

平成28年度 環境科学院 修士論文内容の要旨

Introduction of renewable energy in the crop production

-A case study in asparagus fusekomi forcing culture-

(農作物生産における再生可能エネルギー導入に関する研究

ーアスパラガス伏せ込み生産の事例ー)

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**[Introduction]** Domestic fresh asparagus is greatly demanded in Japan from late autumn to winter. However, the oil or electricity heating systems for raising asparagus cause large amounts of CO<sub>2</sub> emissions and costs. An alternative heating system instead of oil or electricity in winter is awaited in today's low carbon society.

**[Methodology]** A heating system using wood pellet (biomass renewable energy) boiler was experimented in asparagus fusekomi forcing culture in a plastic greenhouse in Experimental Farm, Hokkaido University. The heating system by wood pellet boiler consists of 3 components: 1) pellet boiler, 2) hot water storage tank (6,000 L for soil warming and 1,000 L for air warming inside the tunnel) and 3) asparagus culture bed. The hot water was circulated when soil temperature of the culture bed and air temperature inside the tunnel decrease below 20°C and 15°C, respectively. Temperature, accumulated electric power for electric wire system and flow volume of hot water for the pellet boiler system were measured continuously in three culture beds, i.e. a) electric wire system for soil heating, b) hot water system for soil heating, c) hot water system for soil and air heating. The CO<sub>2</sub> emission and cost for raising asparagus with each heating system were estimated by using the data and life cycle assessment (LCA).

**[Results]** The soil temperature at 14 cm depth was kept to 15-20°C averagely in mid-winter in each system, even when the outside temperature fell down to -15°C. The hot water heating systems showed the great spear yield. The electric wire heating system, the hot water system for soil heating, the hot water system for soil and air heating supplied calorific value of 565.6, 2151.7, and 5491.0 MJ to the culture bed throughout the experiment, respectively. The two hot water systems generated excessive heat. The annual CO<sub>2</sub> emission and cost of the production of 1 kg marketable asparagus were calculated to be 28.7 kg-CO<sub>2</sub> and 6,458 yen for the electric wire heating system, 36.5 kg-CO<sub>2</sub> and 23,112 yen for the hot water system for soil heating, and 19.9 kg-CO<sub>2</sub> and 14,508 yen for the hot water system for soil and air heating, respectively.

**[Discussion and Conclusion]** This study suggests that the wood pellet boiler heating system can be realistically applied to asparagus fusekomi forcing culture in winter and can reduce the CO<sub>2</sub> emissions during the agricultural production. However, there was a problem that heating efficiency was very small in pellet boiler heating system in spite of supply of much amount of calorific value. And it is necessary to reduce the costs if the system is put into practical use.