Crop and soil response from phosphorus and potassium fertilizer rate verification for the state of Tennessee

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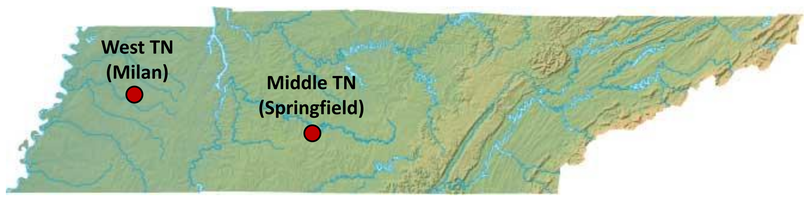
Introduction

Soil testing laboratories follow several philosophies when making fertilizer recommendations including maintenance, building and sufficiency. Based on 'maintenance' philosophy, fertilizer recommendations depend on the rate of crop removal without considering soil nutrient contents. Heavy rates of fertilizer applications are recommended based on 'building' philosophy which result in high or very high soil test values. 'Sufficiency' philosophy is based on 'feeding the crop' concept in which the fertilizer recommendations are based on filling the gap between soil supplied nutrients and nutrient amount needed for maximizing yield. University of Tennessee (UT) follows a combination of building and sufficiency philosophies which has proven to be the most profitable approach. Accordingly, UT had stopped recommending phosphorus (P) and potassium (K) fertilizer applications since 2008 on soils testing high for P and K. Field studies have been started since 2009 for corn-soybean-wheat rotation system in both middle and west Tennessee to verify the current soil test calibration and resulting fertilizer recommendations on soils testing low and high for P and K. For low testing soils, we expected yield response to the addition of the low testing nutrient, and for high testing soils we expected no yield response to the addition of the high testing nutrient.

Objectives

1. Assess the yield response of row crops to P and K fertilizers on soils testing low and high on soil P and K levels
2. Determine whether the currently recommended rates of P and K fertilizers on low testing soils build soil test levels out of the low range
3. Compare the soil available P and K contents extracted by three commonly used extraction agents

Study locations



Field trial sites

Locations	Soil test levels	Soil types
Milan	High soil P & K	Loring silt loam
	Low soil P	Grenada silt loam
	Low soil K	Grenada silt loam
Springfield	High soil P & K	Dickson silt loam
	Low soil P	Mountview silt loam
	Low soil K	Mountview silt loam

Fertilizer rates

Pounds of N, P_2O_5 and K_2O per acre		
High P & K rates	**Low P rates**	**Low K rates**
175 0 80	175 0 160	175 160 0
175 80 0	175 60 160	176 160 50
175 40 40	175 120 160	175 160 100
175 80 80	175 180 160	175 160 150

- Field trials ongoing since 2009
- Corn-Soybean-Wheat rotation
- Field replications: 4 for high testing sites and 5 for low testing sites
- P and K fertilizers applied annually in December
- Soil extraction using three extraction agents: Mehlich-1, Mehlich-3 and Lancaster
- Analysis of soil available P and K using Inductively Coupled Plasma Emission Spectroscopy
- Measurement of crop yield and plant P and K content every year

Results

(a) Yield response from high testing sites

Year	Crop	P response (Yes/No)		K response (Yes/No)	
		Milan	Springfield	Milan	Springfield
2009	corn	No	No	No	No
2010	corn	No	No	No	No
2010-11	wheat	No	No	No	No
2011	soybean	No	No	No	No
2012	corn	drought	drought	drought	drought
2012-13	wheat	No	No	No	No
2013	soybean	No	No	No	No
2014	corn	No	No	No	No
2014-15	Wheat	No	No	No	No
2015	soybean	No	No	No	No

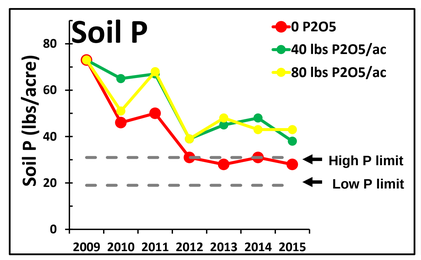
- No yield response from sites which tested high for soil P and K before the start of the experiment

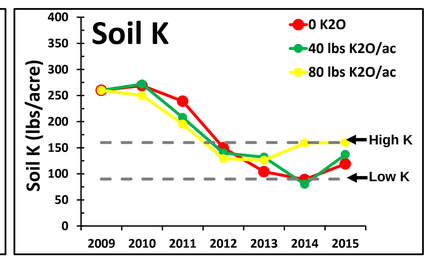
(b) Yield response from low testing sites

