International Journal of Architectural, Civil and Construction Sciences
ISSN: 2415-1734
Vol:8, No:4, 2014

The Study of Groundcover for Heat Reduction

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Abstract**—**This research investigated groundcover on the roof (green roof) which can reduce the temperature and carbon monoxide. This study is divided into 3 main aspects: 1. Types of groundcover affecting heat reduction 2. The efficiency on heat reduction of 3 types of groundcover, i.e. lawn, arachis pintoi, and purslane 3. Database for designing green roof. This study has been designed as an experimental research by simulating the 3 types of groundcover in 3 trays placed in the green house for recording the temperature change for 24 hours. The results showed that the groundcover with the highest heat reduction efficiency was lawn. The dense of the lawn can protect the heat transfer to the soil. For the further study, there should be a comparative study of the thickness and the types of soil to get more information for the suitable types of groundcover and the soil for designing the energy saving green roof.

Keywords**—**Groundcover, Green Roof, Heat Reduction, Energy Saving.

I. Introduction

GROUNDCOVER is easy to grow with several properties such as its beauty, easy for maintenance, fast growing with long lasting, and cheap. One important property is its heat reduction; so, groundcover can be applied for energy reduction in the building. With the tendency of high temperature due to the climate change [1], there have been poor weather conditions in several areas causing urban heat island phenomenon (UHI) [2] in several big cities. An urban heat island (UHI) is a metropolitan area that is significantly warmer than its surrounding rural areas due to human activities. The temperature difference usually is larger at night than during the day, and is most apparent when winds are weak. The main cause of the urban heat island effect is from the modification of land surfaces, which use materials that effectively store short-wave radiation. Waste heat generated by energy usage is a secondary contributor.

The study of groundcover for heat reduction can be beneficial to energy saving as well as increasing green area in the cities. [3], [4] The purpose of this research is to investigate 3 types of groundcover in Thailand on their heat reduction property [5].

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II. Objectives

1) To study the physical characters of groundcover affecting heat reduction.
2) To analyze and compare the efficiency on heat reduction of 3 types of groundcover, i.e. lawn, arachis pintoi, and purslane.
3) To construct database for designing green roof for energy saving.

III. Methodology

This research investigated the reduction of heat transfer through 3 types of groundcover with the experiments as follows:

A. Research Tools

1) Greenhouse

The size of the greenhouse is 2x3x2.5 meters with no wall. It has a steel structure and poly-carbonate roof. The trays are separately placed on the table with the size of 0.6x1.2 meters located under the greenhouse.

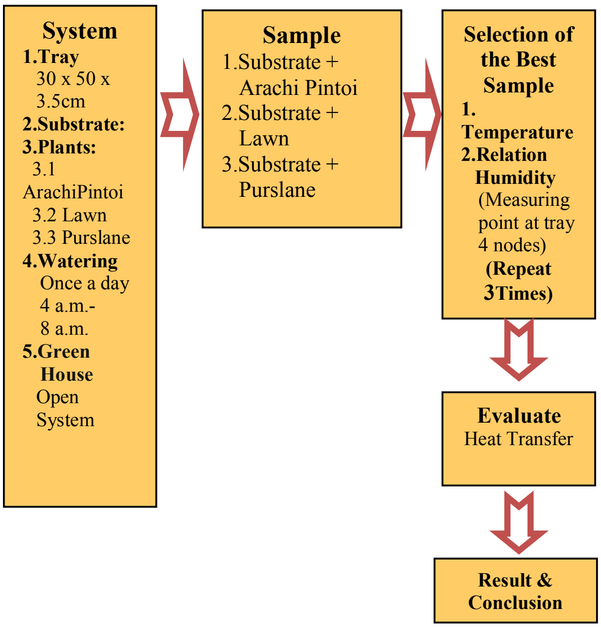


Fig. 1 The research methodology

TABLE I
PLANTS SELECTION MATRIX

Species name	Common name	Family name	Minimum soil depth (cm.)	Maintenance H/M/L	Wind Tolerant	Pollution Tolerant	Growth rate (F/M/S)
Arachis pintoi	Fabaceae	*Amarillo*	4-8	L	H	H	F
Zoysia matrella (L.) Merrill	Manila Grass	*Gramineae*	4-8	L	H	H	F
Portula caolerace L.	Purslane	*Portulacaceae*	5-8	L	M	M	F

