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"6TH INTERNATIONAL WORKSHOP ON CROP PRODUCTION AND PRODUCTIVITY UNDER GLOBAL CLIMATE CHANGE"

Editors :

Dr. Afandi
Prof. Dr. Ken Hiramatsu

DECEMBER 3-4, 2018

at FACULTY OF AGRICULTURE, LAMPUNG UNIVERSITY
BANDAR LAMPUNG, INDONESIA

PROGRAM

Date : December 3rd,2018
Venue : Hall of Faculty of Agriculture, Lampung University (UNILA),
Plenary Session

Start		Speaker/Chair Person	Title
8:00	Registratio		
8:30	Session 1	Chair: Cicih Sugianti & Auliana Afandi	Welcoming and Introductory Session
8:30		Prof. Dr. RA Bustomi Rosadi,	Committee Report
		Prof. Dr. Irwan S.Banuwa, Dean of Faculty of Agriculture,	Welcome Address
		Prof. Dr. Hasriadi Mat Akin, Rector of UNILA	Welcome Address
		Prof. Masateru SENGE Dean of UGSAS, GU	Declaration of Opening
9:00	Photo Session & Welcome Ceremony		
9:15	Coffee Break		
9:30	Session 2	Chair: Prof. Chihara E., GU	
9:30		Dr. Dwi Hapsoro, Faculty of Agriculture, UNILA	Roles of Plant Tissue Culture on Agricultural Productivity
10:00		Assoc. Prof. Shimadzu M., GU	Airflow resistance of insect screen and evaporative cooling for natural ventilated greenhouse in humid temperate/ tropical climate region
10:30		Supriyono Loekito PT.GGP	Sustainable agriculture, a strategy to maintain the business sustainability of PT. Great Giant Pineapple under Global Climate Change
11:00	Q & A		
11:45	Lunch break		
12:45	Session 3-Paralell at Post Graduate Building, Fac. of Agriculture, Lampung University		
15:15	Coffee Break		
15:35	Session 4	Chair: Dr. Tumiar K Manik	
15:35		Assis. Prof. Tanaka, T., GU	Applications of Structural Equation Modeling in Crop Yield Variability of the Farmers' Fields
15:55		Agustini (Agric.Service, Bandar Lampung City)	Potential of yard Utilization for Supporting the Fulfillment of Food Security in Bandar Lampung City, Indonesia
15:15		Assis. Prof. Noda, K., GU	GIS analysis for vulnerability assessment of salt damage on Taro Patch in Palau
16:45		Prof. K. Hiramatsu, Vice Dean of UGSAS, GU	Closing
18:30		MC: Dr. Afandi UNILA	Banquet , at Bandar Lampung' s mayor house

Study Excursion/field trip, at December 4, to PT.GGP, Central Lampung
Start : 06.30 from Faculty of Agriculture, Lampung University.

Parallel Session

Venue : Post Graduate Building, Faculty of Agriculture, Lampung University

Room 1

Start	Speaker/Chair Person	Title
12:45	Chair: Assis. Prof. Noda,	*Influence of Climate Change on Crop Production*
12:45	T.K.Manik	Predicting Cassava Suitability as Impacted by Climate Change in Indonesia
13:00	Siti Chairani/Afandi	Tracking the fate of organic matter residue using soil dispersion ratio under intensive farming in red acid soil of Lampung, Indonesia
13:15	WARJI	Multi-layered Microcapsules of Biopesticides to Support Sustainable Agriculture
13:30	Q&A	
13:45	Coffee break	
13:55	Priyo Cahyono	Effects of Waterlogging on Pineapple Growth and Soil Properties on Red Acid Soils of Lampung, Indonesia
14:10	Rusdi EVIZAL	Potential Yield of Replanted Trees of Cocoa Clones Introduced in Lampung
14:25	Dudy Arfian (PT GGP)	Effects of aluminum stress on shoot growth, root growth and nutrient uptake of three pineapple smooth cayenne clone [*Ananas comosus* (L.) Merr.]
14:40	Didin Wiharso	The effect of long-term cassava cultivation on organic carbon content and soil physical properties in Central Lampung
14:55	Q & A	
15:15	Coffee break	

