MOISTURE CHARACTERISTICS OF THE ARTIFICIAL MEDIA COMPOSED OF RICE HUSK AND DEMONSTRATION ON SWEET POTATO CULTIVATION

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ABSTRACT

The amount of the rice husk reached 2 million tons and the rice husk of 710,000 tons was abandoned and incinerated in 2000. It is necessary to expand the use of rice husk from the viewpoint of a material cycle in ecosystem. The rice husk was investigated on the possibility as an artificial culture medium. Moisture characteristics of the new culture media were measured and the proof examination was carried out for the sweet potato cultivation. The indexes of water retentivity Θ and hydraulic conductivity K of culture media were determined using the centrifugal method and the suction method. The values of 100% rice husk were the smallest in culture media respectively, and increased in order of 100% crushed rice husk and 100% rice husk charcoal. These values influence the water-supplying-power of rice husk to plant roots. Four kinds of cultivation bed filled with different type of rice husk were made, and sweet potato was grown for 142 days. The root grown in rice husk media penetrated into the soil under and side of the cultivation bed to supplement the lack of moisture. It was clarified that the growth of sweet potato was vigorous through the cultivation experiment and the rice husk was useful as a good culture media.

Keywords: *Rice husk, Culture medium, Hydraulic conductivity, Water retentivity.*

INTRODUCTION

The Ministry of Agriculture, Forestry and Fisheries (MAFF) decided THE BIOMASS JAPAN SYNTHESIS STRATEGY (MAFF, 2003). This national project will promote industry related to the biomass as strategic industry of Japan by 2010. The gross weight of waste in Japan is 493 million tons, and the biological waste occupies 281 million tons (60%). Moreover, agricultural waste is 128 million tons, and this amount reaches about 47% of the biological waste (BWRW, 1999). The rice husk is produced about 2 million tons, every year. However, the rice husk of 710,000 tons is abandoned and incinerated (CPD, 1998). The MAFF is guiding the technology of effective use for the rice straw and the rice husk. The purpose is improvement of fertility and of the feed self-support ratio, and securing of agricultural materials. It is paid attention to use the rice husk for the culture medium in recent years, and obtains a good growth result in the strawberry cultivation and water culture and organic cultivation (Yamanaka et al., 2000). Then, the measurement of the moisture characteristic of the rice husk and the growing test of the sweet potato was done.

MATERIALS AND METHODS

The culture media which are used to experiment are rice husk (RH100), crushed rice husk

(CRH100), rice husk charcoal (RHC100), rice husk+rice husk charcoal (RH50+RHC50), and MASA (control). The moisture characteristic curve and the available moisture of various media were obtained by the suction method and the centrifugal method. Moreover, index of the water retentivity and hydraulic conductivity of various media were obtained by the unsaturated hydraulic conductivity measurement method in which the centrifugal method was used (Tanaka, 1993).

Figure 1. *Sweet potato seedling transplanted to RH100*

The shape of the cultivation bed is 180 cm in length, 50 cm in width, and 30 cm in depth. The moisture movement is caused between the culture media in the bed, in addition, between the soil and the media which exist in the side and the bottom on the bed. To prevent dispersion of culture media by the wind and evaporation from the surface of the cultivation bed, the upper surface of bed was covered the whole with a black mulch film. Six sweet potato seedlings were transplanted in the direction of the vicinity of length of the bed at intervals of 30cm. Figure 1 shows one example of the cultivation bed of the transplant. Water was sprinkled until the rooting was confirmed by the appearance of the sprout. Moisture of culture media in the bed was measured by TDR for the cultivation period. When the sweet potato tuber was harvested, the fresh weight, the length, the diameter, and the fresh weight of the foliage and the root system were measured.

RESULTS AND DISCUSSION

To clarify the moisture characteristic of the culture media composed of the rice husk, the amount of the available moisture (amount of moisture of pF1.8-pF4.2) obtained from the moisture characteristic curve is shown in Table 1. Because the rice husk has the character to shed moisture, moisture in the culture media is chiefly maintained in the space between rice husks. The water holding capacity of the rice husk increases by crushing and charcoaling.

Table 1. *Index of water retentivity, hydraulic conductivity and available moisture*

Sample	water retentivity Θ (cm^3/cm^3)	hydraulic conductivity K (cm/day)	available moisture %
RH100	0.0142	0.0016	3.5
CRH100	0.0250	0.0052	5.0
RHC100	0.0642	0.0136	11.5
RH50 +RHC50	0.0571	0.0106	8.5
Masa (Control)	0.0790	0.0225	17.0
Sand (Reference)	0.0350	0.0021	5.5

Index of water retentivity (Θ) is defined as a difference of the volumetric water content (θ_2 and θ_3) which corresponds to pF2 and pF3. Index of water conductivity (K) is defined as geometric average of unsaturated hydraulic conductivity (K_2, K_3) in pF2 and pF3. (Tanaka, et al., 1993).

$$(\Theta) = \theta_3 - \theta_2, \quad K = (K_2 * K_3)^{1/2}$$

K value greatly influences the moisture replenishment power from a lower soil to the root

zone. Table 1 show that the value of Θ and K of RH100 is small, but one of CRH100 and RHC100 is large. These values of RH100 are closer to the value of sand.