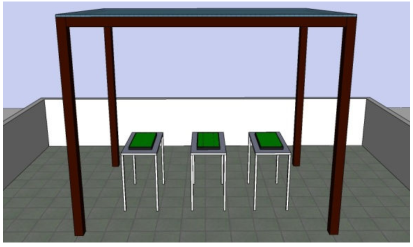


Fig. 2 Trays in the green house

2) Substrates

Soil used in this study was the mixtures of natural materials which were light, high permeability, such as Din Kuipai (bamboo soil), rain tree leaves, natural fertilizer, coconut fibers, and necessary plant minerals.

3) Groundcover

Three types of groundcover in this study included lawn, arachis pintoi, and purslane because they are fast growing, easily spreading, long lasting, and beautiful. [6], [7]

Fig. 3 Groundcover used in the study: lawn, arachis pintoi and purslane

4) Trays

The size of the tray is 30x60x3.5 cm made from PP. which was light, moveable, and cheap. There were 3 trays for each type of the groundcover.

5) Instruments

Instruments for temperature measuring and data recording

Graphtec data loggers and thermocouple wires were used to measure and record the temperature. [8]

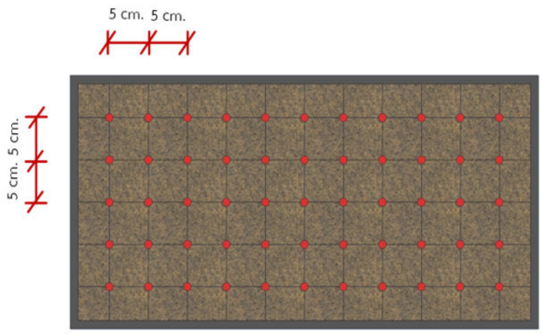
Fig. 4 Graphtec data loggers and thermocouple wires

B. Experimental Process and Measuring

There were 2 main stages in the experiment:

1) The Preparation of Trays

Put the soil mixtures in 3 trays with the thickness of 3 cm. and bring the sprouts of the 3 types of groundcover in each particular tray with the planting space at 5cm for arachis pintoi, and purslane (Vertical and horizontal) while the lawn, was planted completely covering the tray. The trays, then, were placed in the greenhouse and left for 1 week before measuring the temperature.



● Position plants on the tray

Fig. 5 Planting space in the trays

2) Measuring Method

When the groundcover was strong and healthy, the researcher started measuring the temperature with 3 times recording at different positions as shown in Fig. 6

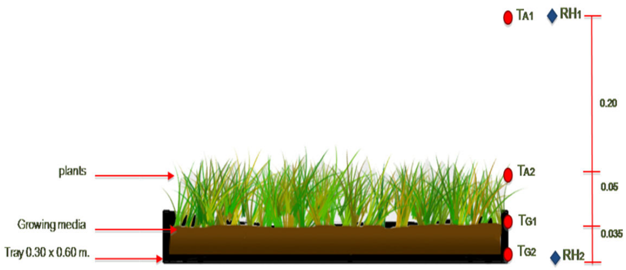


Fig. 6 Positions for temperature measuring

The temperature measuring was conducted every hour in each day [9] with the record to show the humidity change of each plant.

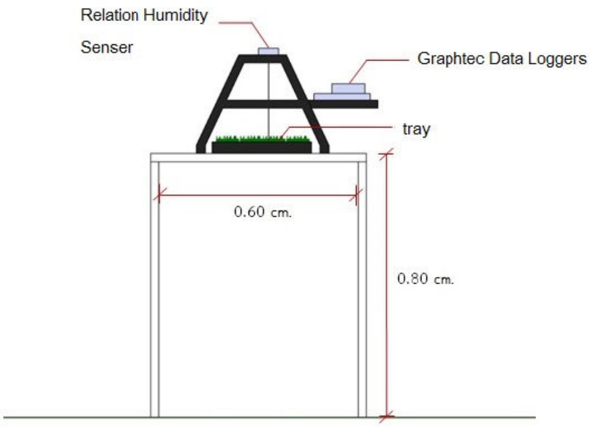


Fig. 7 The location of measuring instruments

Fig. 8 The temperature measuring of purslane tray

IV. Results

After collecting the data of the 3 types of groundcover for 3 months, the data on heat reduction of the groundcovers were shown in the graphs below:

