MEASURING ERROR ON WORKING DEPTH OF REAL-TIME SOIL SENSOR

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ABSTRACT

This paper described about the measuring error on working depth of the Real-time soil sensor (RTSS). It is necessary for accurately evaluating to observe the variation on the working depth, because the RTSS run in various real field conditions, such as soft or hard and even or uneven, and the RTSS has various using objective. In this paper, the RTSS run on asphalt with steps while the three-point hitch was free and position-controlled. In position-controlled, the measuring depth that is the length between the surface on the track running and the measuring surface was greater influenced from tractor orientation than in free. The result will be inapplicable on a real field, and hence, an experiment on a field will be planned.

Key Words: Real-time soil sensor, error of measuring depth, orientation of tractor, terrain, trafficability

INTRODUCTION

A real-time soil sensor has been used to measure soil components variability in various farm fields (2005; Shibusawa, S et al. 2009; Kodaira, M et al.). And also, soil components have vertical variability in farms, so it is necessary for RTSS to obtain the information of depth very precisely. However, it has not been studied for a field surface running the RTSS on, and measuring error on working depth of RTSS due to different terrain. For example, on a wheat field after harvest and tilled by harrow, the RTSS is bitterly rolled due to variation of orientation of the tractor. On the other hand, on a paddy field after harvest, the variation is smaller, because tractor is stable running. Working depth on RTSS can be truly varied due to terrain, but it has been difficult to measure the working depth precisely, because the base level to decide the working depth is not exactly defined, or the field surface that has been known as the base level can be easily varied from minute to minute. First, the working depth was defined in this report.

The RTSS has normally the gauge wheels that stretch to field surface, which is defined as base level (fig. 1-a). Moreover, the gauge wheels follow in the surface that is trod by tractor. And that is, the working depth is defined as the constant length between the surface trod by tractor and the measuring surface in subsurface. But in fact, the working depth is not constant because the wheel gauge is lifted up by orientation of tractor over a big stone or a bump, and the true working depth is shorter than the target one (fig. 1-b). And when field irregularity is too large, the

RTSS is controlled its position by three-point hitch, because pressure on the chisel running in subsurface is higher, and the RTSS cannot run. On position control, error of the working depth will be larger. This paper verified the error.

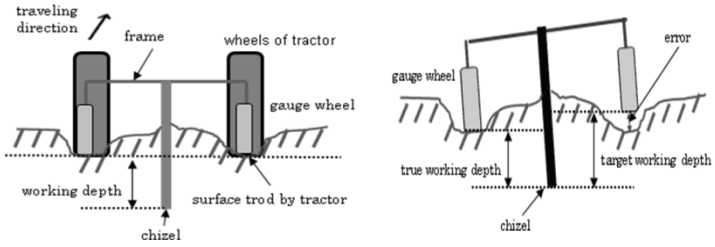


Fig. 1 (a) definition of the working depth (left)
(b) error of the working depth (right)

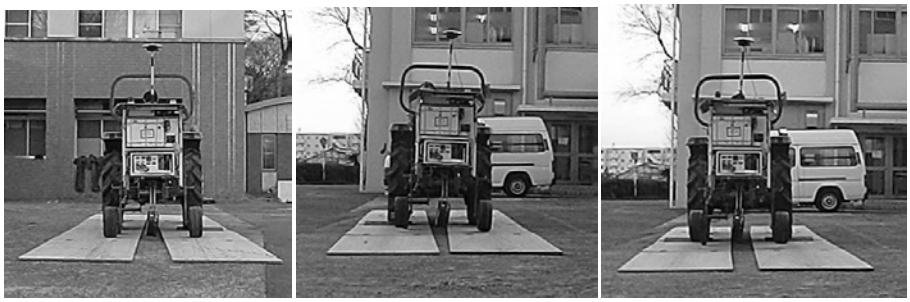
MATERIALS AND METHODS

Before the field experiment, RTSS which attached a tractor ran on three steps which have 5cm, 10cm and 15cm, respectively, and the steps put on only left or right or both side. The steps were fixed to boards, which is steady because of treading by the tractor. The board is made of plywood, and its thickness is 2cm. RTSS was a 01 model, Omron detached a sensor unit, which interferes in running on the road. Tractor was GEAS253, Iseki. Working depth was measured by a potentiometer running on between tractor wheel and gauge wheel. The three-point hitch was free or position control, the tractor ran two-wheel, the gear was low, and 2000rpm. A video camera put on behind the tractor to observe the behavior of RTSS outside.

RESULTS & DISCUSSION

Fig.2 indicates the results of video camera. All figures are that the rear wheels of the tractor were running over the steps. (a) indicates that three-point hitch was free, and the tractor orientation didn't effect to the RTSS. (b) 8band (c) indicate rear of the tractor were respectively rolling and pitching with position control. Both were observed the wheels were lifted up, that is error of the working depth because of orientation the tractor.

The results of the potentiometer will show in the conference on the poster.



fFig.2 (a) no effect to working depth of the RTSS with free three-point hitch
(b) error of the working depth because of rear pitching of the tractor
(c) error of the working depth because of rear rolling of the tractor

CONCLUSIONS

In this report, the position control effects to working depth of the RTSS. If the position control is used to measure soil components with precise depth, the definition of soil surface as base level for the working depth is different from the surface trod by a tractor. If on control free, the definition is the surface trod, but the working depth is affected a lot from tractor orientation. To get the precise depth, it is necessary to define the base level with repeatability of the working depth of the RTSS.

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