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Effects of the applications of excessive irrigation water and acetaldehyde on Chinese yam tubers at byobusan area of Aomori prefecture in Japan

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Abstract

Byobusan area of Aomori prefecture in Japan was a marshy sand dune and had developed for agricultural land use with a large-scale sprinkler system. Recently, it becomes an agricultural problem at this area that distinctive damage with browning maculation and fissures frequently occurs in Chinese yam tubers. Acetaldehyde is one of the factor candidates of underground part damage in plants. In this study, incidence rate of the tuber damage, and the morphological character and elemental composition of the damage parts in tubers were investigated with applications of excessive irrigation water or acetaldehyde water solution into the yam field. The incidence rate of the distinctive tuber damage increased as the input amount of irrigation water was increased. At the browning maculation parts of the tubers, many fissures and damages of cork layer were observed under scanning electron microscopy. In addition, the periderm of tubers was significantly thicker in damaged parts than in non-damaged parts. Funguses, bacterium and nematodes were not observed in the damaged part under scanning electron microscopy. The weight ratio of each constituent element in an analyzed area relative to the total weight of major essential elements was measured with energy dispersive X-ray spectrometry. The results showed that the weight ratios of boron, carbon, phosphorus, sulfur and calcium were higher in damaged parts than in non-damaged parts whereas the weight ratios of oxygen and chlorine were lower in damaged parts than in non-damaged parts. It was also shown by this spectrometry that iron, cadmium, lead and zinc were not directly involved in occurrence of the tuber damage. In this study, there was no remarkable difference of tuber appearance between non-acetaldehyde and acetaldehyde application treatments. From the above results, it is shown that the damage would be a physiological disorder induced by the input of a large quantity of water in the sandy field.

Keywords: Chinese yam, damage, sand dune, tuber, yam

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