Polymer Composite Turf Grass Fertilizer

Jake Behrens¹, Dr. David Grewell¹, Dr. James Schrader², Kenneth McCabe²
Agricultural and Biosystems Engineering Department¹, Department of Horticulture²
Iowa State University - Ames, IA

Background

This research investigated the use of soy based materials as a source of nitrogen in a natural, slow-release fertilizer. Traditional, synthetic fertilizers are water soluble and can contribute to contaminants, such as nitrogen, in watersheds.

The fertilizer formulations studied consisted of two components, a stabilizer and a functional component. A polymer matrix, consisting of PLA polymer, was used to stabilize the composite and control degradation rate. In addition, soy based filler materials were used as a nutrient base to supply nitrogen (functional component).

The formulations were varied to test their effect on plant health and growth, including:
- Grade of PLA
- Plasticizer content within PLA
- Filler material type

Materials and Methods

Testing was completed in two phases. Phase one was conducted at ISU’s Turf Grass Research Center and was used to define the design space of formulations of soy-based materials. Phase two was conducted in Horticulture Department’s greenhouses with the goal of collecting quantifiable data for statistical analysis.

Phase one:
- Materials tested include:
  - 14 soy-based materials
  - 1 synthetic fertilizer
  - 1 commercially available, bio-based alternative
  - 3 negative control plots (no fertilizer)
- 4 replicates each
- 1 lb of nitrogen per 1000 ft²
- 5' x 5' turf plots
- Fall fertilizer application
- Visual data only (1-9 scale, 1 being brown, 9 being dark green)

Phase two:
- Materials tested include:
  - 8 soy-based materials
  - 1 synthetic fertilizer
  - 1 commercially available, bio-based alternative
  - Each treatment’s own negative control
- 9 replicates each
- Data for marigold plants collected on:
  - Visual health rating
  - Shoot volume
  - Shoot dry mass
  - Leachate nutrient analysis
  - Plant tissue nutrient analysis

Results

Growth Trials

Soy and PLA based fertilizers have proven to work on turf grass plots, as well as in greenhouse container trials. Growth studies suggested the biobased fertilizer promoted plant growth, both turf and pot grown plant, as well as synthetic fertilizers and had relatively low levels of nitrogen loss.

Cost Analysis

A techno-economic analysis was conducted to determine the cost of manufacturing soy based biocomposite fertilizers. The purchase price of the synthetic fertilizer used for testing was $54.73 per pound of nitrogen. Soy fertilizer production costs were calculated to be $13.77 to $29.45 per pound of nitrogen depending upon material formulation. Soy and PLA biocomposites were found to be feasible for large scaled production.