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Title: Establishing Portable X-Ray Fluorescence (PXRF) as a Rapid Soil Analysis Tool for Golf Courses

Project Leaders: Dr. Joseph Young and Dr. David Weindorf

Affiliation: Texas Tech University

Summary Text:
Portable X-ray fluorescence spectrometry (PXRF) has been used to identify soil pollution and contamination following natural disasters, estimate soil chemical and nutrient characteristics, and most recently to assess elemental levels within vegetation samples. Much of the work and progression of these evaluations have been conducted by Dr. Weindorf and colleagues in his time at LSU and Texas Tech. We set out to better understand how the instrument could provide information suitable for assisting golf course superintendents in rapidly obtaining soil nutrition data and estimating salinity levels, cation exchange capacity, or identify potential contaminants.

This initial work compared PXRF data to soil lab tests conducted at LSU's soil testing facility. Soil samples were obtained at a 6 inch depth from 50 geo-referenced locations spread over a golf course in Amarillo, TX; Midland, TX; and Hobbs, NM. The soil was prepared and a subsample was submitted to the soil testing facility, while a second sample was scanned with the PXRF.

A summary table of soil testing data is provided to demonstrate the variation in some factors from location to location. Linear or non-linear regression lines were fitted to each select soil test results and PXRF determination. The high correlations for these elements demonstrate the similarities in readings and the potential viability of the instrument to be used to rapidly estimate some of the same properties a golf course superintendent would obtain from various soil testing procedures. Removing outliers from the plots would further strengthen the relationship between soil test and PXRF results. It is important to realize that these data can be obtained in seconds from any soil obtained on the golf course in comparison to the time required to collect, ship, and wait for soil testing results.

Further analysis with data obtained and possibly expanding soil collections to a wider array of circumstances would allow for the development of simple conversion spreadsheets that could be provided to golf course superintendents who may be interested in this technology. Conducting multiple regression analysis is necessary to develop algorithms for determining more intricate soil physical and chemical properties based on PXRF output; however, Dr. Weindorf has developed a great research team with the capabilities of establishing these types of deliverables.

Figure 1. A portable X-ray fluorescence spectrometer.

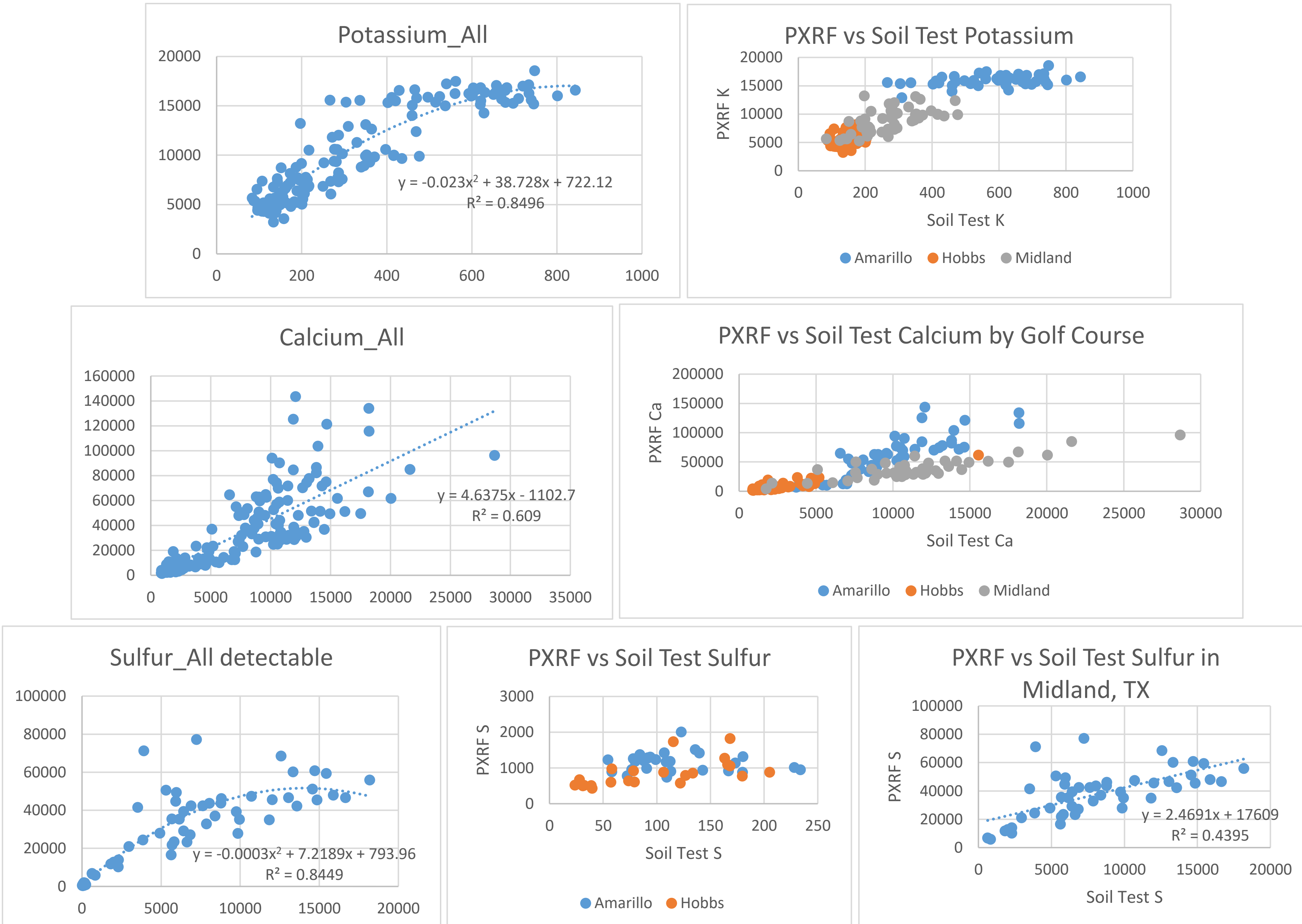

Figure 2. Linear or non-linear regression lines were fit to each select soil test results and PXRF determination. The high correlations for these elements demonstrate the similarities in readings and the potential for the device in the golf course industry.

Table 1. Minimum, maximum, and mean soil testing facility (LSU) results from soil obtained at three locations within the Southern High Plains.

		Amarillo	Hobbs	Midland
pH (1:1)	Range	7.86-8.31	7.96-8.52	7.13-7.86
	Mean	8.07	8.26	7.49
P (ppm)	Range	6.07-46.9	6.75-37.5	8.01-112
	Mean	17.4	14.3	49.4
K (ppm)	Range	266-843	87.3-285	83.2-476
	Mean	584	147	278
Ca (ppm)	Range	3,712-18,204	871-15,557	1,759-28,670
	Mean	10,068	2,625	11,510
Mg (ppm)	Range	685-1,633	96.6-310	200-927
	Mean	1,268	170	593
S (ppm)	Range	35.2-234	15.5-205	630-18,182
	Mean	110	70.1	8,105
Na (ppm)	Range	86.5-266	50.3-278	148-617
	Mean	170	108	367
Zn (ppm)	Range	2.89-89.6	0.65-3.07	1.23-13.7
	Mean	21.3	1.41	7.31