EVALUATION OF MACRONUTRIENT UPTAKE AND PARTITIONING IN WINTER WHEAT

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ABSTRACT

A better understanding of nutrient uptake patterns during the growing season for winter wheat (Triticum aestivum) can help to improve nutrient management decisions at the farm level. The objective of this study was to evaluate the effect of macro and micronutrient fertilization on nutrient uptake and partitioning for a Kansas wheat variety. This study was conducted during the 2014-2015 growing season at the Manhattan North Farm research station, Kansas State University. The experimental design was a randomized complete block with two treatments and four replications. Treatments included a control with agronomic recommended N, P, and K application, and a treatment with N, P, K plus micronutrient fertilization. Aboveground wheat biomass was collected every 7-10 days from spring green-up until harvest, with 1-2 samplings in the fall before dormancy. Plant samples were separated into the main plant fractions including leaves, stems, spike, grain and roots. Weights of all plant samples were recorded and samples were analyzed for total nutrient content.

INTRODUCTION

Winter wheat (Triticum aestivum) is one of the most important crops in Kansas agriculture and there is a consistent strive to increase yields. Understanding nutrient uptake and partitioning is key to improving the fertilizer recommendations of wheat to increase both yields and quality in Kansas. Likewise, as yields do increase over time, it is important to understand the changes in nutrient distribution within the plant as this can affect grain quality. There is very little previous research that has extensively observed the nutrient uptake patterns of wheat varieties in Kansas and we believe this information is very beneficial to improving wheat production within the state.

MATERIALS AND METHODS

This study was conducted at the Kansas State Agronomy North Farm research station in Manhattan, KS during the 2014-2015 growing season. The soil is classified as a Smolan silty clay loam. The experimental design is a randomized complete block with two treatments and four replications. Treatments were designed to compare the effect of micronutrient application on uptake of nitrogen (N), phosphorus (P), and potassium (K). Treatments included an application of N, P, and K only and the second treatment included the same application of N, P, and K plus zinc (Zn), manganese (Mn), copper (Cu), boron (B) and sulfur (S). Nitrogen was split applied (as UAN) between pre plant and top dress at the beginning of spring green-up and one third of P was applied (as APP) along with the pre plant application. All other fertilizer was applied at planting as dry granular broadcast.

Soil samples were collected at planting and 0-6” sample was analyzed for organic matter,

phosphorus, potassium, pH, boron, copper, manganese and zinc while a 0-24” sample was analyzed for nitrate, sulfur and chloride. Above ground biomass samples were taken from each plot once in the fall and every week after spring green-up except when weather limitations disallowed sampling. Samples were taken by hand clipping from 4.16 feet^2. Along with aboveground biomass. Samples were partitioned into main plant fractions of; leaf, stem, spike, and grain. Samples were dried, weighed for dry matter, and then ground for analysis. Plots were also harvested for grain. Samples were analyzed for N, P, and K along with micronutrients in the Kansas State University Soil Testing Laboratory.

RESULTS AND DISCUSSION

Initial results from the study show a significantly high level of nutrient uptake occurring early in the spring season after greenup. Nitrogen uptake occurs rapidly and by 27 days after green-up 62% of total nitrogen accumulation has occurred in the NPK treatment. The NPK+micros however, seem to show a slower initial uptake of nitrogen but a larger total accumulation by the end of the season. By day 27, total nitrogen accumulation is at only 50% and it isn’t until day 46 that total accumulation reaches 61%. Plots receiving micronutrients accumulated 11% more nitrogen by day 70 than plots without micros.

Phosphorus uptake showed a steadier increase throughout the season than nitrogen. In the NPK treatment, only 37% of total P accumulation had occurred by day 27 and P accumulation continued to rise to a peak of 16 lbs/acre on day 70. P accumulation for the NPK+micros treatment followed the same trend as nitrogen, accumulating a larger percentage of P later in the season. By day 34, plants had only accumulated 33% of total P accumulation and it wasn’t until after day 46 that 50% of total accumulation had been reached. The total P accumulation for the season was increased with the application of micronutrients to 18.5 lbs/acre on day 70.

Potassium accumulation also showed a very rapid increase shortly after green-up. K accumulation in the NPK treatment peaks earlier than in the NPK+micros treatment and in both treatments K levels decrease drastically as plants approach maturity. K is much more concentrated in the stem portion of the plant than N and P.

SUMMARY

Some differences between the accumulation patterns of NPK in plants can be observed between plants receiving only NPK and plants receiving NPK and micros. Further data analysis will continue to be done as well as continued replication of the study.

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Table 1. Average Soil Test

Treatment	pH	O.M.	P	K	NO3-N	Cu	Mn	Zn	Cl	SO4-S
		%	ppm							
NPK	5.87	2.21	39.28	289	10.01	1.57	30.65	1.15	2.74	9.99
NPK+Micros	5.80	2.10	32.08	296	15.69	1.42	20.23	1.01	2.83	9.53

Table 2. Amount of Fertilizer Applied

Treatment	N	P	K	Cu	Mn	Zn	B	S
	Lbs/Acre							
NPK	100	77	50	0	0	0	0	0
NPK+Micros	100	77	50	10	10	15	2.5	40