Room 2

Start time	Speaker/Chair Person	Title
12:45	Chair: Diding	*Cash Crop productivity and its constraint*
12:45	Siti Nur Rohmah	Corn Yield and Soil Properties under long term conservation tillage in clayey soil tropical upland of Lampung, Indonesia
13:55	Lestari Wibowo	The role of refugia in the wetland paddy ecosystem
13:10	Dwi Oktaria	Soil organic carbon in soil fraction and corn yield under long-term tillage system and nitrogen fertilization
13:20	Ahmad Tusi	Ventilation Flow Rate and Photosynthesis Prediction based on Water Vapor Balance under Ventilated Greenhouse
13: 35	Q & A	
13:50	Coffee break	

14:00	M. A. Fauzan	Aggregate Stability and Root Biomass Affected by Soil Tillage and Mulching in the Gedung Meneng Soil Planting Green Nut (*Vigna radiata* L.) of the Long Term Experiment
14:15	Ayu Wulan Septitasari	Application of induced compost of cellulolitic (*aspergillus fumigatus*) and ligninolitic (*geotrichum* sp.) inoculum on the vegetative growth of red chili (*Capsicum annuum* L.)
14:30	Yogi Irawan	Soil Compaction, Water Content, Bulk Density and Soil Root Biomass Affected by Tillage and Fertilizer on Gedung Meneng Soil under Green Bean Growth
14:45	Tubagus Hasanuddin	Perceptions of farmers, Effectiveness of Farmers Group, and Diffusion of Innovation of Organic Farming System in Lampung Province
15:00	Q & A	
15:15	Coffee break	

Room 3

Start time	Speaker/Chair Person	Title
12:45	Chair: Prof. K. Hiramatsu, GU	*Annual Crop productivity and technology for supporting*
12:45	Novita Desri Wanti	Production and harvested nutrient of cassava (*manihot esculenta l.*) affected by compost and its combination with NPK inorganic fertilizer for the 5th planting period
12:55	Debby N.A	Simulation of Cavendish Banana Transporation
13:10	Cicih Sugianti	The application of hot water treatment in mango cv arumanis
13:20	Maria Viva Rini	The Diversity of Arbuscular Mycorrhiza Fungi at Rhizosphere of Cassava of Thailand Clone Cultivated in Lampung Timur and Tulang Bawang Barat
13:35	QA	
13:50	Coffee break	
14:00	Adinda Kusuma Dewi	Harvested nutrient and production of cassava (*manihot esculenta*) affected by tillage and herbicide in the 4th planting period in Gedung Meneng soil Bandar lampung
14:10	Nurhidayat	Production and Harvested Nutrients of Sugarcane 1st Ratoon (*Saccharum officinarum* L.) Affected by Organic and Inorganic Fertilizer
14:25	Agus HARYANTO	Biogas Production From Oil Palm Empty Fruit Bunches through Dry Fermentation Process: Preliminary Results
14:40	Diding	The Current Status of Authentication of Indonesian Specialty Coffees Using UV-Visible Spectroscopy and Chemometrics
15:55	Q&A	
15:15	Coffee break	

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Ventilation Flow Rate and Photosynthesis Prediction based on Water Vapor Balance under Ventilated Greenhouse

Ahmad TUSI[1,2], Teruaki SHIMAZU[2], Katsumi SUZUKI[3], and Masaki OCHIAI[2]
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SUMMARY
The water vapor balance method was tested and evaluated in ventilated greenhouse soilless tomato crops grown under summer season in Gifu city, Japan. This study was conducted to estimate the ventilation flow rate and the net photosynthesis in the ventilated tomato greenhouse. The water vapor mainly released by transpiration that followed a periodic shape variation like a solar radiation and the amount of water vapor released from the greenhouse due to ventilation that proportional with outside wind velocity. The amount of water vapor was significant during summer. Using of the simple water vapor balance method that calculated from real-time transpiration measurement can predict ventilation rate and the net photosynthesis quiet well.

Introduction

Ventilation in a greenhouse systems is very important part to keep the air temperature condition, water vapor pressure deficit (VPD) at optimal conditions for plants when solar radiation is high. Ventilation is not only to create a good micro-climate condition for the plant but also photosynthetic and transpiration rate of the plants.

The net photosynthetic rate increases with increasing the CO2 concentration in the daytime and supply CO2 gains from the outside greenhouse through ventilation. However, the high of CO2 supply under ventilated greenhouse will be not efficient when the air flow to inside greenhouse was too high. Therefore, it should be evaluated and controlled that considered the area opening of ventilation.

