International Journal of GEOMATE, Sept., 2017, Vol. 13, Issue 40, pp. 24-28
Special Issue on Science, Engineering & Environment, ISSN: 2186-2990, Japan
DOI: http://dx.doi.org/10.21660/2017.40.2521

THE EFFECTS OF WATERING FREQUENCIES AND SLOW-RELEASED-FERTILIZER LEVELS ON THE GROWTH OF PLATYCERIUM CORONARIUM IN YOUNG SPOROPHYTE PHASE

*Sawat Pimsuwan**,** Yaowarat Wongsrisakulkaew, Nadda Jumradjit, Patthamawadee Thumsuk and Supawadee Mulmanee

[1]Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi, Thailand

*Corresponding Author, Received: 19 April 2016, Revised: 23 Aug. 2016, Accepted: 20 Feb. 2016

ABSTRACT: This study was conducted at the nursery of the Crop Production Department, Faculty of Agricultural Technology, Rajamangala University of Technology, from February to August 2015. The effects of two factors on the growth of *P. coronarium* ferns in the young sporophyte phase were assessed using a factorial in CRD experiment. Factor A consisted of 3 watering frequencies: watered every day, every two days and every three days. Factor B consisted of 4 levels of a commercial slow-released-fertilizer (SRF: 13-13-13, 3 months): 0 g, 1 g, 2 g and 3 g per pot. It was found that the ferns which received water once every three days possessed the highest canopy of 29.47 cm, a sterile leaf width of 14.054 cm, a fertile leaf width of 22.58 cm and a fertile leaf length of 22.20 cm. On the other hand, the fertilizer level of 2 g gave the highest canopy of 27.31cm and a sterile leaf width of 14.63 cm, while the fertilizer level of 3 g gave the biggest fertile leaf width of 21.54 cm and a fertile leaf length of 19.62 cm. However, no interaction between the two factors was demonstrated.

Keywords: Watering frequency, Fertilizers, Staghorn fern, Sporophyte, Platycerium, Slow-released-fertilizer

1. INTRODUCTION

Ferns are plants that do not have flowers or fruits. They propagate by means of spores. A variety of fern species classifications based on natural habitat is as follows: aquatic ferns named Water Clover (*Marsilea* spp) and Azolla (*Azolla pinnata* R.Br); terrestrial ferns named Tree Fern (Cyatheales), Golden Chicken Fern (*Cibotium barometz*); and epiphyte ferns named Bird's-nest Fern (*Asplenium nidus*) and Staghorn Fern (*Platycerium* spp) [1]. Ferns have a great many uses for humans, for example: wicker from Climbing Ferns (*Lygodium polystachyum* Wall.ex Moore); food from Vegetable Ferns (*Diplazium esculentum*) [2],[3]; and ornamental plants from Oak-leaf Fern (*Drynaria quercifolia*) and Staghorn Fern (*Platycerium* spp).

Many ferns are beautiful and are used as ornamental plants. Ferns' delicate beauty make them ideal for gardens of ornamental plants. Their aesthetics are determined by their foliage color and form [4]. The genus Platycerium is one of the most beautiful ferns among the few epiphytic fern genera. This genus is divided into 18 species by biogeography. There are three main groups consisting of the Java-Australian line, Malayan-Asiatic line and Afro-American line [5],[6].

The popularity of the staghorn fern leaves over other species makes this a good ornamental plant. This fern is a unique adaptation that is very attractive as an epiphyte fern. The stem is a rhizome. There are two types of leaves (fronds), the sterile leaf (shield frond) and the fertile leaf. The sterile leaves are like a basket which gathers organic matter. They turn brown and form layers between which the roots grow. They can then store water like a sponge and protect the rhizome [7]. The fertile leaf is staghorn-like. This leaf forms a spoon-shaped appendix on which a spore patches is formed. In nature, staghorn ferns grow well as they naturally enrich themselves allowing for frequent propagation.

Within the fern genus platycerium, *P. coronarium* has been very popular among ornamental plant growers [8]. It has been referred to as the queen of staghorn ferns. The leaves are dimorphous with unequal base leaves. Fertile leaves are asymmetrical with consecutively forked branches [9]. *P. coronarium* is a distinctive and large fern that frequently grows in the crotches of the tallest trees. In the primitive forests, fertile leaves can reach 200 cm long with suspended dichotomous lobes [3]. There is a relationship between *P. coronarium* and *P. ridleyi* as indicated by the location of their spores which create an appendage resembling a spoon [6].

