Spring Wheat Responses to Starter Fertilizer, Micronutrient and Root Inoculant

Armitava Chatterjee, Dept. of Soil Science, NDSU

Research Questions

Can we increase spring wheat yield and protein content with phosphorus, sulfur, copper, zinc and root inoculant in addition to recommended NPK fertilizers?

Results

Significant increase in yield over recommended NPK fertilizers was observed only in 2015 growing season (Fig. 1). Application of copper, zinc and sulfur had significantly higher yield (76 Bu/ac) than recommended NPK application (70 Bu/ac) at 90% significance level. Highest yield was achieved with 11-52-0 at 40 lb P_2O_5/ac and inoculant treatment in 2014 and 2015, respectively. Significant increase in protein content was also observed with addition of copper and sulfur together over recommended rate of NPK. However, grain protein content did not show any increase over recommended NPK in 2015 and 2016. Grain nutrient concentrations did not increase over recommended NPK applications.

Application and Use

Our study indicates that additions of either 11-52-0 at 40 lb/ac or integrated use of copper (1 lb/ac), zinc (1 lb/ac) and sulfur (10 lb/ac) with recommended NPK have potential to increase yield and protein content.

Economic Benefit to a Typical 500 Acre Wheat Enterprise

Integrated use of copper, zinc and sulfur or 11-52-0 at 40 lb/ac increased yield 6 Bu/ac in 2015. So, these treatments have potential to increase the profit by $8.00/Bu×6 Bu/ac×500 ac= $24,000.

Materials and Methods

Field experiments were conducted during 2014-2016 growing season near Glyndon, MN on a Beardon Silty Clay Loam soil. Initial soil properties are presented in Table 1. Eleven treatments of various combinations were arranaged in a randomized complete block design with four blocks. The treatments were: 1. Control (no fertilizer applied); 2. Recommended NPK; 3. Starter fertilizer (11-52-0) @ 40 lb/ac with recommended NPK; 4. Sulfur @10 lb/ac (as ammonium sulfate) with recommended NPK ; 5. Copper @ 1 lb/ac with recommended NPK; 6. Zinc @ 1 lb/ac with recommended NPK; 7. Copper + sulfur (as $CuSO_4$ matching the amount of Cu and S with treatment 4 and 5) with recommended NPK; 8. Zinc + sulfur (as $ZnSO_4$ matching the amount of Zn and S with treatment 5 and 6) with recommended NPK; 9. Copper + zinc + sulfur (as $CuSO_4$ and $ZnSO_4$ matching the amount of Cu, Zn and S with treatment 4, 5 and 6) with recommended NPK;10. Root inoculant (Trichoderma spp.) with recommended NPK; and 11. Root inoculant+ (Trt. 9: copper + zinc+ sulfur) with recommended NPK. Individual treatment plots measured 10 feet wide and 30 feet long.

The initial nutrient status of the soil was presented in Table 1. The soybean stubbles were removed from the field before the application of the treatments. All of the above mentioned treatments were mid-row banded, and spring wheat was planted on May 16, April 18, April 28 in 2014, 2015, and 2016, respectively, with an 8' wide, small plot sized grain drill. ND Wheat variety Glenn was planted in 2014 and Faller was planted in 2015 and 2016, at the seeding rate of 2 bushels per acre. Overall germination and plant stands were very good. Husky herbicide was applied one time for weed control on the spring wheat. At physiological maturity, the middle five rows of each plot were harvested using the small plot combine harvester on August 24, August 4, and August 15 in 2014, 2015 and 2016, respectively. Wheat grains were dried at 60˚C for 3 days and adjusted to 14 % moisture level before recording grain yield. Grain protein content was analyzed using Infratec 1241 Grain analyzer (FOSS analytical AB, Hoganas, Sweden). Statistical analyses were performed using PROC-ANOVA procedure for RCBD in SAS 9.3 (SAS Institute Inc, Cary NC). Means comparisons were conducted at the 90% confidence level using Fisher's least significance difference method.

Related Research

Soon, Y.K., G.W. Clayton, and P.J. Clarke. 1997. Content and uptake of phosphorus and copper by spring wheat: Effect of environment, genotype, and management. Journal of Plant Nutrition. 20(7&8): 925-937.

Franzen, D.W., M.V. McMullen, and D.S. Mosset. 2008. Spring wheat and durum yield and disease responses to copper fertilization of mineral soils. Agronomy Journal. 100(2): 371-375.

Rehm, G.W. 2008. Response of hard red spring wheat to copper fertilization. Communications in Soil Science and Plant Analysis. 39:2411-2420.

Recommended Future Research

I strongly suggest to conduct more research on spring wheat yield and protein response to additions of phosphorus, sulfur, copper and zinc particularly in light textured, low organic matter soils. I also suggest to explore the effect of *Trichoderma spp*. inoculation on spring wheat root growth, yield and nutrient uptake particularly in saline conditions.

Publications

Chatterjee, A., Thapa, R. 2016. Can We Increase Spring Wheat (Triticum aestivum L.) Grain and Protein Yields with Urease and Nitrification Inhibitors? ASA-CSSA-SSSA Annual Meeting, Nov. 6-9, Phoenix, AZ (Poster).

Table 1. Basis initial surface (0-15 cm depth) soil properties of field site at Glyndon, MN.

BD ($Mg\ m^{-3}$)	pH	OM $g\ kg^{-1}$	NO_3-N $Kg\ ha^{-1}$	Olsen-P $mg\ Kg^{-1}$	K $mg\ Kg^{-1}$	S $kg\ ha^{-1}$	Cu $mg\ Kg^{-1}$	Zn $mg\ Kg^{-1}$	CEC $Cmol^{+}\ kg^{-1}$
1.28	8.4	47	15	19	240	18	1.37	1.44	26.1

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Figure 1. Spring wheat grain yield (Bu/ac) and protein content (%) in response to mid-row banded phosphorus, copper, zinc and sulfur applications during 2014-2016 growing season of on-farm field experiment conducted at Glyndon, MN.