Year	Crop	P response (Yes/No)		K response (Yes/No)	
		Milan	Springfield	Milan	Springfield
2009	corn	No	No	No	cattle
2010	corn	No	No	No	drought
2010-11	wheat	No	Yes	No	No
2011	soybeans	No	No	No	No
2012	corn	drought	drought	drought	drought
2012-13	wheat	Yes	Yes	Yes	Yes
2013	soybeans	No	No	No	Yes
2014	corn	Yes	Yes	No	No
2014-15	Wheat	Yes	Yes	No	No
2015	soybeans	Yes	Yes	No	No

- Yield response more frequent since 2012 especially with P application

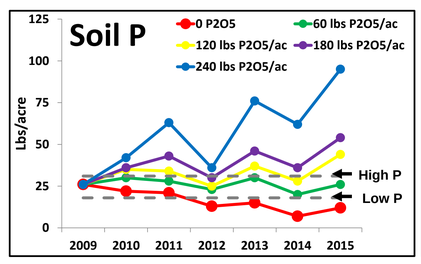
(c) Soil P and K levels in high testing soils at Milan

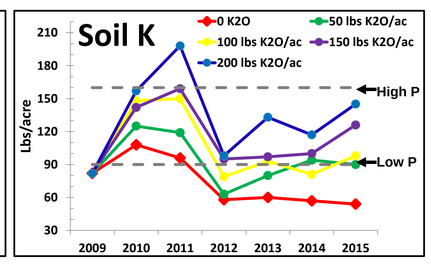




- Soil P did not reach to low level even without P fertilizer addition
- Soil K took 3 years to reach to low level

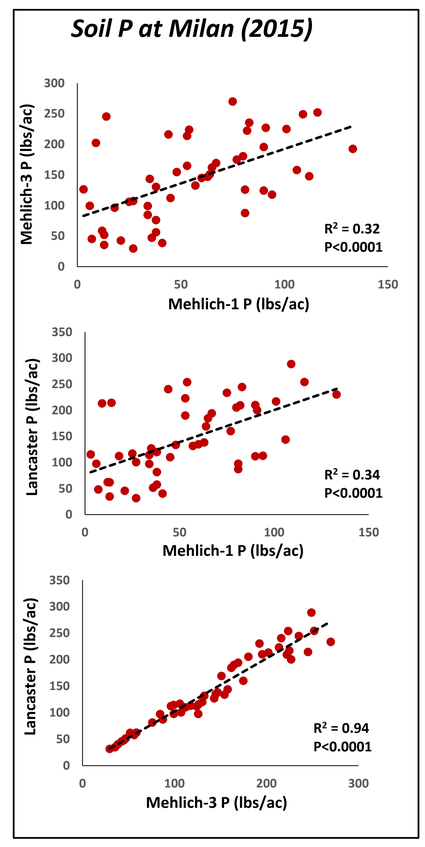
(d) Soil P and K levels in low testing soils at Milan

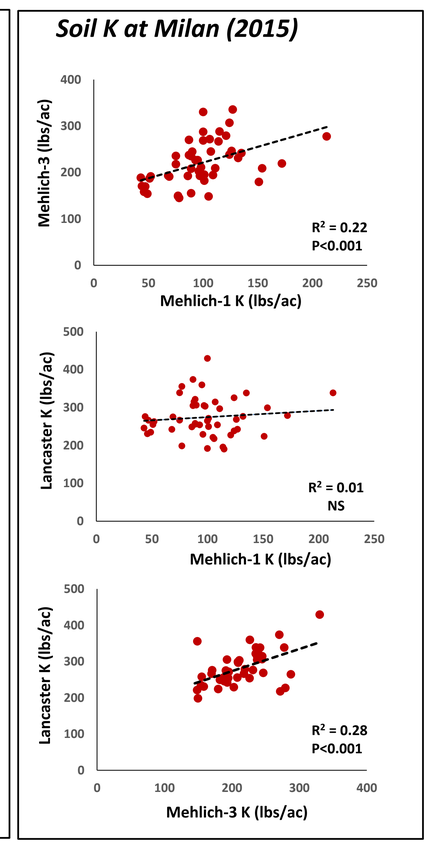




- Addition of 120 lbs of P_2O5/ac resulted in high soil P level
- >150 lbs of K_2O/ac brought soil K levels to medium range only

(e) Relationships among extraction agents on soil P & K





Ongoing analysis

- Soil extractions using Haney's extractant (H^3A)
- Relationships among grain yield, crop removal of nutrients, and soil P and K extracted by different reagents

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