The process of fern spore germination depends on the time of storage and the conditions of storage, including temperature, humidity and light [11][12]. When the spores are cultured in the nursery, the important factors affecting propagation are the

strength of the wind, humidity, light and temperature. The process of germination transforms the spores into the young sporophyte phase. The spore cultures are kept in plastic containers which maintains constant moisture [13]. The ferns are then able to adapt to these conditions even though they are not natural. When the young sporophytes are ready to be introduced into the external environment, they will be strong enough to adapt.

The important factors that affect the growth of the staghorn fern are moisture and nutrients. The sterile leaves of the staghorn fern retain moisture. There is no need for frequent watering. Normally staghorn ferns get nutrients from natural organic matter. When the ferns grow in the nursery, the necessary nutrients can be added with slow release fertilizers which gradually release nutrients. This method does not pollute the environment and it releases the nutrients in a way that fits plant growth [14]. This experiment wanted to consider how slow release fertilizers might be beneficial to growers working with staghorn ferns in the nursery [15].

The purpose of this research is to study watering frequencies and levels of slow-released-fertilizer on the growth of *P. coronarium* in the young sporophyte phase.

2. MATERIALS AND METHODS

2.1 Materials

This research began with the cultivation of *P. coronarium* spores. Plants were transplanted into plastic containers until they were one year old. The factors that were controlled included moisture, humidity, light and temperature. In the nursery, plants with a similar diameter size of about 27 cm on average were selected. They were then put into 8 x 8 inch plastic pots with plant material. The preparation of plant material involved chopping coconuts and soaking them in water for 1 hour. This absorption of water in the coconut reduces the coconut acidity. These young sporophyte phase ferns were then arranged on the plant bench by Factorial experimental design. The slow release fertilizers were prepared at the different levels of 1 g, 2 g and 3 g with 500 ml of water.

2.2 Experimental design and data analysis

Factorial experiment in CRD was used in this experiment. Factor A consisted of 3 watering frequencies: watered every day, every two days and every three days. Factor B consisted of 4 levels of a commercial slow-released-fertilizer (SRF:13-13-13 , 3 months): 0 g, 1 g, 2 g and 3 g per pot with 3 replications. The data was statistically analyzed by ANOVA (Analysis of Variance) and comparisons were made with Duncan at a significance level .05.

3. RESULTS AND DISCUSSION

This study found that for Factor A, the frequency of watering every three days resulted in the average following results: a canopy height of 29.47 cm; a sterile leaf width of 14.05 cm; a fertile leaf width of 22.58 cm; and a fertile leaf length of 22.20 cm. There was no statistical difference compared to other watering frequencies. For Factor B, the commercial slow-released-fertilizer weight of 2 grams per pot resulted in the average following results: a canopy height of 27.31 cm; and a sterile leaf width of 14.63 cm. The rate of 3 grams per pot gave the biggest fertile leaf width of 21.54 cm and a fertile leaf length of 19.62 cm. There was no statistical difference compared to the other levels (Table 1 and Fig 1-3).

Table 1 showed the results of two factors on the growth of staghorn ferns in the young sporophyte phase at 12 weeks.

Treatment	Growth of *P. coronarium* (x̄/cm)			
	CH	SLW	FLW	FLL
Factor A				
Every day	18.98	10.58	13.01	14.38
Every 2 days	23.45	9.87	18.17	16.59
Every 3 days	29.47	14.05	22.58	22.20
CV%	27.23	43.75	36.60	28.17
F-test	ns	ns	ns	ns
Factor B				
SRF 0 g/pot	17.06	7.52	11.93	14.08
SRF 1 g/pot	25.19	11.81	17.38	17.81
SRF 2 g/pot	27.31	14.63	20.83	19.40
SRF 3 g/pot	26.31	11.35	21.54	19.62
CV%	27.23	43.75	36.60	28.17
F-test	ns	ns	ns	ns

CH =Canopy Height, SLW =Sterile Leaf Width, FLW =Fertile Leaf Width, FLL= Fertile Leaf Length

These figures show the growth of Staghorn ferns at 12 weeks consists of two factors (figures 1-3) and chart the overall growth every week of *P. coronarium*; canopy height, sterile leaf width, fertile leaf width and fertile leaf length. (figures 4-9)

