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Abstract

This study was conducted to determine the effectiveness of AgZyme and SuperHume (both products of Ag Concepts Corp) application on phosphorus (P) uptake and utilization efficiency in grain sorghum. Treatments were a control, 30 lb P_2O_5/a, 20 oz/a AgZyme, 20 oz/a AgZyme + 30 lb P_2O_5/a, 20 oz/a AgZyme + 30 lb P_2O_5/a + 6 qt/a SuperHume, which were arranged in a randomized complete block design with four replications. Preliminary results in 2016 showed grain sorghum aboveground biomass, grain moisture content, and test weight were not affected by the application of either P alone or with a bio-stimulant. Applying AgZyme alone resulted in a 9 bu/a yield increase above the control. The application of AgZyme with P did not improve grain yield compared to control. This observation was possibly due to greater initial soil P content (45 lb P/a) at the study site. However, tissue P concentration was greatest when AgZyme was applied with 30 lb P_2O_5/a. Applying AgZyme, SuperHume, and 30 lb P_2O_5/a together reduced both sorghum grain yield and tissue P concentration.

Keywords

Bio-stimulant, Humic Acid, AgZyme, SuperHume, grain sorghum

Cover Page Footnote

This research was developed in collaboration with Jeremy Cusimano and supported by Ag Concepts Corp., Boise, ID.

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Summary
This study was conducted to determine the effectiveness of AgZyme and SuperHume (both products of Ag Concepts Corp) application on phosphorus (P) uptake and utilization efficiency in grain sorghum. Treatments were a control, 30 lb P_2O_5/a, 20 oz/a AgZyme, 20 oz/a AgZyme + 30 lb P_2O_5/a, 20 oz/a AgZyme + 30 lb P_2O_5/a + 6 qt/a SuperHume, which were arranged in a randomized complete block design with four replications. Preliminary results in 2016 showed grain sorghum aboveground biomass, grain moisture content, and test weight were not affected by the application of either P alone or with a bio-stimulant. Applying AgZyme alone resulted in a 9 bu/a yield increase above the control. The application of AgZyme with P did not improve grain yield compared to control. This observation was possibly due to greater initial soil P content (45 lb P/a) at the study site. However, tissue P concentration was greatest when AgZyme was applied with 30 lb P_2O_5/a. Applying AgZyme, SuperHume, and 30 lb P_2O_5/a together reduced both sorghum grain yield and tissue P concentration.

Introduction
Phosphorus fertilization is essential for crop production and is one of the most common nutrient inputs by Kansas growers. This nutrient is involved in many essential metabolic roles within the plant; deficiencies result in reduced yields, poor growth, and lost income. Soils vary in their ability to supply P to plants due to its low solubility and fixation by calcium, iron, and aluminum. Due to P fixation many growers over-apply P fertilizers, operating outside the curve of economic return. Thus improving phosphorus use efficiency is important for crop production in the region.

Agricultural plant bio-stimulants are a wide and broad class of compounds designed to promote plant growth and development, nutrient cycling, microbial activity, and soil health. Application of agricultural bio-stimulants increased the efficiency of organic fertilizers and significantly increased cotton lint yield (Khaliq et al., 2006). Calvo et al. (2013) found that applications of bio-stimulants reduced nitrous oxide emissions by 80% in soils fertilized with UAN 32. Other studies have demonstrated the effectiveness of additions of bio-stimulants on plant nutrient uptake (Shaharoona et al., 2008). This suggests that bio-stimulants have some effect on soil nutrient dynamics. However, research has shown these products to have varied results. The objective of this study was to determine the effectiveness of AgZyme and SuperHume application on P uptake and utilization efficiency in grain sorghum.

Procedures

Field experiments were conducted in the summer of 2016 at the Kansas State University Agricultural Research Center—Hays, KS to measure the effect of AgZyme application on grain yield and P utilization in grain sorghum. The soil at the experiment site was a Harney silt loam (fine, montmorillonite, mesic Typic Agriustoll). Prior to this study, the experimental site was planted to winter camelina in the fall of 2013. The camelina crop had 40 lb N/a and 20 lb P_2O_5/a applied as broadcast urea and monoammonium phosphate, respectively. The field has been fallowed since the camelina harvest in June 2014. Soil fertility analysis conducted from soil samples collected at 0 to 6 in. depth in the summer of 2016 was not different among the pre-assigned treatment plots. Averaged across the four experimental blocks, initial soil chemical analysis was as follows: 2.1% soil organic matter, pH 6.4, 45 lb P/a, 1080 lb potassium (K)/a , and 22 lb nitrate (N)/a.

