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“Current status of electricity use, especially in heat pumps, in Japanese horticulture”

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Abstract

Since the 1950s, many energy-driven equipment have been introduced in greenhouse horticulture fields. In the 1950s, rice nurseries were warmed using an electric heater. In the 1960s, flowering time of Chrysanthemum started to be controlled using supplemental lighting. Further, automatic ventilation systems, fans, automatic watering systems, etc., have been used in greenhouses. The oil heating system installed since the 1960s in greenhouses is the most effective but energy-consuming equipment. At present, about 96% of greenhouses fulfill their heat requirements by using combustion heaters that require kerosene, fuel oil, and other such fuels. In modern horticulture, the conversion from heating equipment requiring fossil fuel to heat pumps (HPs; especially, those that need an air heat source) has been expected to prevent global warming. However, HPs have not become widely disseminated, although they are known to have higher energy efficiency than combustion heaters. Since HPs can be used for not only heating but also dehumidification and cooling, they are suitable for Japanese horticulture. Japan lies in the Asian monsoon climate zone, and its climatic conditions are characterized by high temperatures and humidity during summer and low temperatures during winter. HPs were used as cooling and dehumidification machines for producing high-quality flowers for the first time. Further, they were used for mango and orange cultivation that need high temperature during winter. Currently, HPs are being used for tomato cultivation. They might become widely used in horticulture, because tomato is one of the most important fruit vegetables in Japan and is cultivated over large areas. However, investigations need to be performed to compare the performance between HPs and conventional oil heaters in greenhouses since HPs are being thought to have low effectiveness, which might hamper the promotion of conversion from oil heaters to HPs. In this study, we compared energy consumption, yield, and quality of tomato obtained from identical greenhouses installed with a HP and an oil heater to clarify that HPs are superior to oil heaters.