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

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

Nutrient Pollution and Harmful Algae Blooms

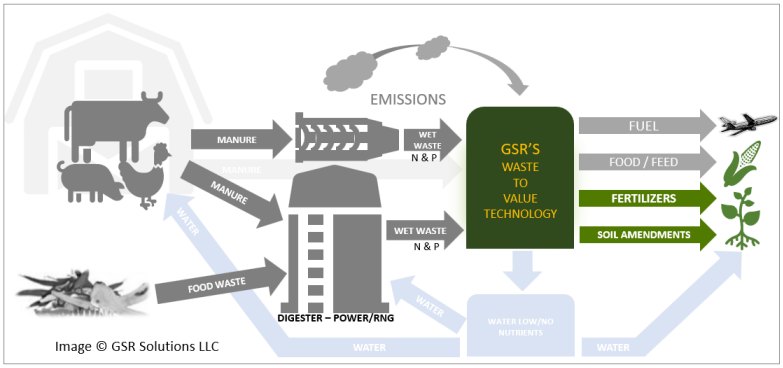
Excess nutrients from agricultural, industrial, and wastewater runoff result in harmful algae blooms in rivers, lakes, and the ocean. Inorganic nitrogen and phosphorous can fuel the rapid growth of algae, which deprives the aquatic environment of oxygen and sunlight. This process, eutrophication, results 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 both the digested or non-digested waste effluent streams and convert them into specialized 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 it captures nutrients from organic waste streams. 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

THE UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

COLLEGE OF AGRICULTURE AND LIFE SCIENCES

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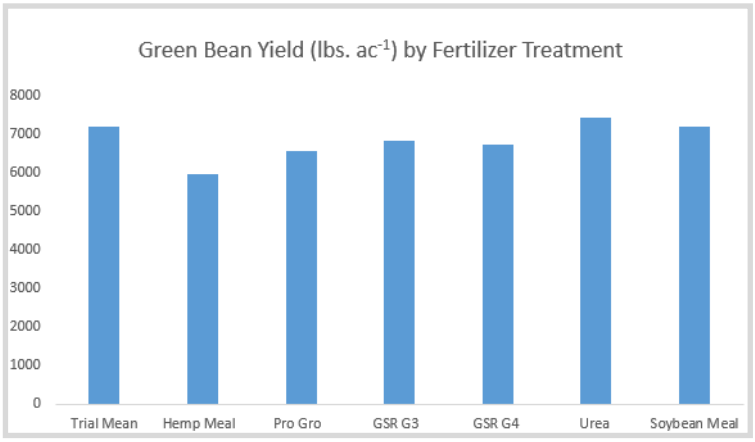
Results From Field Trials

In May 2022, UVM Extension's Northwest Crop and Soils Team evaluated two nutrient-recovered fertilizers made from the treatment of anaerobically digested liquid dairy manure effluent with the Ag-Biotechnology developed by GSR Solutions in comparison to commercial chemical and organic fertilizers. The GSR fertilizers (3% N) and (4%N) were compared to North Country Organic Pro-Gro (5%N), soybean meal (6% N), hemp seed meal (5% N), urea (46% N), and an untreated control.

There were no statistical differences between bean yield, dry matter yield, and yield moisture between the four treatments.

Compared to the Pro-Gro and hemp seed meal, green bean yield with the application of the GSR fertilizers (G3 & G4) were higher by 874 lbs/acre and 774 lbs/acre respectively compared to hemp seed meal, and 264 lbs/acre and 164 lbs/acre respectively higher than Pro-Gro.

Application rate: 30 lbs N ac^{-1}
Planting date: 31-May
Harvest date: 1-Aug
Crop*: Green Bean (var Provider)*
Soil Type: Benson rocky silt loam
Row spacing: 30" between rows



Field trials and crop growth. Image: Northwest Crops and Soils Program

There were no statistical differences in percent of organic matter and pH by treatment. Most soil nutrients declined from the beginning to the end of the season. After harvesting beans, a beet crop was grown and harvested in October. The increase in pH from 6.93 on 14-Jun to 7.06 on 27-Oct was significant and likely attributed to the degradation of the organic matter over time. The decrease in organic matter from 4.73% to 4.38% was also significant and possibly due to the multiple tillage operations throughout the season. Additionally, phosphorous (P), potassium (K), sulfur (S), manganese (Mn), zinc (Zn), and boron (B) all had significant differences between the two sampling dates. All of the nutrient levels, except copper (Cu) which remained the same, decreased over the course of the season. This is most likely due to the crops using these nutrients and reducing their levels in the soil. Magnesium (Mg), calcium (Ca), sulfur (S), iron (Fe), and boron (B) differed statistically by treatment. Soybean meal had the highest concentration of Mg at 158 ppm, being statistically similar to GSR 3 and GSR 4. Soybean meal also had the highest concentration of Ca at 2744 ppm, being statistically similar to GSR 3, urea, and the control. Additionally, soybean meal had the highest concentration of B at 0.780 ppm, being statistically similar to GSR 3, GSR 4, and the control. Pro-Gro had the highest concentration of S at 10.4 ppm. Finally, GSR 3 had the highest Fe concentration of 3.94 ppm, being statistically similar to GSR 4, soybean meal, and the control. The soil amendments did not impact bean compared to the control treatment. The planting of the bean crop may have produced enough of their own nitrogen, which minimized the need for fertilizer. Additional field trials of GSR fertilizer varieties will be conducted.

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