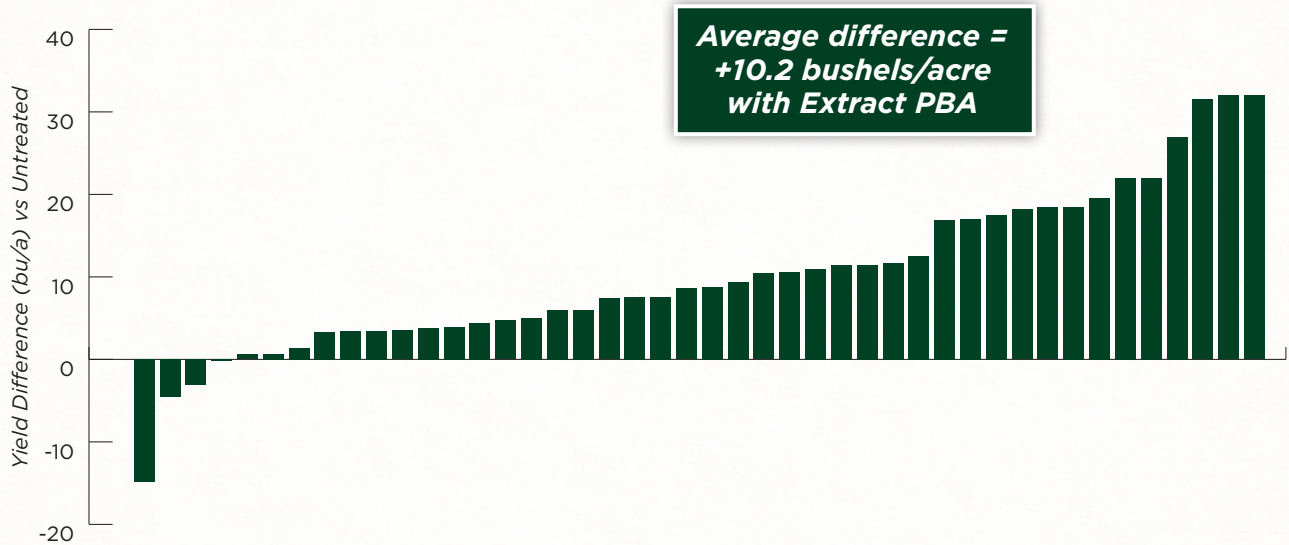


Corn Trials: More Nutrient Availability and Uptake, Higher Yields with Extract PBA

The practice of using Extract PBA to increase nutrient efficiencies in high-residue fields is supported by data from numerous corn trials, as seen in the multi-trial summary and individual trial results below.

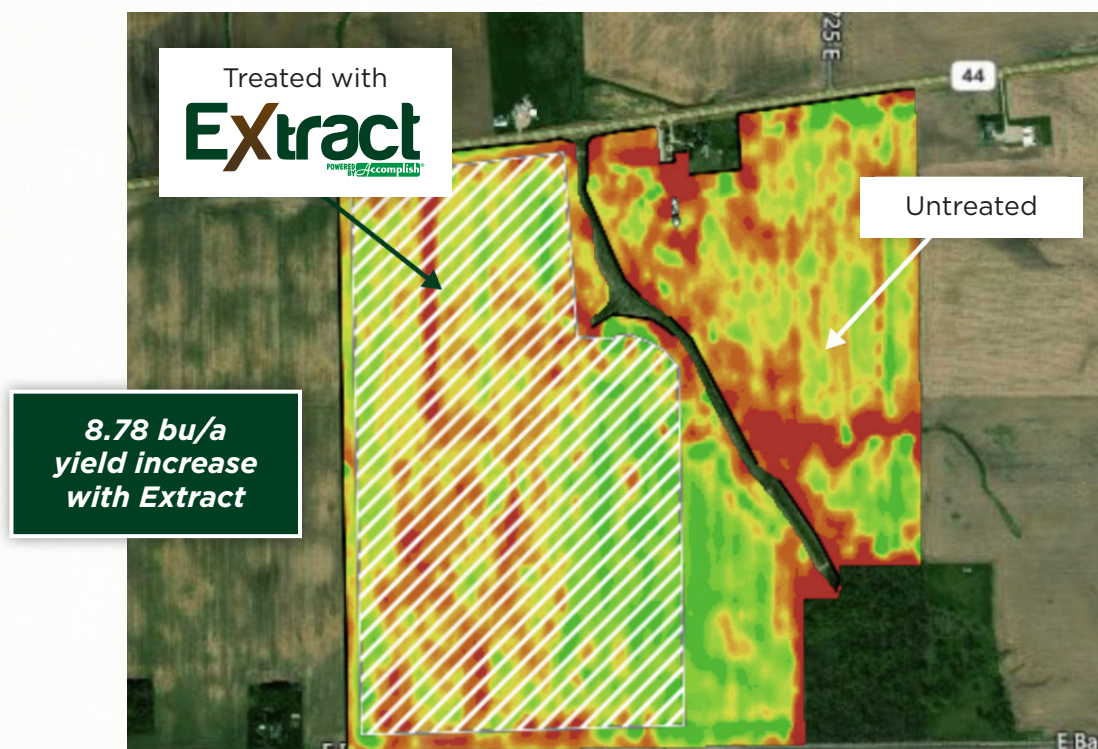
Extract PBA Corn Trials (44 Trials, 2016-2020)

