THE SOIL P_2O_5 MAPPING USING THE REAL TIME SOIL SENSOR

Masakadu Kodaira, Yuya Nagami, Sakae Shibusawa, Ryuhei Kanda

Faculty of Agriculture
Tokyo University of Agriculture and Technology
Fuchu-shi, Tokyo, Japan

ABSTRACT

There are a few researches to perform on-the-go measurement of P_2O_5 (P). The objectives of this paper are to measure the soil P by the on-the-go Real-time Soil Sensor (RTSS) and to create soil P maps.

The experiment was conducted on a 4ha-commercial farm in Hokkaido, Japan. The Vis-NIR spectra data (350 to 1700 nm, 5-nm intervals) were recorded, and at the same position soil samples were collected. A multivariate linear regression technique in partial least squares (PLS) approaches with full cross validation was employed for analysis, followed by the use of the multiple coefficient of determination (R^2) and the root mean square error (RMSE) for evaluation in the Unscrambler v9.8 (CAMO ASA, Norway). The soil P Maps were created using Inverse Distance Weighted (IDW), Arc GIS 9, US.

In this research R^2 of the PLS model for the soil P was 0.66. The soil prediction P maps (P-map) exhibited a similar variation pattern on the soil measured P maps (M-map).

Keywords: Real Time Soil Sensor, soil map, precision farming, P_2O_5, PLS.

INTRODUCTION

Amid concerns that depletion of mineral phosphate; in Japan, the price of phosphorus fertilizer in 2008 become 1.5 times as high as it were in 2005.

Real-time soil sensing techniques have continuously improved; however, there were few researches to create the soil P map. Mouazen et al (2007) measured soil P using an on-the-go soil sensor. Their methods are different from those of this research. They used the PLS model to analyze soil reflectance spectra obtained at lab.

The objectives of this paper are to measure the soil P with the RTSS and to create the soil P maps for site specific management purposes.

MATERIALS AND METHODS

The experimental fields were two contiguous parts of a commercializing experimental farm. The fields were named No.1 (4.43ha, 303 × 146 m) and No.2

(4.51 ha, 303 × 148.8 m). The experiment was conducted after the harvest of crop in August and October 2008 and in November 2009. The soil was alluvial soil.

The RTSS moved longitudinally along 6 segments of 24m spacing and collected Vis-NIR soil reflectance spectra every 2.24m at a depth of 0.2m. For calibration purposes, a total of 144 soil samples were collected every 24.64m from No. 1 and No. 2 in 2008.

Soil reflectance spectra were subjected to smoothing and Savitzky-Golay second derivative treatment. The PLS model was used to predict the soil P parameter of No.1 in 2009.

The RTSS captured DGPS data. The recorded soil parameters were provided as an IDW map. M-map and P-map were generated from lab and RTSS data.

RESULTS

Comparing the PLS model for the soil P of this paper to Mouazen's one by R^2, there was 4% error (Fig.1 and Table 1).

Between M-map and P-map of No.1 and No.2 in 2008, a similar variation pattern was shown and Mean value error was within 1%. Between M-map and P-map of No.1 in 2009, a similar variation pattern was found and Mean value error was 6.88mg/100g and smaller than RMSEV (Fig.2 and Table 2).

CONCLUSIONS

The PLS model for the soil P with on-the-go RTSS was accuracy equal to Mouazen's. Mean value Between M-map and P-map of No.1 in 2009 there was 6.88mg/100g error.

REFERENCE

Mouazen AM, Maleki MR, De Baerdemaeker J, Ramon H. 2007. On-line measurement of some selected soil properties using a VIS-NIR sensor. SOIL & TILLAGE RESEARCH. Vol.93 No.1 13-27

Table 1. the PLS model for the soil P of this paper and Mouazen

Year	Method	Units	Spectral range (nm)	Multivariate method	No.	P Max	P Min	RMSEV	R^2 (val)	Authors
2009	Truog	mg/100g	350-1700	PLSR (PC=4)	144	114.8	25.20	10.12	0.66	This paper
2007	Olsen	mg/100g	305-1710	PLSR (PC=9)	175	12.19	1.990	1.345	0.69	Mouazen

Table 2. P2O5 parameter (mg/100g) of M-map and P-map

	2008 No.1		2008 No.2		2009 No.1	
	M-map	P-map	M-map	P-map	M-map	P-map
Max	114.75	89.02	86.30	73.71	114.75	85.67
Min	33.40	28.19	25.20	13.11	40.69	30.54
Mean	61.66	61.54	46.80	47.33	64.36	57.48

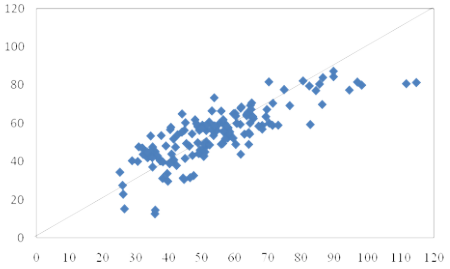

Fig.1. Measured vs. predicted P_2O_5

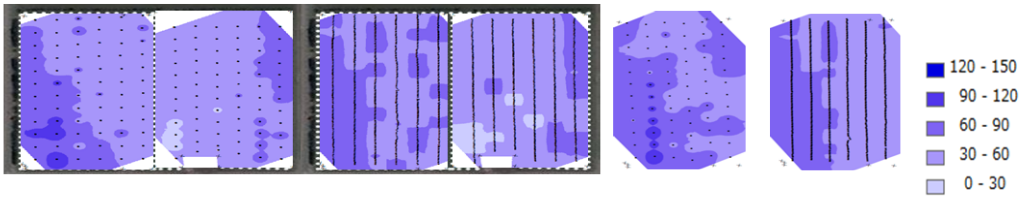

Fig.2. M-map and P-map