Crude Glycerol Impact on Soil Health, Nutrient Loss, and Crop Yield – Year 2, Soybean

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Introduction

Cover crops have been widely regarded as an effective means to reduce soil nitrate (NO_3^-) losses via leaching. In contrast to this known function of cover crops, they remain underutilized due to difficulties in adoption and increased costs. The goal of this project is to propose glycerol, a non-toxic and natural byproduct of biodiesel production, as a "liquid cover crop" substitute to traditional cover crops. The objectives of this project are to determine if the application of crude glycerol reduces soil NO_3^- levels and to evaluate soybean yield response to glycerol additions.

Materials and Methods

The experimental design included a randomized split-plot block design with four replications. The plots were eight rows wide and 50 ft in length. Plot treatments included three crude glycerol rates (0, 60, and 240 gallons/acre) and six spring nitrogen (N) fertilizer rates (0, 50, 100, 150, 200, and 250 lb/acre) applied to the 2019 corn. The N fertilizer used in this study was slow-release Super U. Glycerol was broadcast applied October 28, 2018, (prior to 2019 corn) and November 4, 2019, (prior to 2020 soybean) as a 1:1 ratio of glycerol and water mixture. The soybean variety used in this study was Pioneer P23A15X with a seeding rate of 140,000 seeds/acre and was planted following corn May 4, 2020, in a no-tillage system. Soil cores were taken April 21, 2020, to an 18-in. depth, with the cores being divided into four increments (0-2, 2-6, 6-12, and 12-18 in.), in plots representing all three glycerol treatments and three N treatments (0, 100, and 250 lb N/acre). Soybean leaves were sensed with a SPAD meter and measured at the growth stages R2 and R5 in every plot. The middle six rows were harvested September 30, 2020, using a six-row plot combine. Soils were analyzed for inorganic ammonium (NH_4^+) and NO_3^-. Soil inorganic N was analyzed using a 0.5 M potassium sulfate (K_2SO_4) extraction and light spectrophotometry using the microplate method. Results were fitted to a linear mixed-effects model with random variables and were run under a 2-way ANOVA with type 3 sums of squares in R (Version 4.0.1). Paired contrasts were used to determine treatment differences for inorganic N at individual soil depth increments.

Results and Discussion

Soil NO_3^- did change and was significantly lower between both glycerol rates and the glycerol control at the shallowest soil depth increment, but both glycerol rates were not different from each other. Soil NH_4^+ was not significantly affected at each depth under the three glycerol treatments. Soybean yield was shown to have no significant glycerol or N fertilizer treatment effect (Table 1).

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Table 1. Effect of glycerol application on soil profile nitrate and soybean yield.[1]

Measurement	Glycerol (gal/acre)	Average (±SD)	Change from control (%)*
NO_3-N (mg/kg)	0	0.88 (±0.18)	-
	60	0.75 (±0.24)	-14.4
	240	0.68 (±0.36)	-23.1
Soybean yield (bu/acre)	0	64.1 (±4.2)	-
	60	63.4 (±3.8)	-1.17
	240	64.2 (±3.2)	0.15

[1]All soil sample depths were averaged (n = 48) with their respective standard deviations (SD) and all N rate yield values were averaged (n = 24) with their respective SD.

*Percent differences were calculated from treatment averages ((Treatment-Control)/Control) x 100).