Nutrien Ag Solutions - Corn Side by Side Results



Corn - Greensburg, IN

Extract applied at 1 gal/acre; corn on corn acres



Research conducted at the University of Illinois (below) also illustrates the value of residue management using Extract PBA in a corn on corn system. In that trial, both mechanical chopping and the addition of ammonium thiosulfate (AMS) tended to increase yield through improved residue management, but only through the addition of Extract PBA did corn yield begin to exceed statistically significant levels.

Residue Management Effect on Grain Yield

Chemical/Biochemical Treatment	Mechanical Harvest Treatment	
	Standard	Chopped
Untreated	175 bu/a	181 bu/a
AMS	181 bu/a	185 bu/a
Extract power to accomplish	192 bu/a	203 bu/a

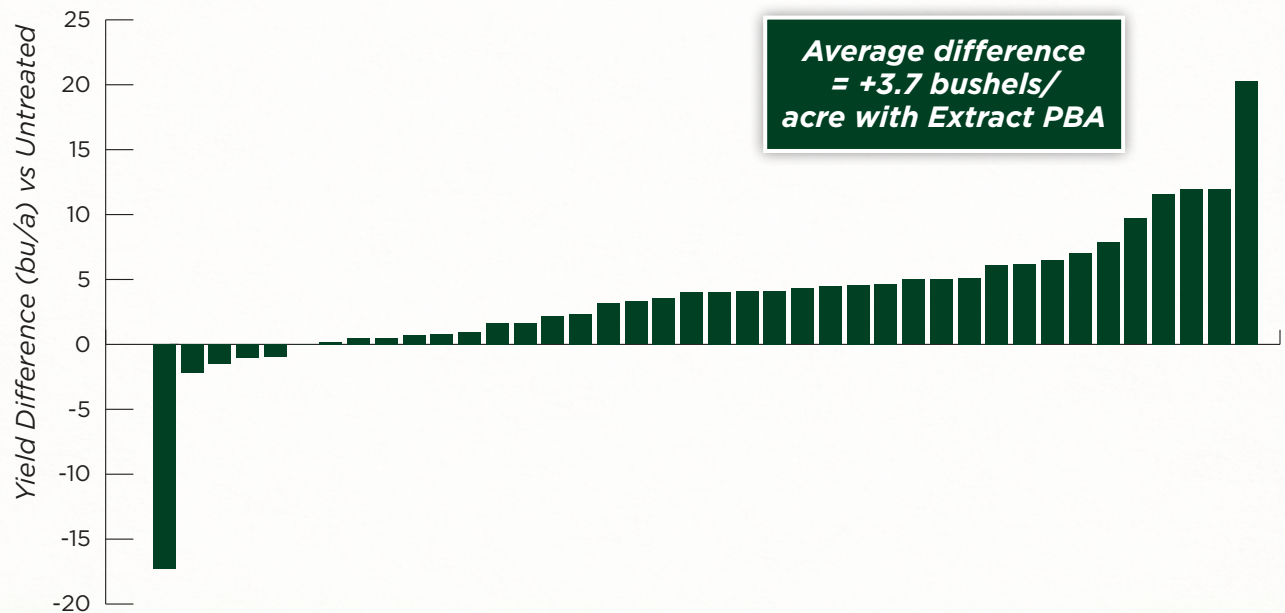
LSD ($P \leq 0.10$) = 18.4. Averaged across Rotation and Input Level with hybrid 6594SS/RIB.
Research performed by University of Illinois Crop Physiology lab.

