

Demonstration of CO₂ Emission Reduction in a Double Layered Greenhouse

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INTRODUCTION

In greenhouse horticulture heating a greenhouse during winter costs quite a lot and has become a serious problem for growers due to the steep rise in heavy oil price. To heat a greenhouse by burning heavy oil emits CO₂ to the air and this causes environment problems. By applying two layers of roof covering material for higher heat insulation we were able to demonstrate a reduction in the usage of heavy oil and CO₂ emission.

RESEARCH OUTLINE

Research period: 6 Feb. 2009 to 19 Feb. 2009.

Location: Ishiguro Nozai Co., Ltd., experimental farm. This trial was conducted in two greenhouse (width 9 m × length 27 m = 243 m²) in the same area.

Double layered greenhouse: Covered by F-Clean® [ethylene tetrafluoroethylene (ETFE) film] with double layers (thickness: outer layer 0.08 mm; inner layer 0.05 mm).

Control greenhouse: Covered by F-Clean with single layer (thickness: 0.08 mm).

Method: Exactly the same heating temperature settings were applied in both the double layered greenhouse and the control greenhouse.

Heating temperature settings: 16 °C (6 Feb.–10 Feb.), 14 °C (10 Feb.–14 Feb.), 12 °C (16 Feb.–19 Feb.).

Data recorded: Outside temperature, greenhouse temperature, and usage of heavy oil.

RESULT

Reduction rate of usage of heavy oil and CO₂ emission by a double layered greenhouse was 27.4%–30.5% and these results proved its effectiveness (Table 1).

PROSPECTIVE DEVELOPMENT

A double layered greenhouse can possibly save a heating cost of more than 1 million yen per year for average size growers who grow crops which require higher temperatures during production (current cost is more than 3 million yen per year per grower). Reduction of CO₂ emission is an important theme for our company which is involved in greenhouse horticulture.

Table.1 Comparison of the usage of heavy oil at different heating temperature settings between double layered greenhouse and single layered (control) greenhouse

Heating temperature setting		Usage of heavy oil (L)		Ratio compared with Control per degree hours**	Estimated burning hours per day
		Per each period	Per day		
16 °C	Double layered	129.7	32.4	70	6.8
	Control	187.5	46.9	100	9.8
14 °C	Double layered	62.4	15.6	69.5	3.3
	Control	94	23.5	100	4.9
12 °C	Double layered	82.7	27.6	72.6	5.7
	Control	107.7	35.9	100	7.5

*Degree hour was calculated in order to revise influence of daily differences of outside temperature. First cumulative temperatures in each period were calculated by adding temperature differences between greenhouse temperature and outside temperature in each day, and then the usage of heavy oil was divided by the calculated degree hours in each period.

**Ratio of usage of heavy oil per degree hours when the usage of heavy oil per degree hours in Control is 100.