In order to measure and estimate the ventilation characteristics of greenhouse was conducted with the decay method or tracer gas method (Baptista et al., 1999; Boulard and Draoui, 1995), heat balance method (Yasutake et al. 2017; Teitel and Tanny 1999), and regression method under greenhouse without plant (Yasutake et al. 2017). This paper was tested and evaluated of the ventilated greenhouse with the water vapor balance method for predicting the ventilation flow rate and the net photosynthesis for the soilless tomato crops.

Material and Method

The experiment was conducted in May – September 2018 in a single-span greenhouse of the Gifu University, Japan. The naturally ventilated greenhouse has 0.9m double glass vent openings each side and a roof vent. All the vent have worked automatically to keep the inside greenhouse temperature 25 C. the tomato plant, Momotaro variety, were planted north-south orientation along the axis of greenhouse. There are three treatments of opening the side vent opening with roof vent was always opened, SV12 (both upper and lower side vent open); SV1 (lower side ventilation open); and SV2 (upper side vent open).

Water vapor balance was analyzed by the mass balance method (eq. 1) with assumption there is no condensation on the inside surface of the glazing; and also there is no evaporation resulted from the soil because the greenhouse has covered by plastic.

Water vapor supply = water vapor losses /1/

$E_c + ET = E_v$ /2/

$E = E_v$ /3/

Considering the two sources of water vapor as one component (eq. 3), and then expressing the water vapor content within the greenhouse air as absolute humidity, g [H2O] kg-1 dray air [DA], then resulting mass balance equation is:

$AH_{out}.\ q_v.\ \rho = AH_{in}.q_v.\ P + E$ /4/

$q_v.\ \rho\ (AH_{out} - AH_{in}) = E.Af$ /5/

Where q_v was ventilation flow rate (m3 m-2 s-1); AH_{in} and AH_{out} were the absolute humidity of the air (g [H2O] kg-1 [DA]), inside and outside greenhouse respectively, and E was measured directly from the plant with a stem heat balance sensor attached to the stem of tomato plant. It recorded at 1, 15, and 60 minutes intervals with CR1000 data logger (sciences Campbel). Transpiration measurement with a sensor was compared with weighing lysimeter. This on-line monitoring of the ventilation flow rates were used to predict the net photosynthetic rate based on the carbon dioxide balance equation of the greenhouse from Takakura et al. (2017) model.

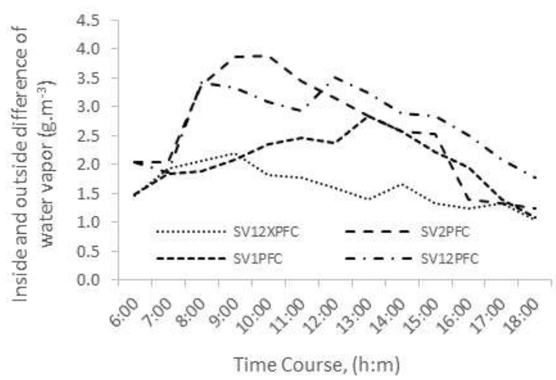

Fig. 2 Time Course of the inside and outside water vapor difference (the net radiation 700 w.m^{-2})

Result and Discussions

Fig. 1 shows that transpiration rate increased linearly with the net solar radiation. The transpiration rate is not only affected by the solar radiation but also by air flow around the crops inside greenhouse. SV12 opening treatments was more higher compared to SV1 and SV2. It can be elucidated that the effect of the large opening resulted the air flow to inside greenhouse. This result agrees with the others results experiments (Thongbai, Kozai, and Ohyama 2010; Kitaya et al. 2003)

Application of evaporative cooling technology affected the water vapor condition in the greenhouse. It can be seen from the below graph, that shows application of

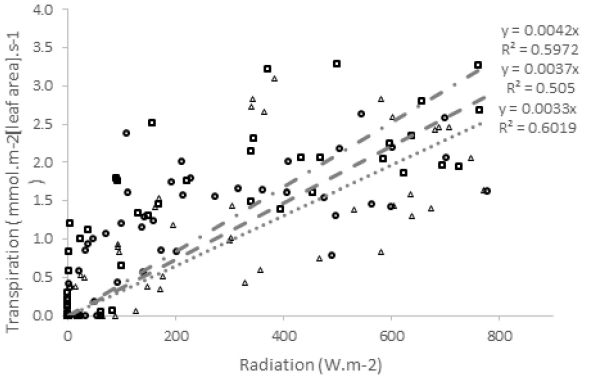

Fig.1 Relation between hourly averaged transpiration based on leaf area and net solar radiation above the canopy. SV12 opening vent (□); SV1 opening vent (Δ); and SV2 opening vent (○).

evaporative cooling on summer seasons to perform a good micro-climate environment inside greenhouse increased the difference of inside and outside water vapor. SV12 treatment combined with evaporative cooling was increased the water vapor about 60% compared to without evaporative cooling application.