Soybean and Wheat Trials: Higher Yields & Better Plant Performance with Extract PBA

With corn prices trending lower, many growers will move from a corn on corn rotation to producing soybeans, relying on nutrients remaining from their previous corn crop to help fertilize their soybeans. Given the high potassium levels in corn stover and the high potassium demand for a soybean crop, this is a perfect situation for improving plant performance and gaining a yield advantage in the coming soybean crop.

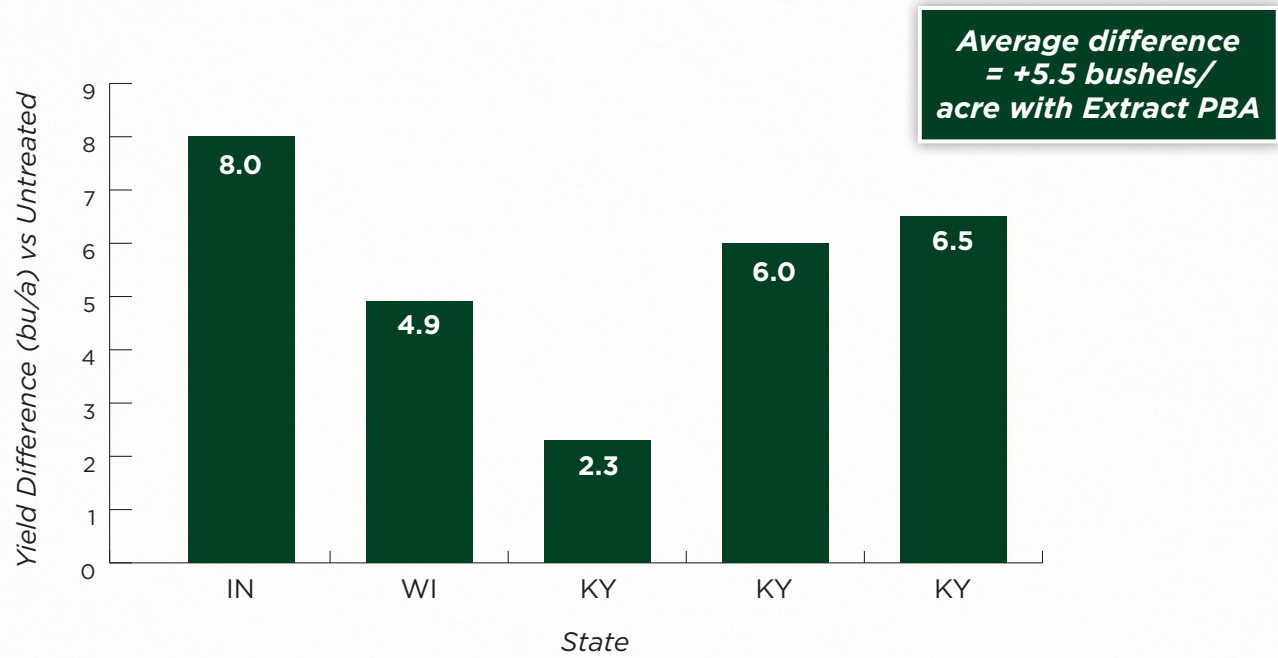
Growers can also use Extract PBA on soybean and other crop residues for similar benefits in the following crop.

Extract PBA Results on Soybeans (40 Trials)



Yield benefits can also be seen in wheat and other crops with a broadcast application of Extract PBA on the prior crop's residue.

Extract PBA Results on Wheat (5 Trials)



Conclusions

Valuable nutrients for next season's crops are locked up in crop residues, but releasing them can be a challenge. Growers can use Extract PBA to speed residue breakdown, release valuable nutrients and improve nutrient mineralization for better yield opportunities in the next season.



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