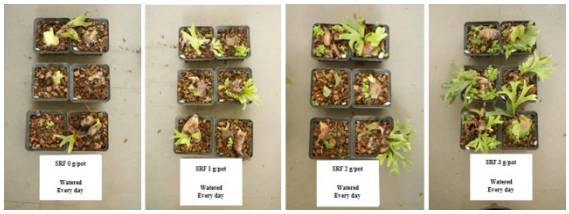

Fig. 1 Watered every day with SRF: 0 g, 1 g, 2 g and 3 g/pot

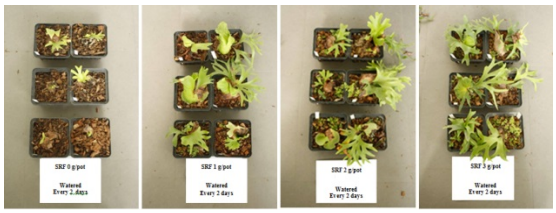

Fig. 2 Watered every 2 days with SRF: 0 g, 1 g, 2 g and 3 g/pot

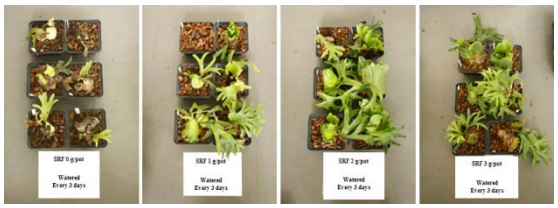

Fig. 3 Watered every 3 days with SRF: 0 g, 1 g, 2 g and 3 g/pot

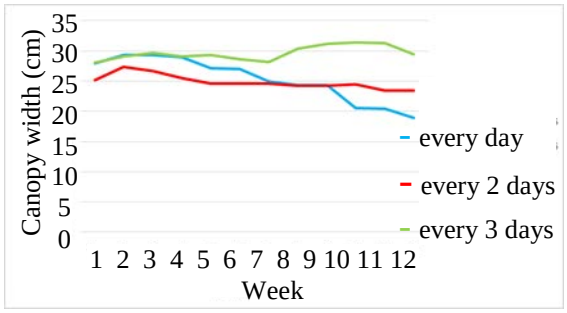

Fig. 4 Canopy width of *P. coronarium* with 3 watering frequencies

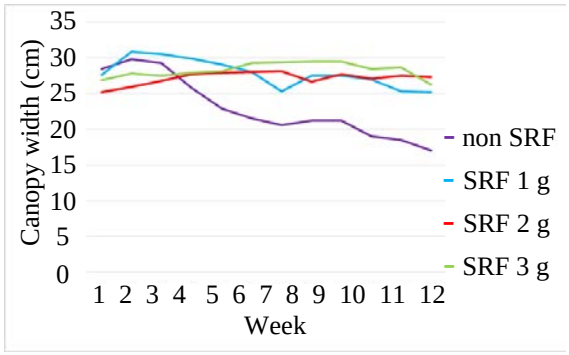

Fig. 5 Canopy width of *P. coronarium* with 4 levels of SRF

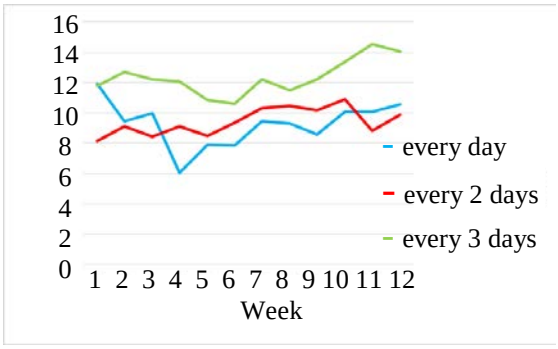

Fig. 6 Sterile leaf width of *P. coronarium* with 3 watering frequencies

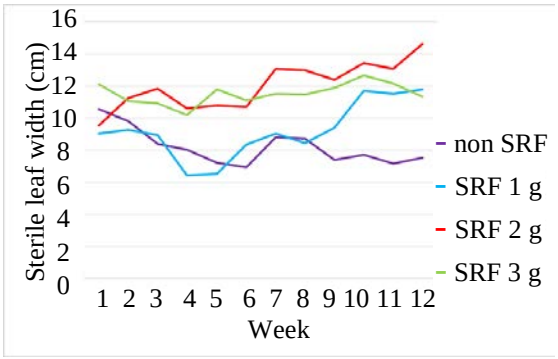

Fig. 7 Sterile leaf width of *P. coronarium* with 4 levels of SRF

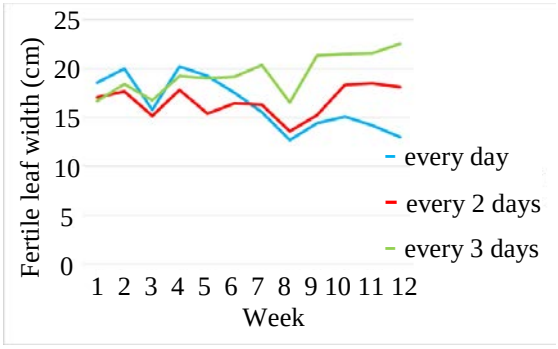

Fig. 8 Fertile leaf width of *P. coronarium* with 3 watering frequencies

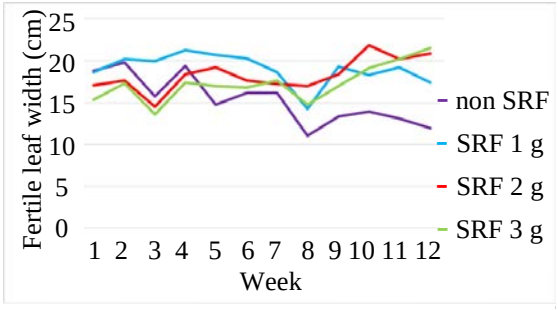

Fig. 9 Fertile leaf width of *P. coronarium* with 4 levels of SRF

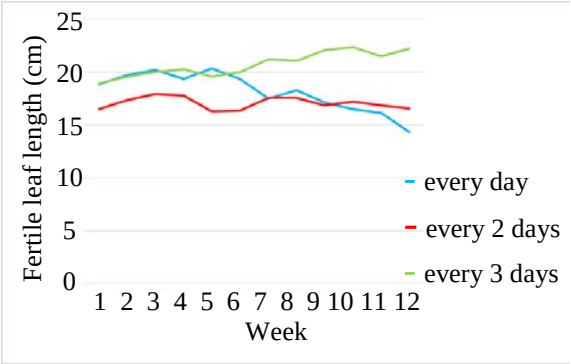

Fig. 10 Fertile leaf length of *P. coronarium* with 3 watering frequencies

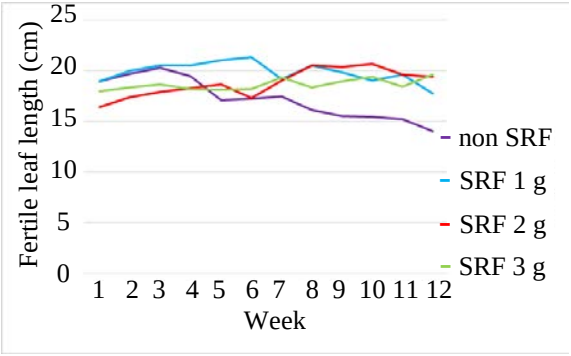

Fig. 11 Fertile leaf length of *P. coronarium* with 4 levels of SRF

4. DISCUSSION

This research showed a watering frequency of every three days produced the best fern growth (Fig 4, 6, 8 and 10). Roy Vail [7] said that most staghorn ferns only need enough water to be moist. If the ferns are watered until wet, they may die. Some species need far less water. The *P. coronarium* fern can store water easily in the shield frond. However this may create a problem with rot so in the rainy season, watering should be avoided. In the rainy and dry seasons, to minimize problems with the young sporophyte phase of the fern, it must be maintained carefully in a plastic roof house and be moist in the daytime in the dry and hot seasons.

