Corn Starter Impacts Early Season Plant and Soil Properties

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Introduction

Starter fertilizers are utilized by farmers to help overcome harsh, early season conditions like cold, wet soils. Starters provide nutrients to the new seedling up until the root system develops. Typically starter fertilizers are used for corn production but not soybean since soybeans are usually planted later in the season when the soil is warmer and less likely to benefit from the starter application. Starter fertilizers are applied at planting in a 2x2 or in-furrow placement. The 2x2 placement method applies the fertilizer two inches to the side and two inches below the seed depth with the planter. In-furrow placement applies the fertilizer in the row and in contact with the seed. A concern with starter fertilizer applications is due to salt injury. Salt injury can be caused by osmotic effects, high levels of biuret or high concentration of ammonia produced by certain nitrogen (N) fertilizers. Osmotic effects of fertilizers are described as fertilizer "pulling" away water from the seed. Biuret and ammonia can reach levels high enough to inhibit seed germination and/or growth. Further, potassium (K) fertilizers typically have higher salt content than phosphorus (P) or N fertilizers.

Higher starter rates can be used with 2x2 placement than in-furrow placement because of the greater distance the fertilizer is placed from the seed. Starter fertilizer rates should not exceed 100 lb of nitrogen (N) plus potash (K_2O) per acre for 2x2 placement. When using the in-furrow placement, less than 15 lbs of N and K_2O is recommended (Ritchey and McGrath, 2019). Lower rates are used in-furrow because of the close proximity to the seed and can reduce germination due to the salt content of the starter fertilizer. Using a high salt fertilizer can inhibit seed germination. Starter fertilizers should contain low salt (LS) formulations, low rates of fertilizer, or a combination of low salt content and low rates to reduce the risk of seedling injury. Out of all the macronutrients, phosphorus is the most beneficial, followed by nitrogen.

Objective

Determine if starter fertilizer formulation or rate influences corn emergence, growth, yield, or soil electrical conductivity.

Materials and Methods

Corn (AgriGold AG6472) was planted on 6 June, 2019 with a four row precision planter. The starter fertilizer was applied in-furrow at planting with a Surefire injection pump system using metered hoses to apply the desired rates of fertilizer (Table 1). Nitrogen, phosphorus and potassium fertilizer was broadcast applied with a gandy drop spreader at appropriate rates for the given soil test values according to University of Kentucky Cooperative Extension recommendations (AGR-1). The fertilizer applied included 200 lbs of N as urea (46-0-0), 71 lbs of K_2O/A (0-0-60), and 102 lbs of P_2O_5/A (0-45-0). Stand counts, corn height, and electrical conductivity (EC) were measured on 13 June, 17 June, and 1 July. Stand counts and corn heights were collected on 10 ft of the middle two rows for each plot. Electrical conductivity was collected with a Spectrum Field Scout 110 EC meter to a depth of two inches five times for each treatment in the middle row between corn plants. Tissue samples were collected on 8 July 2019 for plant nutrient content. Ten leaves from the uppermost mature leaf (collared leaf) from each plot were collected and submitted to *Waters Agricultural Laboratories* for analysis (Schwab et al., 2007). All data was analyzed with SAS version 9.4.

Results

The 5 gpa APP treatment had significantly taller plant heights at all three sample dates than the control treatment (Figure 1). The 5 gpa APP treatment was taller than the control, 5 gpa UAN treatment, and 5 gpa LS treatment at the 1 July sample date, but only taller than the control at the 11 July sample date. There does not appear to be a negative effect of APP associated with plant height compared to the other treatments within this study. The LS treatment at either rate was statistically greater than the 5 gpa UAN treatment at the 21 June, but no other treatment. The 2.5 gpa LS treatment had statistically greater plant heights than the control, 2.5 gpa UAN, 5.0 gpa UAN and 5.0 gpa LS treatments at the 1 July sample date. A similar trend was observed at the 11 July sample date (Figure 1). These results may indicate that although the starter has no negative impact on growth, adequate nutrition might have been achieved with the lower rate of starter.

Generally, treatments containing UAN resulted in a higher EC than treatments without UAN in the formulation for the 19 June sample date. Electrical conductivity did not differ between treatments at the second sample date (Figure 2). However, EC increased due to leaching of the surface broadcast application of 0-0-60 fertilizer after 2.7 inches of rain. After an additional 1.8 inches of rain, leaching more of the fertilizer salts below the 2 inch sample depth causing EC to decrease for the last sample date. UAN 5.0 gpa was the only treatment that was statistically different than the rest in the last sampling date (Figure 2). Nutrient content of tissue samples were not statistically different due to treatments with all nutrients, except magnesium and calcium. No reason is known for these results.

