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Protocols for Determination of Coefficient of Transpiration (T_μ) Using a New Innovative Instrument Rhythmometer Version 2

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ABSTRACT

Transpiration is a physiological process by which aerial parts of plants release water in form of vapour. It is affected by many environmental factors like temperature, light, humidity, etc. In this present work, we propose a new protocol for the determination of the Coefficient of Transpiration (T_μ) which is useful for the determination of trends of transpiration concerning different climatic factors. For determination of the Coefficient of Transpiration (T_μ) can achieve by using a new innovative instrument Rhythmometer Version-2 (Fig-1) which was developed by two authors Aishwarya Khamari and Akshya Ku. Mishra in 2021. Rhythmometer (PEG) is an analytical instrument used to measure plant rhythm concerning its electrical conductivity. This instrument measures plant rhythm as well as detects several environmental parameters. In this study, it was found that the Coefficient of Transpiration was maximum in wind, moderate in sunlight, and minimum in shade and it varies with environmental factors like temperature, light intensity, wind speed, etc. Rhythmometer Version 2 not only helpful in the detection of rhythm and plant physiological processes but also detection of several environmental parameters Therefore we called it a portable all in one lab for plant physiology and phytoecology.

Keywords- Transpiration, Rhythmometer Version 2, Rhythm, Environmental factors

I. INTRODUCTION

Transpiration is a physiological process by which aerial parts of plants releases water in form of vapour. It is affected by many environmental factors like temperature, light, humidity etc. In this present work, we propose a new protocol for the determination of the Coefficient of Transpiration (T_μ) which is useful for the determination of trends of transpiration concerning different climatic factors. for Determination of Coefficient of Transpiration (T_μ) can be achieved by using a new innovative instrument Rhythmometer Version 2(Fig-1) which was developed by two authors **Aishwarya Khamari** and **Akshya Kumar Mishra** in 2019.

Rhythmometer (PEG) is an analytical instrument used to measure plant rhythm concerning its electrical conductivity. This instrument measures plant rhythm as well as detects several environmental parameters. As ECG can measure the cardiac rhythm in animals, PEG or Rhythmometer can measure the circadian rhythm in plants. Plants have rhythm and biological clock. It is a noble idea for the plant sciences and agriculture. Rhythmometer (PEG) is an analytical instrument used to measure **electrical conductivity** and **rhythm in plants**. It is just like the **ECG** of plants. It is useful in **hydroponics culture** to study metal deficiency and metal toxicity levels of specific plants, which have a significant role in horticulture. It opens a new door to **study taxonomy** based on Rhythm. It is also used for the detection of environmental temperature and humidity, soil temperature and humidity, wind speed, light intensity, pH of soil and water and TDS of water.

It is not only helpful in the detection of rhythm and plant physiological process but also detection of several environmental parameters Therefore we called it a portable all in one lab for plant physiology and phytoeology. This instrument got recognised in 3M young innovation challenge and Kritagya hackathon ICAR.

Downes *et.al*. (1970) found that the rate of transpiration is more in wheat as compared to sorghum and the rate of transpiration is directly proportional to temperature for both species. Agata *et.al.* (1985) found that a saturated curve obtained for the response of transpiration to light intensity and an optimal curve obtained for the response of transpiration to humidity. Schymanski *et.al*. (2015) found that the wind speed increases the potential evaporation which results in an increase in the rate of transpiration and the ratio between transpiration and potential evaporation depends upon the stomatal resistance, wind speed, atmospheric temperature, irradiance and relative humidity. Dixon *et.al*. (1984) found that in a controlled environment the rate of transpiration decreases with an increase in wind speed in a wind tunnel. Grantz *et.al*. (1990) found that the rate of transpiration decreases with an increase in atmospheric humidity or evaporative demand. Khamari *et.al*. (2021) reported that AM Transpirator is useful in the analysis of transpiration and transpiration affected by the pH of the solution.

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II. MATERIALS & METHODS

We had taken a rooted plant for Determination of Coefficient of Transpiration (T_μ) in three different conditions sunlight, wind & shade.

Methods of Determination of Coefficient of Transpiration (T_μ)

– Put the power plug in 230V AC.
– Insert +VE, -VE and reference sensors into the plants.
– Rotate the knob of the multi-meter to µA.
– Press the Bluetooth icon of the multi-meter.
– Open the meter box Pro application in the display unit.
– The real-time plant rhythm graph is shown on the display.
– The Mean, maximum peak and the minimum peak of current in µA shown on the display unit.
– Coefficient of Transpiration (T_μ) can determine by taking half value of maximum peak (A_{max}) $\mathbf{T_{\mu=}\ 1/2\ A_{max}}$
– We have taken 30 minutes each for all the environmental conditions
– Open Google map on display which will give altitude and latitude.
– Open lux meter app on display which gives light intensity in lux.
– Power on the anemometer which shows wind display in km/h
– When the sensor direct towards the upper side it gives atmospheric temperature and humidity and when put in the soil it gives soil temperature and humidity.
– Put the PH sensor into 10ml of distilled water containing 1 gm of soil to get the PH of soil.
– All data fitted into a special format to get PEG (Phytoelectrogram) report (Fig-2)

Fig. 1: Rhythmometer version-2

PEG (phyto electrogram) report for plant

Time: 04:12PM Date: 22/07/2021 Instrument-Rhythmometer V2.0

Name of plant: *Curcuma longa* (Turmeric) Family: Zingiberaceae

Location Dhankauda, Sambalpur, Odisha

GPS position: Latitude N 21°28' 1.67484 Longitude E 84°0' 4.22172

Temperature: Environmental: 35°C **Soil:** 39 °C

Humidity: Environmental: 60% **Soil:** 94%

Light intensity: 4320 lux. **wind speed** 1.12 km/hr.