The study had five treatments (Table 1; control, 30 lb P_2O_5/a, 20 oz/a AgZyme, 20 oz/a AgZyme + 30 lb P_2O_5/a, 20 oz/a AgZyme + 30 lb P_2O_5/a + 6 qt/a SuperHume) which were arranged in a randomized complete block design with four replications. The trial was planted on June 8, 2016 at a seeding rate of 26,000 seeds/a with a John Deere four row planter. Plot sizes were 10 feet wide (in 30-inch row spacing) by 30 feet long. Nitrogen fertilizer was applied to the plots at the time of planting as a broadcast urea at 100 lb N/a. Except the control and AgZyme only treatments, the remaining treatments received 30 lb P_2O_5/a as broadcast application of monoammonium phosphate (11-52-0). The AgZyme and SuperHume products were applied in-furrow with the seed at planting at 20 oz/a and 6 qt/a, respectively and diluted with 10 gal/a water to allow for uniform application.

At maturity, entire plants in a 2.5 × 5 ft area from the outer row in each plot were cut at 2 in. above the soil surface. Fresh weights of the harvested samples were recorded, sub-samples were collected, chopped through a wood chipper and weighed (samples included both sorghum seeds and stalks). The samples were oven dried at 140°F for at least 48 hours in a forced-air oven for dry matter determination. Oven-dried samples were ground to pass through a 1-mm mesh screen in a Wiley Mill, Standard Model No. 3 (Thomas Wiley, Inc., Swedesboro, NJ). The ground samples were then analyzed for nutrient concentrations at Ward Laboratories, Inc., Kearney, NE.

Two middle rows from each plot were harvested to determine grain yield, moisture content, and test weights. Statistical analysis with the Proc GLM procedure in SAS 9.4 (SAS Institute Inc., Cary, NC) was used to examine sorghum biomass, grain yield and nutrient concentration as a function of bio-stimulant and P application using analysis of variance (ANOVA).

Results

Grain sorghum aboveground biomass, grain moisture content, and test weight were not affected by the application of either P alone or with a bio-stimulant. However, there was a significant (P = 0.05) treatment effect on sorghum grain yield. Applying AgZyme alone resulted in a 9 bu/a yield increase above the control treatment (Table 2). The application of AgZyme with P did not improve grain yield compared to control. This observation was possibly due to greater initial soil P levels (45 lb P/a) at the experimental site. Notwithstanding, tissue P concentration was greatest when AgZyme was applied with 30 lb P_2O_5/a (Table 3). Applying AgZyme, SuperHume, and 30 lb P_2O_5/a together reduced both sorghum grain yield and tissue P concentration (Table 3). Overall, these preliminary findings suggest that AgZyme has an effect on soil phosphorus cycling, but also demonstrates the possible antagonistic effects between AgZyme, SuperHume, and phosphate fertilizer in grain sorghum production. Further studies are needed to confirm these observations.

Acknowledgment

This research was developed in collaboration with Jeremy Cusimano and supported by Ag Concepts Corp., Boise, ID.

References

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Table 1. AgZyme, SuperHume, and P treatments at Kansas State University Agricultural Research Center—Hays, KS, in 2016

Treatment		AgZyme (AZ)	SuperHume (HA)	Phosphorus (P)
		oz/a	qt/a	lb/a
1	Control	0	0	0
2	P only	0	0	30
3	AZ	20	0	0
4	AZ + P	20	0	30
5	AZ + HA + P	20	6	30

Table 2. Grain sorghum total aboveground biomass, grain yield, moisture content, and test weight as affected by bio-stimulant and phosphorus (P) application in 2016 at Hays, KS

Treatment	Moisture	Test weight	Biomass	Yield
	%	lb/bu	lb/a	bu/a
Control	12	57.2	8626	81.3
P only	12	57.1	8871	76.0
AZ	11.9	56.2	8085	90.3
AZ + P	11.9	56.3	8512	80.8
AZ + HA + P	11.9	57.2	8262	69.5
LSD (0.05)	NS	NS	NS	13.0
P-value	0.73	0.51	0.99	0.05

AZ = AgZyme.
HA = SuperHume.
LSD = least significant difference.

Table 3. The concentration of nitrogen, phosphorus (P), potassium, and sulfur in grain sorghum aboveground biomass as affected by bio-stimulant and P application in 2016 at Hays, KS

Treatment	Nitrogen	Phosphorus	Potassium	Sulfur
	---------- % ----------			
Control	1.7	0.23	1.68	0.13
P only	1.6	0.21	2.04	0.12
AZ	1.7	0.24	1.54	0.12
AZ + P	1.8	0.25	1.48	0.12
AZ + HA + P	1.7	0.20	1.62	0.12
LSD (0.05)	NS	0.03	NS	NS
P-value	0.06	0.03	0.10	0.83

AZ = AgZyme.
HA = SuperHume.
LSD = least significant difference.