The LS starter was the only product used in this test that contained K fertilizer (Table 1). The LS starter cost substantially more than the UAN or APP, but did not contain appreciably more nutrients than the other products. The salt index was greatest for the UAN, followed by APP compared to the LS starter. Products with APP have been reported to produce ammonia which can be detrimental to seed germination and early season growth. No negative effects were observed at the rates used for this study. The price of nutrients contained in the various starters was greatest for the LS starter and was the least economical based on the results thus far of this study.

Summary

Overall, starter that contained some P resulted in a greater corn plant height than N alone or the control. The P appeared to have a greater impact on plant height than N or K. Plant heights were similar for the LS 2.5 gpa rate and APP 2.5 gpa rate, but LS cost $12.27/A more than the APP. Starter fertilizer did not influence stand counts at any date. In the end, using 32-0-0 and 10-34-0 showed similar benefits for a much lower cost. Grain will be harvested to determine if final yield, test weight or grain moisture was influenced by starter fertilizer. Based on the results from one year of data, the economic and agronomic advantage would lend itself to utilizing APP or the UAN/APP combination to provide a substantial savings over the commercial LS fertilizer.

References

Mortvedt, J.J., L.S. Murphy, and R.H. Follett. 1999. Fertilizer Technology and Application. Meister Publishing Company.

Ritchey, E.L. and J.M. McGrath. 2018. 2018-2019 Lime and Nutrient Recommendations. University of Kentucky Cooperative Extension Publication AGR-1. http://www2.ca.uky.edu/agcomm/pubs/agr/agr1/agr1.pdf (assessed 22 July 2019)

Schwab, G. J., C.D. Lee, R.C. Pearce, and W.O. Thom. 20017. Sampling Plant Tissue for nutrient Analysis. University of Kentucky Cooperative Extension Publication AGR-92. https://simpson.ca.uky.edu/files/sampling_plant_tissue_for_nutrient_analysis.pdf (assessed 22 July 2019)

Table 1. Corn starter fertilizer treatments and rates.

Treatment	**Treatment #**	**Rate (GPA)**	**lb N/A**	**lb P_20_5/A**	**lb K_2O/A**	**Salt Index**	**$/A**
No Starter	1	Untreated	0	0	0	0	0
UAN	2	2.5 gal/A	8.9	0	0	71	3.88
UAN 2X	3	5 gal/A	17.8	0	0	71	7.76
APP	4	2.5 gal/A	2.9	9.9	0	20	5.98
APP 2X	5	5 gal/A	5.8	19.8	0	20	11.96
UAN/APP	6	2.5/2.5gal/A	11.8	9.9	0	46	9.86
LS Starter	7	2.5 gal/A	2.5	6.8	0.9	17	18.25
LS Starter 2X	8	5 gal/A	5.0	13.6	1.8	17	36.50

