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

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

Nutrient Pollution and Harmful Algae Blooms

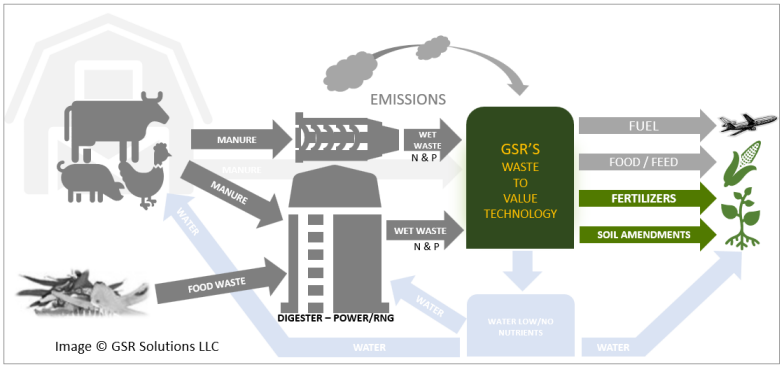
Excess nutrients from agricultural, industrial, and wastewater runoff result in harmful algae blooms in rivers, lakes, and the ocean. Inorganic nitrogen and phosphorous can fuel the rapid growth of algae, which deprives the aquatic environment of oxygen and sunlight. This process, eutrophication, results 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
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COLLEGE OF AGRICULTURE AND LIFE SCIENCES

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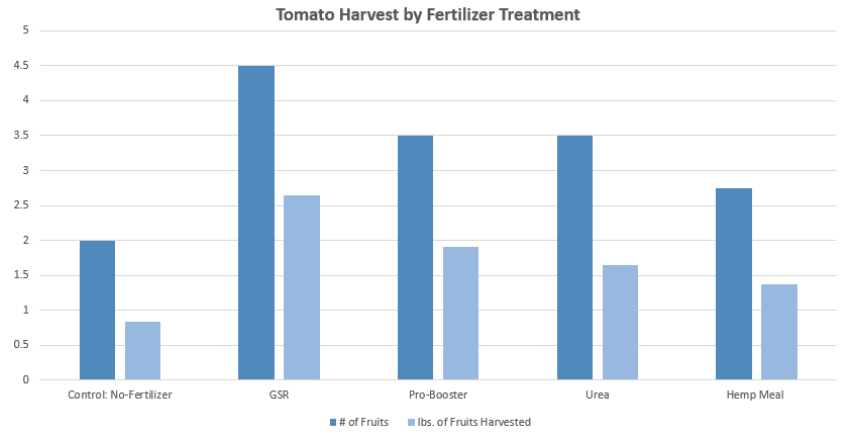
Results From Field Trials

In May 2023, 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 fertilizer (3% N) was compared to North Country Organics Pro-Booster (10% N), hemp seed meal (6% N), urea (46% N), and an untreated control.

GSR fertilizer had a statistically higher number of ripe tomatoes than the control and statistically higher weight harvested than both the hemp meal fertilizer, control, Pro-Booster and urea fertilizers on the second harvest date. There were no statistical differences on other harvest dates.

Application rate: 120 lbs N ac^{-1}
Planting date: 25-May
Harvest dates: 3,9,14,21,28 Aug & 6 Sept
Crop*: Tomato (var Galahad)*
Soil Type: Benson rocky silt loam
Plant spacing: 2' apart

The application of GSR organic fertilizer increased tomato yields (lbs.) by 48%, 38%, and 28% compared to hemp seed meal, Pro-Booster, and urea fertilizers, respectively, and also increased the number of tomato by 39%, 22%, and 22% respectively, in the 2nd harvest. (Chart below)



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

Tomato harvests were only significantly different on the second (9-Aug) and fourth (21-Aug) harvest dates. On 9-Aug, the GSR fertilizer had a statistically higher number of ripe tomatoes than the control and a statistically higher weight harvested than both the control and the hemp meal fertilizer. On 21-Aug, the urea fertilizer treatment had a statistically greater number of ripe tomatoes harvested and weight than all other fertilizer treatments but the control, which was not statistically different. When assessing total yield by treatment, the urea fertilizer had a statistically higher weight than both the Pro-Booster and hemp meal fertilizers, but was not statistically different from either the control or the GSR fertilizer. Soil nitrate concentrations were statistically similar to each other, except for the control which had the lowest levels at 42.8 mg N kg-1. The urea treatments had the highest levels of nitrate in the soil samples at 125 mg N kg-1, but was not significantly different from the other fertilizer treatments. Leaf nitrate concentration had significant differences a month and 5 days after transplanting the tomatoes, but the sampling on 19-Jul showed no significant differences among treatments.

When comparing total pounds of tomatoes harvested, the GSR fertilizer did have a higher weight of fruit collected than both the Pro-Booster and hemp meal fertilizers, suggesting the GSR fertilizer may aid in more fruit development.

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