Results of the 1st Measuring

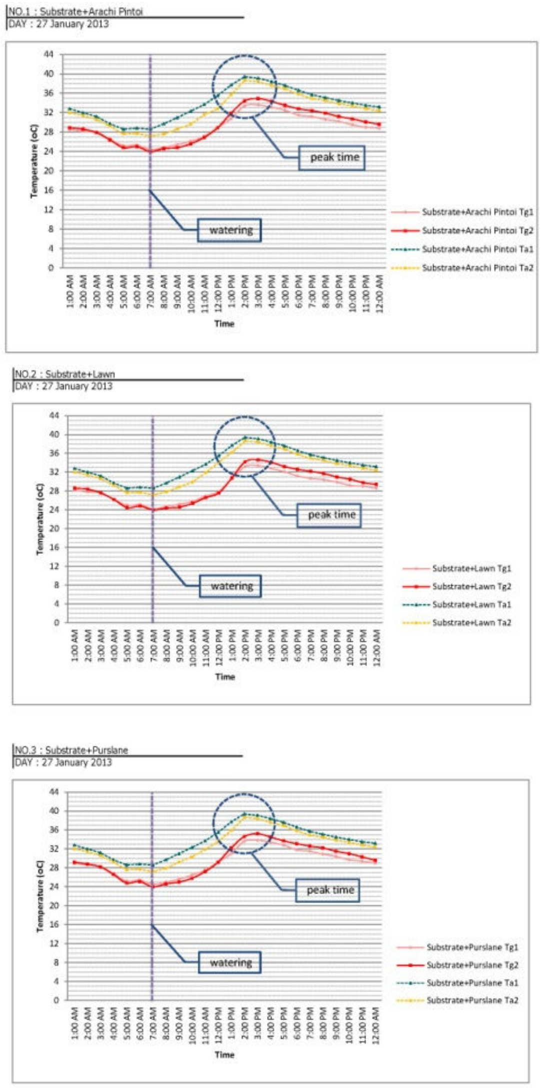


Fig. 9 The 1st measuring graph in January; tray 1, 2, 3 (lawn, arachis pintoi, and purslane)

Results of the 2nd Measuring

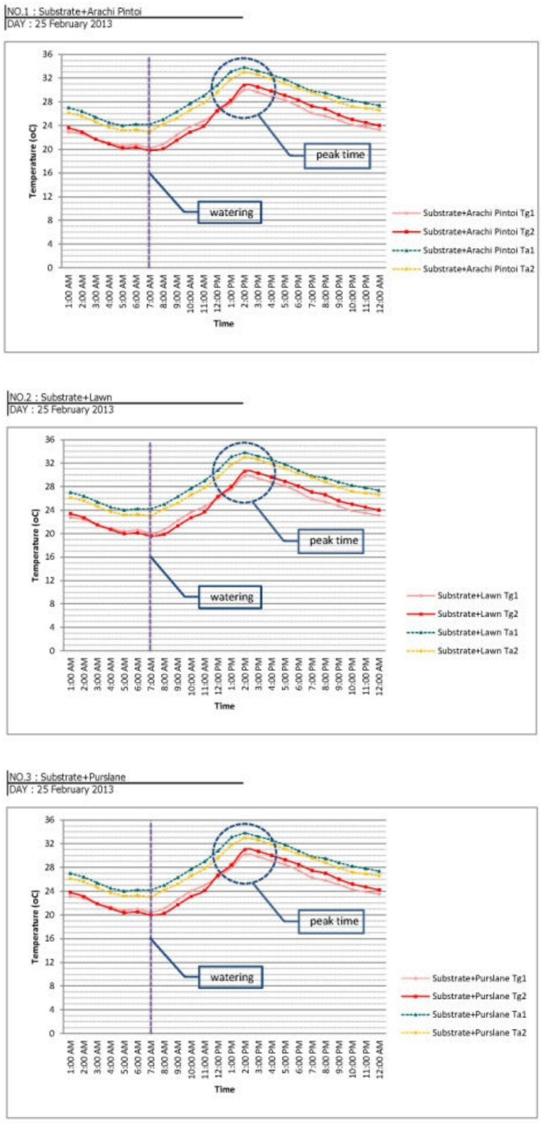


Fig. 10 The 2nd measuring graph in February; tray 1, 2, 3 (lawn, arachis pintoi, and purslane)

