Closing the Nutrient Loop Through an Innovative Organic Fertilizer Technology Field Tested for Corn

A new byproduct of wastewater treatment can provide an organic alternative to chemical fertilizers while improving water quality.

Nutrient Pollution and Harmful Algae Blooms

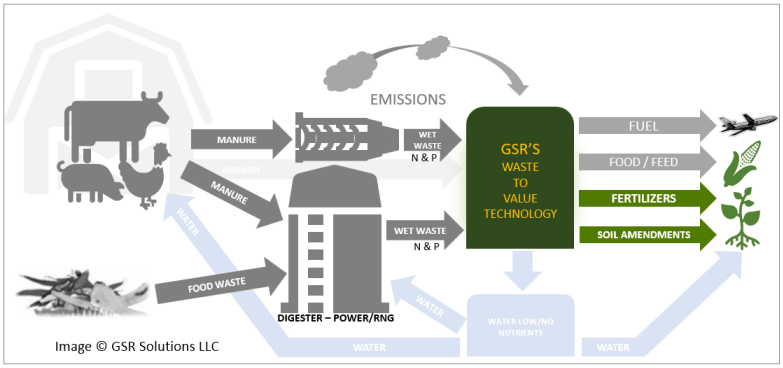
Excess nutrients from agricultural, industrial, and wastewater runoff result in harmful algae blooms in rivers, lakes, and the ocean. Inorganic nitrogen and phosphorous can fuel the rapid growth of algae, which deprives the aquatic environment of oxygen and sunlight. This process, eutrophication, results in anoxic "dead zones" and threatens ecosystems and access to clean water.

In agriculture, this nutrient pollution can be controlled by implementing and improving practices that reduce runoff, such as building good soil structure and not over-fertilizing nitrogen and phosphorus using slow release fertilizers.

Algal bloom in Lake Erie, 2017. Image from NOAA.

Wastewater Treatment

Currently, phosphorus usage efficiency at farms is less than 20%, with the rest ending up in wastewater and surface waters. The waste to value technology developed by GSR Solutions can be used as a nutrient treatment system to remove excessive nutrients from the digested or non-digested waste effluent streams and convert them into microbial biomass, which prevents them from being flushed back out into rivers and lakes. Byproducts of this technology can be repurposed for fertilizers, food, or biofuel. Recycling nutrients through the process returns nutrients to crops, improves water quality, and reduces nutrient loss by "closing the loop".



How the novel bio-based process for valued products works.

From Nutrient Recovery to Organic Fertilizer

Using organic fertilizers helps to reduce nutrient runoff in comparison to synthetic fertilizers, resulting in improved water quality. Organic fertilizers increase organic matter, build good soil structure/aggregate stability, and increase the soil's ability to retain water and nutrients. Organic fertilizers also release nutrients slowly as they decompose, making it harder to over-fertilize. This bio-based technology can provide an organic alternative to chemical fertilizers.

The advanced microbial-based biomass in the waste to value process is relatively quick to grow, as its algal component captures nutrients and carbon dioxide. Implementation of this process at the origin of nutrient runoff for fertilizer production can help to repair an excess algae problem down the watershed and improve water quality and quality of life, especially in rural areas.

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Sources: https://oceanservice.noaa.gov/facts/hab-solutions.html

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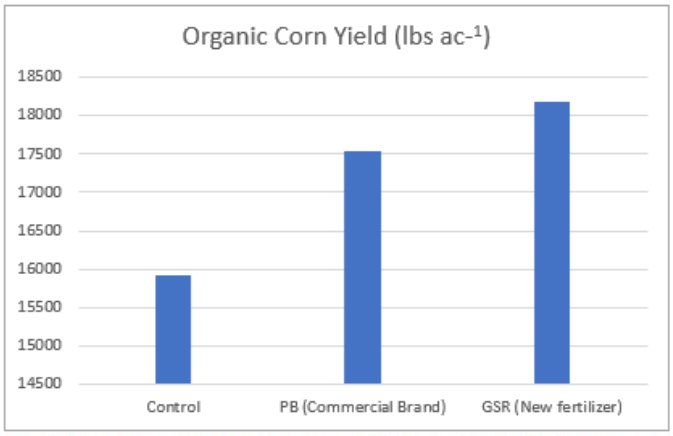
Results From Field Trials

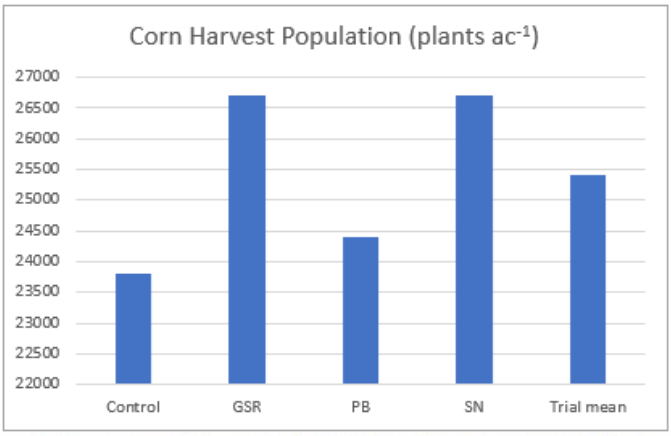
In 2018 and 2019, UVM Extension's Northwest Crop and Soils Team trialed a nutrient-recovered fertilizer made from the treatment of effluent from anaerobic biodigester systems with the technology developed by GSR Solutions in comparison to commercial chemical and organic fertilizers. The GSR fertilizer (3% N) was compared to ProBooster (10% N), Sodium Nitrate (15% N), and an untreated control.

There were no statistical differences between corn yield, plant height, population, and ear length between the three treatments.

Soil nitrate concentrations were statistically similar on all dates except for 19-Jun. GSR's fertilizer released 45% less nitrate in the soil compared to the conventional synthetic fertilizer (SN), indicating its slow release characteristics. Compared to ProBooster (PB), the organic corn yield with the application of the GSR fertilizer was relatively higher: by 639 lbs/acre (~ 11.4 bushel ac^{-1}), average height by 11 cm, and harvest population by 2,323 plants ac^{-1}, indicating more biomass produced per acre.

Application rate: 100 lbs N ac^{-1}
Planting date: 12-June
Harvest date: 26-August
Variety: Trinity F1
Seeds: 24,000 seeds per acre planted with a John Deere 1750 corn planter





Field sample collection. Images: Northwest Crops and Soils

Results suggest that GSR fertilizer could be used for nitrogen, phosphorus, and magnesium supplements. Extractable Magnesium in the GSR fertilizer plots was higher than SN by 14 ppm and PB by 13 ppm, and phosphorus than SN by 6.6 ppm and PB by 6.9 ppm due to nutrient recovery potential. Additional field trials of GSR fertilizer varieties will be conducted for both warm and cold season crops.

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