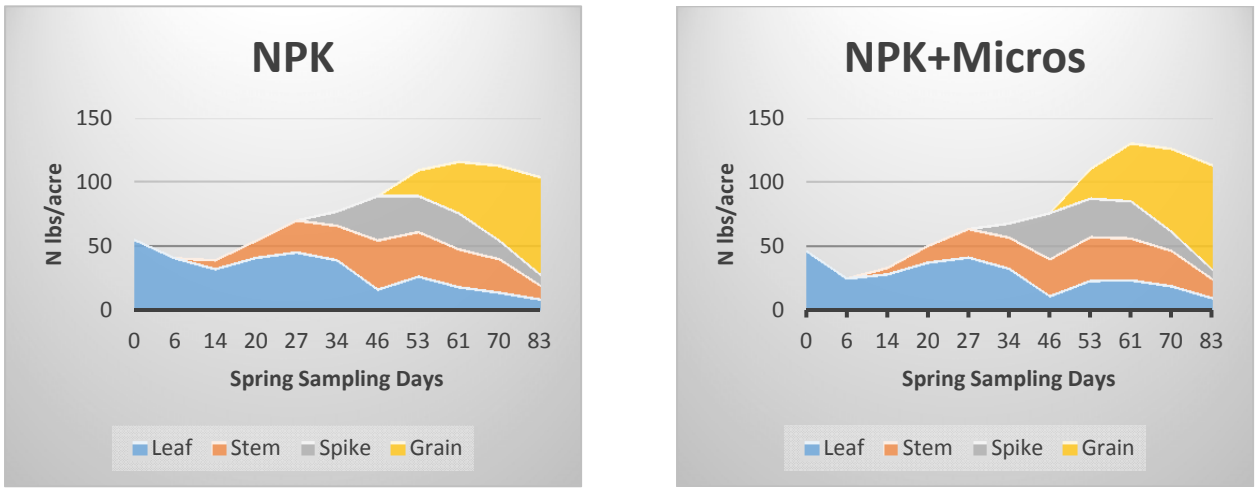
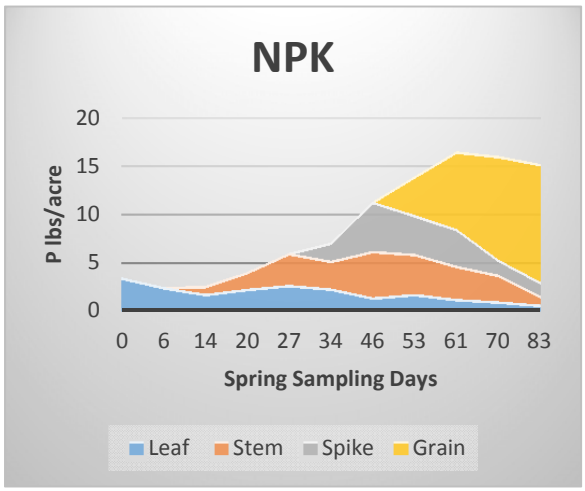


Figure 1. Nitrogen accumulation in plant fractions throughout spring season.



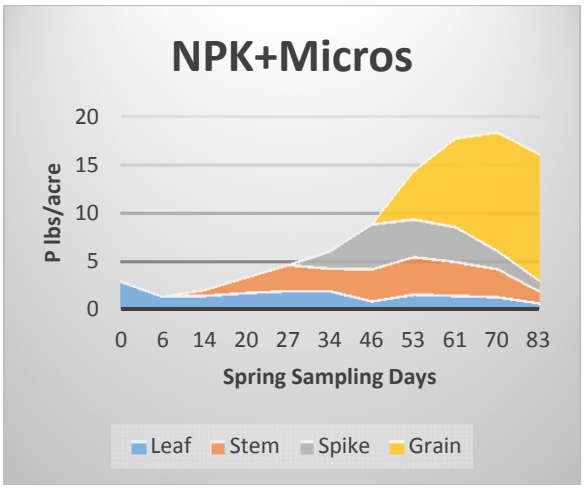
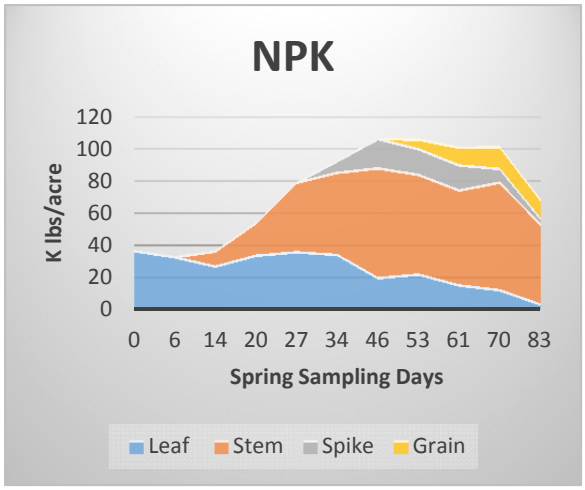


Figure 2. Phosphorus accumulation in plant fractions throughout the spring season.



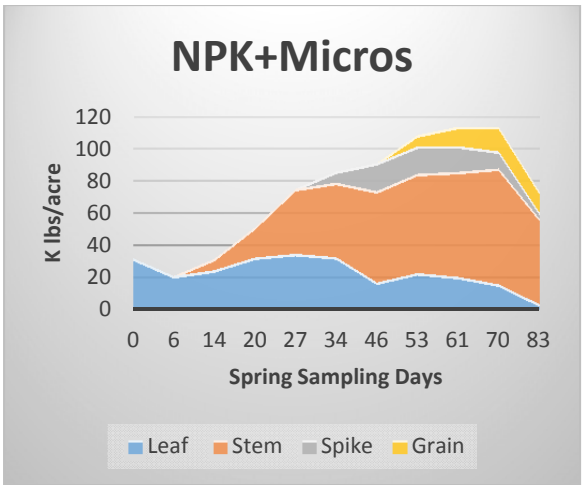


Figure 3. Potassium accumulation in plant fractions throughout the spring season.

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