PREDICTION OF SOIL MOISTURE CONTENT AND PENETRATION RESISTANCE USING REAL-TIME SOIL METER

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ABSTRACT

A real-time soil sensor that refers to the air injection subsoiler, was developed to predict standardized soil compaction that is converted from soil moisture content, working resistance and working speed. This experiment confirmed performance of predicting the soil moisture content and of measuring the working resistance was conducted. The working resistance acting on the chisel chip and light reflection intensity from the soil surface to predict soil moisture content were measured by the sensor. Penetration resistance were measured 4 times by a cone penetrometer at one point, and the observed value of one point was assumed to be a mean value. The correlation coefficient between the horizontal load predicted by the soil sensor and the penetration resistance measured by the cone penetrometer was 0.66. The soil moisture content was predicted using the spectrum reflected from soil surface by the PLS-method based on the moisture content oven dried during 24 hours, and its prediction root mean square error (rmsep) was 0.71%w.b.

Keywords: soil sensor, working resistance, moisture content, PLS

INTRODUCTION

The rise of soil hardness with the heavy machinery happens, and the soil hardness is important information in cultivation. It is known that the soil hardness decreases by the crumbled structures being formed when there are a lot of organic matter content, and there is a possibility that the soil hardness can be used for a fertile index of the soil. A real-time soil sensor that refers to the air injection subsoiler, was developed to predict standardized soil compaction that is converted from soil moisture content, working resistance and working speed. This experiment confirmed performance of predicting the soil moisture content and of

measuring the working resistance was conducted.

EQUIPMENT AND EXPERIMENTAL METHOD

Fig.1. shows overview of detector for horizontal and vertical force at chisel. A working resistance was measured by a load transducer and four strain gage and it can detect horizontal and vertical load acting to the chisel at the same time. Light reflection intensity from the soil surface was measured by a spectroscope. The light intensities were converted into the absorbance of light to predict soil moisture content. The spectroscope using band pass filter detects 9 light signal level and the range of wave lengths is 650 - 1550nm.

As the experiment condition, the running speed was 0.3m/s, the depth of chisel was 10cm, all signal were sampled 1kHz by A/D converter and stored to a hard disk on a computer. Before running the meter, penetration resistance were measured 4 times by a cone penetrometer at one point, and the observed value of one point was assumed to be a mean value.

RESULT AND DISCUSSION

The correlation coefficient between the horizontal load predicted by the soil compaction meter and the penetration resistance measured by the cone penetrometer was 0.66. Coefficient of variation measured by the sensor was smaller than that by the cone penetrometer. The accuracy of the sensor is enough to use.

The soil moisture content was predicted by the PLS-method based on the moisture content oven dried during 24 hours, and its prediction root mean square error (rmsep) was 0.71%w.b. Variance of moisture content predicted by the sensor was bigger than that measured by the oven dried method.

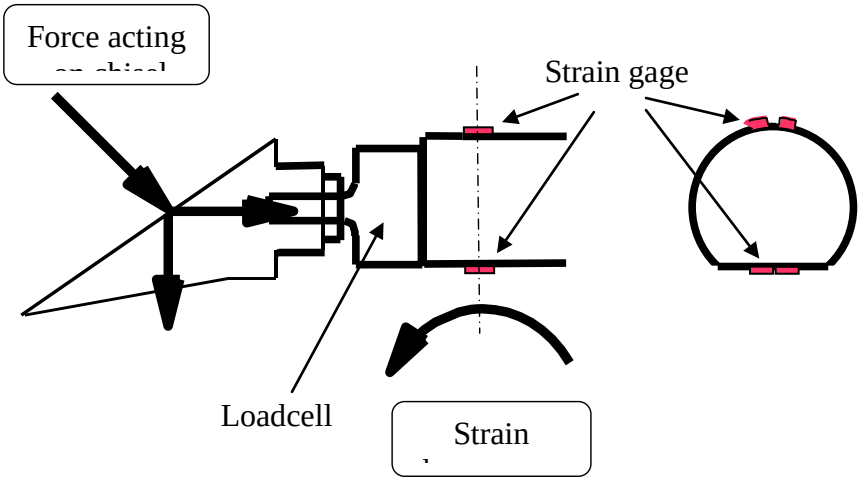

Fig.1. Overview of detector for horizontal and vertical force at chisel.