After the sweet potato seedling is transplanted, a growth situation of the foliage of the sweet potato after 140 days is shown in Figure 2. Figure 3 shows the moisture change of each cultivation bed. The moisture change of MASA, RH100, and CRH100 is almost similar.

Figure 2. *Growth situation of sweet potato in RH100*

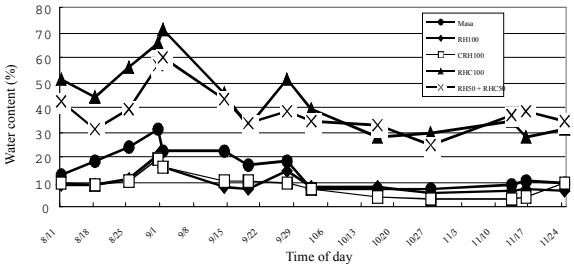

Figure 3. *Diurnal change in watet content of cutivation bed by TDR*

Figure 4 shows the sweet potato harvested with RH100. The hypertrophy of the sweet potato tuber occurred with RH100. Figure 5 shows the weight and the ratio of length/diameter of sweet potato tuber harvested in each cultivation bed. This ratio is one of factors to decide the quality of the sweet potato tuber, and it is assumed that 2.5 or more is good. As for the sweet potato in MASA, it was large and numbers, too. When ratios of the long type to total are compared, RH100 is the highest, and MASA is low. The shape and size of the sweet potato tuber were influenced by the kind of the rice husk.

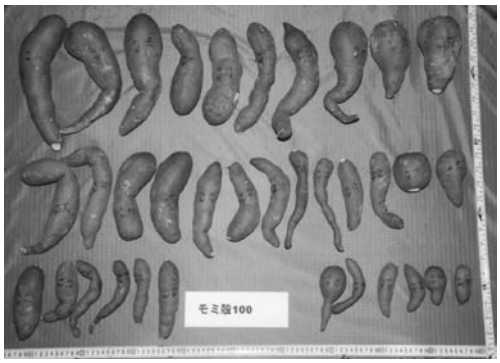

Figure 4. *Sweet potato tuber harvested in the RH100*

Figure 6 shows the dry matter weight of foliage and of the root system. The dry matter weight of foliage is large in MASA, and one of all root system is especially large in CRH100. To supplement moisture shortage of the

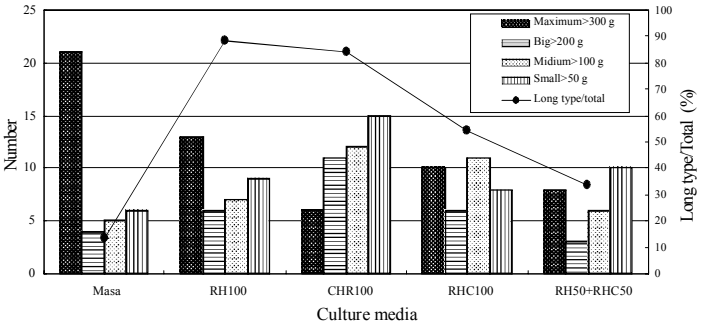

Figure 5. *Number and type of sweet potato*

medium of RH100, moisture is replenished from the root system, which extends to the soil of the side and the bottom in the bed.

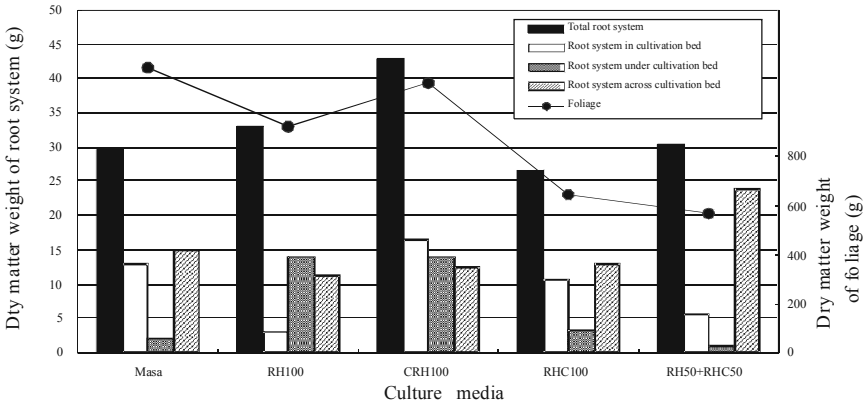

***Figure 6**. Dry matter weight of foliage and root system of sweet potato tuber.*

CONCLUSION

The moisture characteristic was measured to examine the use of the rice husk as the culture medium, and, in addition, the cultivation examination of the sweet potato was done. The moisture characteristic curve, the available moisture, the index of hydraulic conductivity and the index of water retentivity of the culture media composed of the rice husk were clarified. The moisture characteristic value of RH100 is close to the value of sand. The sweet potato seedling took root in the cultivation bed composed of rice husk, and the hypertrophy of the sweet potato was occurred. To supplement the water deficit in the culture media, moisture was supplied by the root system which expanded into the soil through the side and the bottom in the cultivation bed. The shape and the size of the sweet potato were influenced by the kind of the rice husk. It was clarified that the growth of sweet potato was vigorous through the cultivation experiment and the rice husk was useful as a good culture media.

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