Peak- Max: 0.50µA **Min**: 0.02µA **Avg:** 0.24µA

pH: 6.8

Graph:

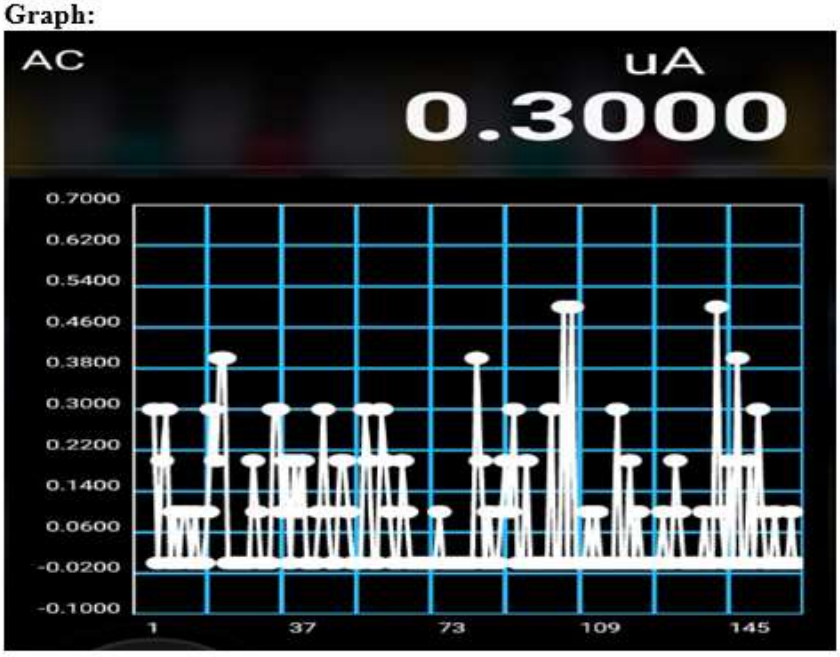

Fig. 2: PEG (Phytoelectrogram) report

III. RESULTS

The Coefficient of Transpiration (T_μ) was determined by using the formula $\mathbf{T_\mu = 1/2\ A_{max}}$ Table no 1 contains Coefficient of Transpiration and different environmental data in three different conditions. A comparison of the Coefficient of Transpiration given in graph 1.

Table 1

ENV Condition	T_μ	Env.Tempin^{0}C	Soil.Tempin^{0}C	Humidity in %	Light intensity in Lux	Wind Speed in Km/hr.	Soil pH	Soil humidity in
Wind	0.85	35	39	60	17300	6.20	6.8	94
Sunlight	0.50	35	39	59	17300	1.25	6.8	95
shade	0.25	32	38	62	4320	1.12	6.8	96

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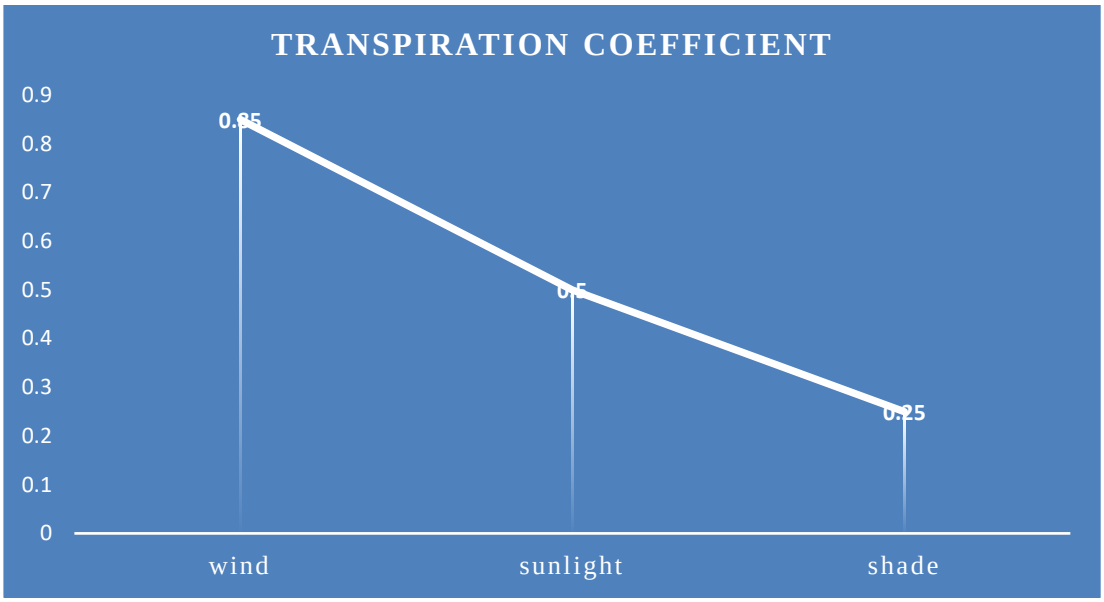

Graph 1

IV. CONCLUSION

In this study, it was found that the Coefficient of Transpiration was maximum in wind, moderate in sunlight and minimum in shade and it varies with environmental factors like temperature, light intensity, wind speed etc. **Rhythmometer Version 2** is not only helpful in the detection of rhythm and plant physiological processes but also detection of several environmental parameters. Therefore we called it a portable all in one lab for plant physiology and phytoeology. Rhythmometer provides us a complete multidimensional analysis of transpiration with reference to environmental parameters.

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