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강 좌

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Outline of the Reverse-rotational Rotary Tiller

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1. INTRODUCTION

In the 1960s, the reverse-rotational soil cutting by rotary was studied[1), 2)]. However, the study of reverse-rotational rotary tillers started in the late 1970s[3)]. The first type was marketed in 1986 by Kobashi Kogyo Co. Ltd., one of the agricultural machinery companies in Japan. The trade name is "UP-cut Rotary", and the amount of sales is about 150 per year. During the past ten years, more than 2,500 rotaries have been sold in Japan.

The use of this rotary has been expanded to greenhouse farmers in the Kanto district of Japan. As this rotary is not very large, with a tillage width of 1.2 m to 1.8 m, it is not suitable for large-scale farming like that done on Hokkaido Island in Japan. The greatest feature of the reverse-rotational rotary tiller is its ability to till at a tillage depth of more than 30 cm. A deeply pulverized filed can be realized with this reverse-rotational tiller.

This paper describes the performance and the soil mixing characteristics of the reverse-rotational rotary tiller.

2. REVERSE-ROTATIONAL ROTARY TILLER

The direction of the reverse-rotational rotary tiller's rotary axle is opposite to that of ordinary rotary tillers. The reverse-rotational rotary tiller is shown in Fig. 1. Its tillage width is 1.2 m. This reverse-rotational rotary tiller is equipped with twenty-six special blades called "*sukui-zume*" in

Fig. 1 Reverse-rotational rotary tiller.

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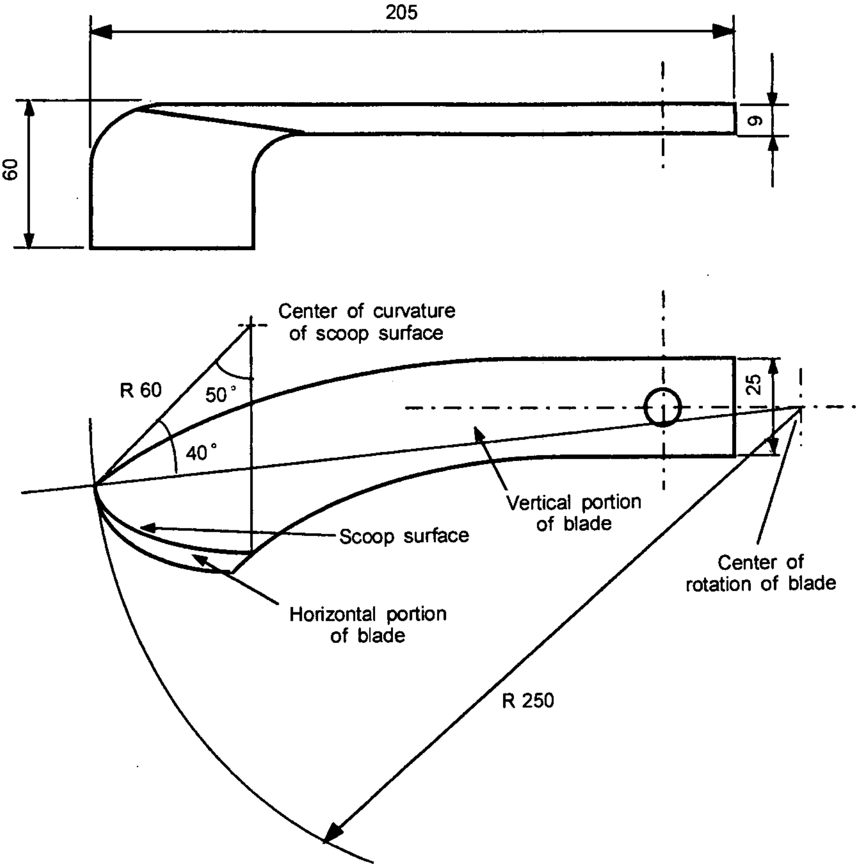

Fig. 2 Rotary blade, "*sukui-zume*".

Japanese, as shown in Fig. 2. "*Sukui*" means scooping and "*zume*" means blade. The shape of the scooping surface of the blade is different from the 'L' blade, the 'C' blade, and the 'C-L' blade of most rotary tillers[4]. The radius of the blade rotation is 25 cm. The velocity of rotary axle revolution is about 160 rpm.