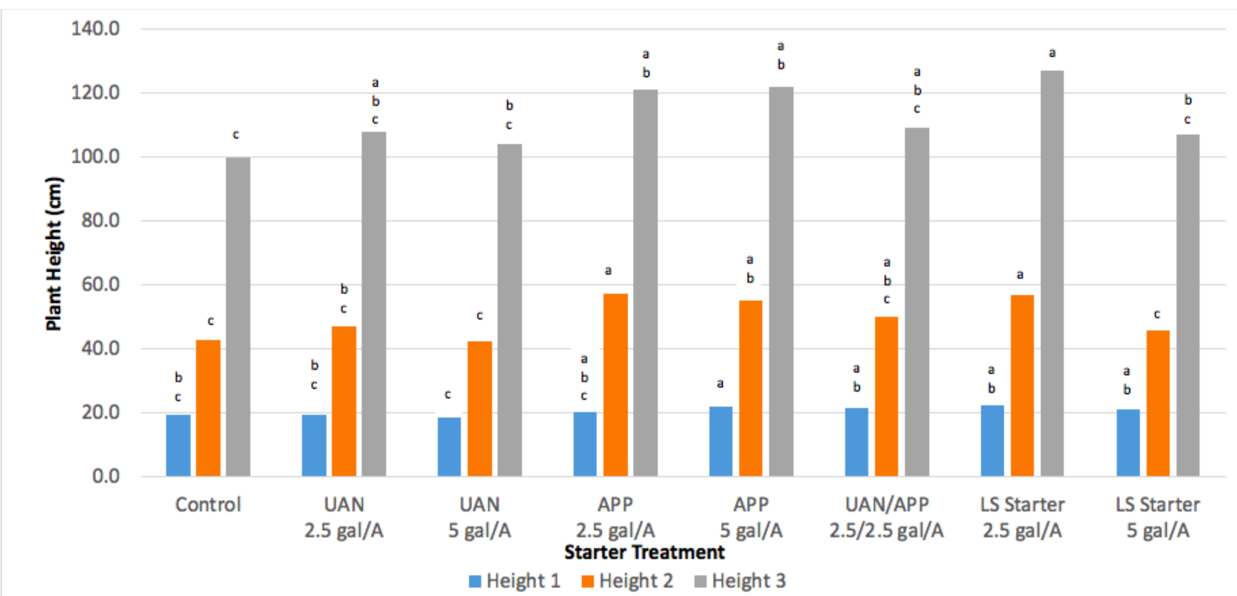

Figure 1. Plant height as influenced by starter formulation and rate. Plant heights collected 21 June, 1 July, and 11 July 2019. Values within a height for a particular sample date followed by the same letter are not different at the 0.1 level of probability.

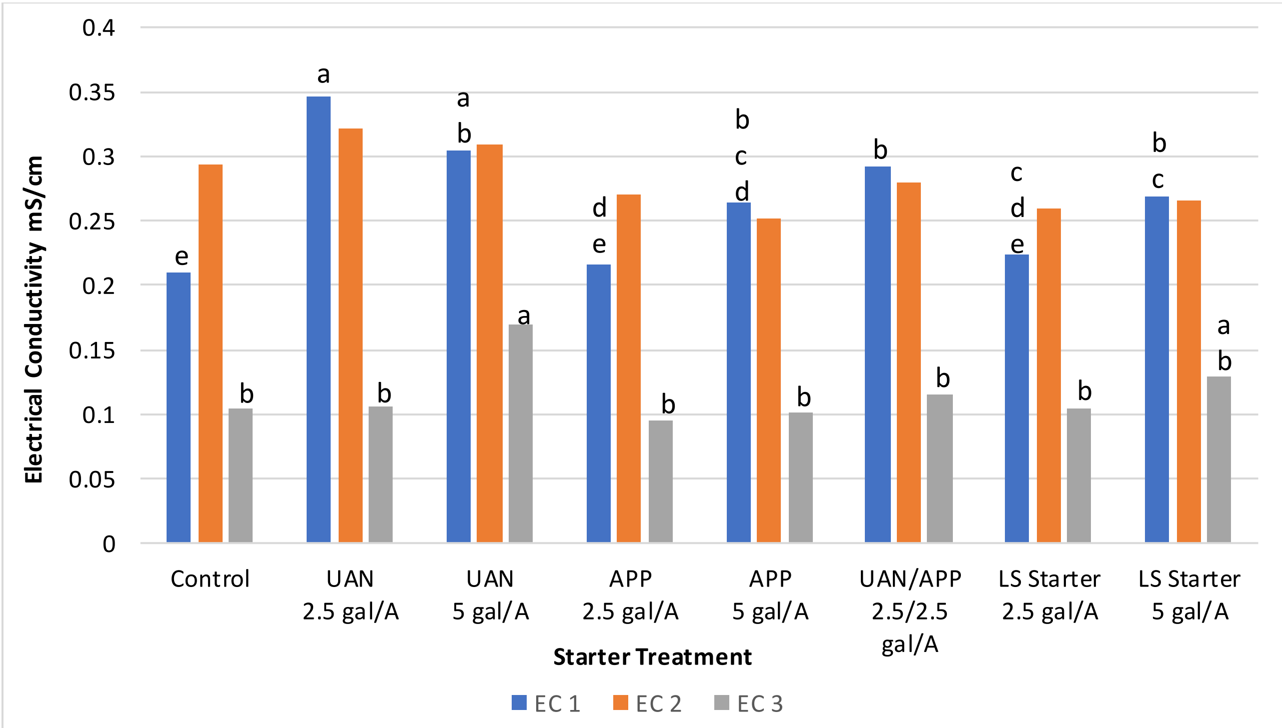

Figure 2. Electrical conductivity (EC) as influenced by starter formulation and rate. EC collected 19 June, 1 July, and 11 July. Values within EC sample date followed by the same letter are not different at the 0.1 level of probability.

Acknowledgements

Funding provided by USDA-NIFA ELI-REEU 2017-06637 and the Kentucky Corn Promotion Board.

Special thanks to Jesse Grey, Shawn Wood, Kayla Shelton, and Catlin Young for all the help.