The slow release fertilizers release nutrients more slowly than general release fertilizers, but the rate and duration of the release of nutrients cannot be controlled. The release rate depends on external factors such as soil moisture, the soil reaction, the size of a grain of fertilizer and watering frequency. This research showed the slow release fertilizer level of 2 g produced the best fern growth (Fig 5, 7, 9 and 11). The slow release fertilizer reduces the amount of fertilizer used because the release process reduces nitrogen losses due to volatilization and leaching [16].

Slow release fertilizers are not easily found in normal markets and are expensive. In nature, these epiphyte ferns can grow and have the ability to thrive [17]. As an epiphytic fern, staghorn ferns can grow in tree crotches. The shield fronds gather dry leaves of plants and other dust from which the fern can absorb nutrients as a result of fermentation. Another way is to use bio-fertilizers instead of chemical fertilizers, for example, compost from leaves and manure for the staghorn ferns.

5. CONCLUSIONS

The best results for growing the *Platycerium coronarium* in the young sporophyte phase were achieved by applying the watering frequency of every 3 days and using the slow-release-fertilizer level of 2-3 g / plastic pot (8x8x3 inches) after taking off the plastic moisture chamber (about 1 year old). Experimental results showed that the ferns which received water once every three days possessed the highest canopy of 29.47 cm, a sterile leaf width of 14.054 cm, a fertile leaf width of 22.58 cm and a fertile leaf length of 22.20 cm. It was also observed that the fertilizer level of 2g gave the highest canopy of 27.31cm and a sterile leaf width of 14.63 cm, while the fertilizer level of 3g gave the biggest fertile leaf width of 21.54 cm and a fertile leaf length of 19.62cm. Interaction between the two factors was not found.