The scooping surface of the "*sukui-zume*" carries out an important function for the performance of this rotary. The scooping surface keeps cutting up soil with the blade tip and throwing it backward outside the zone of the rotary blade rotation. There is no recutting of the soil. This function leads to a reduction in the tillage power requirements.

A small four-wheel drive tractor, with about 15 kW, can sufficiently drive this rotary tiller.

3. SOIL MIXING CHARACTERISTICS

(1) Materials and method

The soil mixing characteristics of the reverse-rotational rotary tiller were investigated in a paddy field and an upland field[5]. The physical properties of the tested fields are shown in Table 1. The moisture contents were about 83% d.b. in the paddy field and 80% d.b. in the upland field.

Small colored plastic spheres were used as

Table 1 Physical properties of tested field

Paddy field	
Specific gravity 2.48	
Particle distribution	
Clay 16.0%, Silt 42.0%, Sand 42.0%	
Consistency	
L. L. 83.8% d.b., P. L. 64.5% d.b.	
Upland field	
Specific gravity 2.50	
Particle distribution	
Clay 44.0%, Silt 36.0%, Sand 20.0%	
Consistency	
L. L. 86.5% d.b., P. L. 77.5% d.b.	

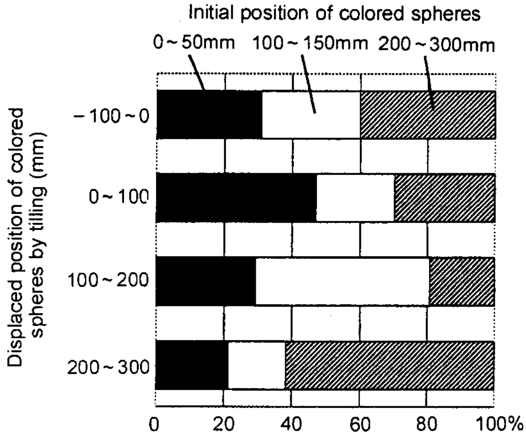

Fig. 3 Soil mixing in paddy field.

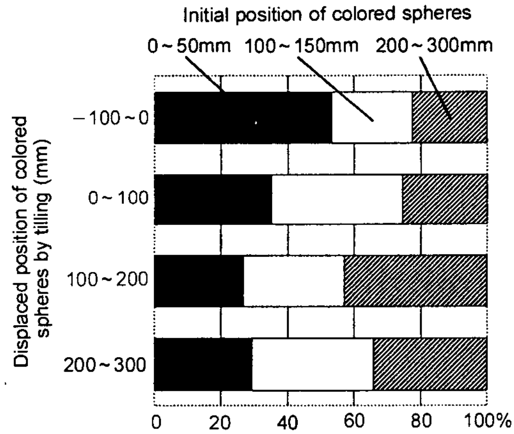

Fig. 4 Soil mixing in upland field.

the medium for soil mixing. The diameter of the spheres was 6 mm and the average density was 2.0 g/cm^3. The rotary tiller tilled the locations where the spheres were buried under the rated power conditions of the tractor.

The tillage traveling velocity was about 100 mm/s and the tillage depth was 320 mm.

Changes in the locations of the spheres before and after tilling described the soil mixing process.

(2) *Results and discussions*

The results in the paddy and the upland fields are shown in Fig. 3 and 4, respectively. The '−100~0 cm' layer on the vertical axis shows the rising up of the soil surface after tilling. The initial soil surface before tilling is shown by the 0 cm. The graph shows the percentages of the spheres, including each layer of soil after tilling.

In the paddy field, the soil in the lower layer showed two types of movement. One was the rising up of the soil to the surface layer and the other was the soil remaining in the lower layer. Soil in the surface layer came down to the middle layer. It seems that this rotary turns the soil layers in the paddy field.

In the upland field, the soil in every layer remained in the same layer. It is seen that the good soil has mixing characteristics in every layer. However, there is no turning of the soil like in the paddy field.

4. CONCLUSIONS

This paper has shown an outline and the soil mixing characteristics of the reverse-rotational rotary tiller. The tendency of the soil mixing characteristics was different for the paddy field and the upland field. With this rotary, there is a turning of soil in the paddy field, while there is a good mixing of the soil in the upland field.

It is important to evaluate the relationship between the tilled field conditions and crop cultivation. This issue will be addressed in future studies.

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