Results of the 3rd Measuring

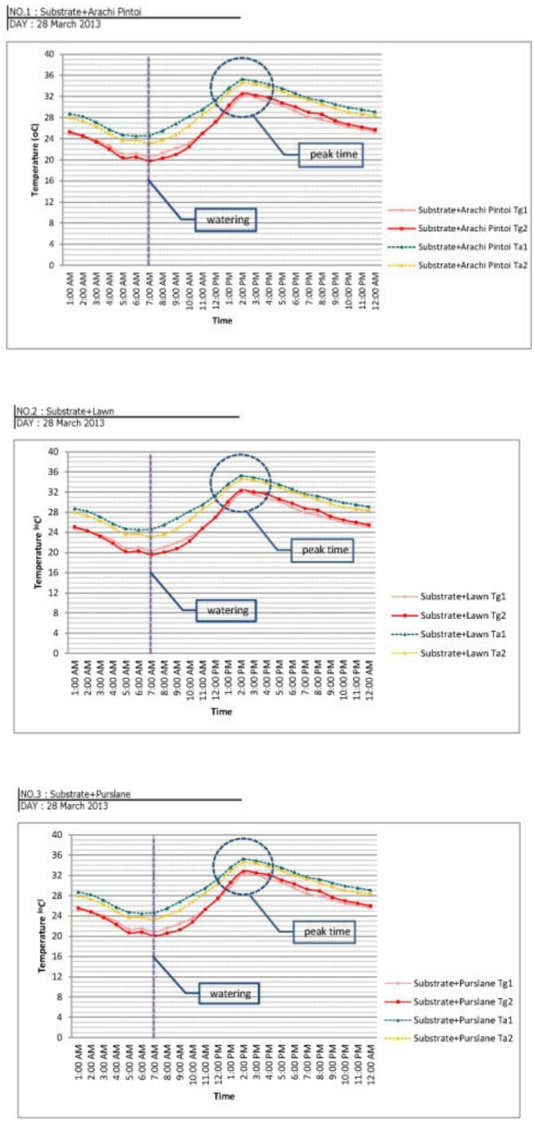


Fig. 11 The 3rd measuring graph in March; tray 1, 2, 3 (lawn, arachis pintoi, and purslane)

V. CONCLUSION

The average temperature at the peak time (14:00 pm) was 31.6°C at Tg2 (under-soil temperature) while the temperature of Ta1 (ambient air temperature) was at 36.2°C. The temperature difference at 4.6°C can be explained due to the dense of the lawn. The dense of the lawn can protect the heat transfer to the soil as shown in Fig. 12.

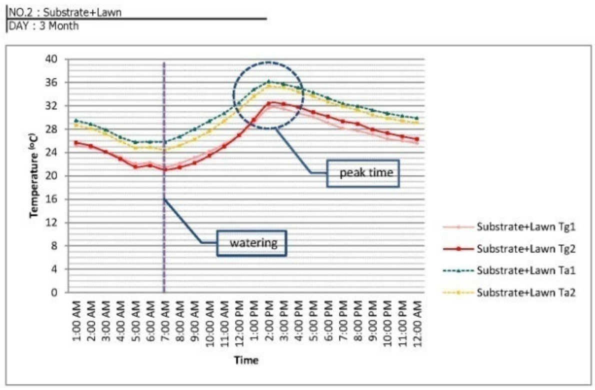


Fig. 12 The average temperature in the 2nd tray (lawn)

VI. SUGGESTIONS

In this study, the thickness of the soil was only 3cm. because the tray in this study should be light and easily moveable. For further study, there should be a comparative study of the thickness and the types of the soil to get more information for the suitable types of groundcover and the soil for designing the energy saving with green roof.

ACKNOWLEDGMENT

The author would like to thank the Research and Development Institute, Suan Sunandha Rajabhat University, Bangkok, Thailand for financial support.

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