6. ACKNOWLEDGEMENTS

This research was partially funded by The Faculty of Agricultural Technology, Rajamangala University of Technology Thanyaburi, Thailand. And this text was edited by Dr. Satain Pogool and Mr. Bruce Groening.

7. REFERENCES

[1] Dubuisson J., Schneider H. and Hennequin S. Epiphytism in ferns: diversity and history. Science Direct. Vol. 332, Issues 2–3, 2009, P. 120–128

[2] Tongco J.V.V., Villaber R.A.P., Aguda R.M. and Razal R.A. Nutritional and phytochemical screening, and total phenolic and flavonoid content of Diplazium esculentum (Retz.) Sw. from Philippines. Journal of Chemical and Pharmaceutical Research, 6(8) 2014:238-242

[3] Yusuf U.K. Ferns of Malaysian Rain Forest a Journey through the Fern World. Serdang ;Universiti Putra Malaysia Press, 2010.

[4] Zhigila D.A., Sawa F.B.J, Oladele FA. And Muhammad S. Aesthetic Values and Significance of Ferns to Landscaping

Industries -A Taxonomic Review. Int. J. Curr. Res. Biosci. Plant Biol. 2(3) 2015: 7-13

[5] Hoshizaki B.J.. Morphology and Phylogeny of Platcerium Species. Biotropica Vol. 4, No. 2, (Aug., 1972), 93-117 Published by: Association for Tropical Biology and Conservation Stable URL: http://www.jstor.org/stable/2989731 Page Count:

[6] Kreier H.-P. and Schneider H., Phylogeny and biogeography of the staghorn fern genus platycerium (polypodiaceae) American Journal of Botany 93(2) 2006: 217–225 6

[7] Vail, R. Platycerium Hobbyist's Handbook. 13th edition. Desert Biological Publications. 2000.

[8] Taha R.M., Haron N.W., and Wafa S.N. Morphological and Tissue Culture Studies of Platycerium coronarium, a Rare Ornamental Fern Species from Malaysia. American Fern Journal, 101(4) 2011:241-251

[9] Aspiras R.A. Sporophyte and gametophyte development of Platycerium coronarium (Koenig) Desv. and P. grande (Fee) C. Presl. (Polypodiaceae) through in vitro propagation. Saudi J Biol Sci. 2010 Jan;17(1): 13–22

[10] Boonkerd T., Chantanaorrapint S. and Khwaiphan W. Pteridophyte Diversity in the Tropical Lowland Rainforest of Khao Nan National Park, Nakhon Si Thammarat Province, Thailand. The Natural History Journal of Chulalongkorn University 8(2) 2008: 83-97

[11] Bonomo M.C., Martínez O.G, Tanco M.E., Cardozo R. and Avilés Z. Spores germination and gametophytes of Alsophila odonelliana (Cyatheaceae) in different sterile media ΦYTON ISSN 0031 9457, (2013) 82: 119-126

[12] Pérez-García B, Mendoza-Ruiz A., Sánchez-Coronado M.E. and Orozco-Segovia A., Effect of light and temperature on germination of spores of four tropical fern species. Acta Oecologica Volume 32, Issue 2, 2007: 172–179

[13] Pimsuwan S, Hongthong P, Phattraporn, Krangpanich P. and Suwanpinta C. The Effect of Fertilizer on Growth of Staghorn Fern at Seedling Stage. International Journal of GEOMATE, Dec., 2016, Vol. 11, Issue 28, pp. 2879-2882 Special Issue on Science, Engineering and Environment, ISSN: 2186-2990, Japan

[14] Ni B., Liu M., Lu S., Xie L, and Wang Y. Environmentally Friendly Slow-Release Nitrogen Fertilizer. J. Agric. Food Chem., 59 (18) 2011, pp 10169–10175

[15] Pauly D.J., Nyborg M., and Malhi S.S. Controlled-release P fertilizer concept evaluation using growth and P uptake of barley from three soils in greenhouse. Canadian Journal of Soil Science 82, 2002: 201-210

[16] Jagadeeswaran R., Murugappan V. and Govindaswamy M., Effect of Slow Release NPK Fertilizer Sources on the Nutrient use Efficiency in Turmeric (Curcuma longa L.) World Journal of Agricultural Sciences 1 (1) 2005: 65-69

[17] Uchida T., Furuno M., Minami T., Yamashita S., Uchiyama T., Arase T. and Hayasaka D., Ecological Significance of Masonry Revetments in Plant Biodiversity. Int. J. of GEOMATE, Japan, 2015, Vol. 9, No. 1 (17), pp. 1353-1359