The fluctuation of water vapor difference between inside and outside due to the ventilation flow rate. It can be explained based on a correlation between outside wind speeds to the ventilation flow rate. An increasing of wind speed from 0.2 until 1.5 m.s-1 followed by an increasing of the ventilation flow rate linearly (Fig. 3).

The analysis of the ventilation flow rate shows that the wind effect is almost linearly proportional to the wind speed between 0.1 – 1.0 $m.s^{-1}$, however it was limited by the opening are of side window opening area. On this experiment, on the day ventilation opened maximum (35 cm).

This results confirms previous studies which show the same pattern with different methods (Boulard T 1995; Teitel and Tanny, 1999). However, it also limited to maximum wind speed around the crops about 1 – 1.5 $m.s^{-1}$ after that it would be constant value because the air velocity induced ventilation greenhouse was dominant (Papadakis et al. 1996).

Furthermore, the canopy crop photosynthesis was predicted smoothly by real time measurement of transpiration combined with prediction ventilation flow rate based on leaf area method. From the Fig. 4, it is clear that net photosynthesis could be predicted with this new proposed method.

It shows that an increasing of flow rate around the plants

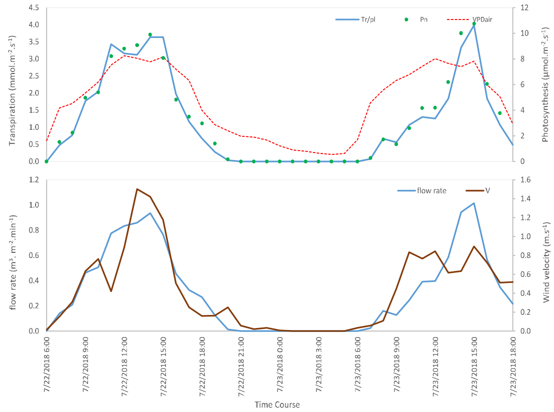

Fig. 4 Time Course of the net photosynthesis, transpiration and vapor pressure deficit (upper); wind speed and ventilation flow rate (below) under SV12 without PFC treatments (22-23 July,2018).

affected the net photosynthesis processes under high the net solar radiation about 600 W.m-2. The air movement around the plant canopies in the greenhouse system is very essential to obtain maximal gas exchange rates (Kitaya et al. 2004). The results of this study confirms

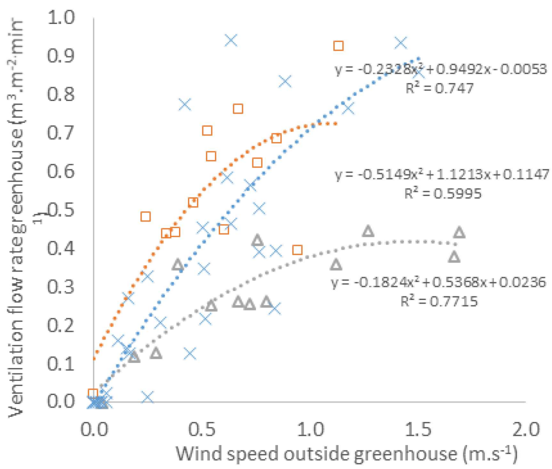

Fig. 3 Time Course of the inside and outside water vapor difference (maximum the net radiation 700 $w.m^{-2}$). SV12 opening vent with evaporative cooling (PFC) (□); SV1 opening vent with PFC (Δ); and SV12 opening vent without PFC (○).

that the importance of air movement for enhancing gas and water vapor exchanges in plant canopies

Moreover, this water vapor balance method that calculated from real-time transpiration measurement can predict ventilation rate and the net photosynthesis quiet well. It can be used for controlling air movement for enhancing the plant canopy photosynthesis with CO2 enrichment level or ambient CO2 concentration under ventilated greenhouse. Also, it can be used as reliable and predictive tools for the measurement of the net photosynthesis based on leaf area based.

Conclusion

A real time prediction of ventilation rates and photosynthesis tools based on transpiration data under ventilated greenhouse was proposed.

Opening side ventilation on the canopy tomato crops could be used as the best option for optimizing the evaporative cooling in summer seasons.

Acknowledgement

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