B -08

THE VEGETATIVE GROWTH RESPONSES OF *TAXITHELIUM OBLONGIFOLIUM (SULL. &LESQ.) Z. IWATS* (FAMILY SEMATOPHYLLACEAE) CAUSED BY PHOTOPERIOD REGIMES

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Abstract

Bryophytes are useful objects for the investigation of stress-induced cellular responses in plant. Hence the purpose of this research was to study the effect that might occur in the lower plants where growing in condition of extreme climate change. This methodology was designed to examine the vegetative growth responses of *Taxithelium oblongifolium (Sull.&Lesq.) Z. Iwats* (pleurocarpic moss) to four photoperiods. These included 0 h light/24 h dark (as control), 8 h light/16 h dark, 12 h light/12 h dark and 16 h light/8 h dark in the controlled cabinets. Differences in their relative growth rate and some photosynthetic pigments of their shoot were analyzed among their photoperiod regimes. Maximum relative growth rate were observed for the 8-hour day length after incubating 14 and 21 days ($p<0.05$). Whereby, the minimum relative growth rate was detected under 0 h light/24 h dark condition. Moreover, their chlorophyll content (total chlorophyll, chlorophyll a and ratio of chlorophyll a to b) which extracted from the leaves of their shoots did not show significant variations ($p<0.05$) among the various photoperiod. However, the chlorophyll b quantity was statistically different significance ($p<0.05$). Thus, these results suggested that photoperiod affected the vegetative growth and some photosynthetic pigmentation of the shoots in this lower plant. In addition to, chlorophyll b might be feasibility indicator of the ability of this species to contrasting photoperiod regimes.

Key words: moss, vegetative growth, photoperiod

INTRODUCTION

There is strong evidence that there has been an increase in the global mean temperature of about 0.6°C since the start of the twentieth century (Easterling et al., 2000). After that, global warming is well-known as a global problem.Especially, the natural disaster derived from extreme climate change has received increased attention because the often large loss of human life and exponentially increasing costs associated with them. Moreover, climate change interteracts with agriculture through various direst and indirest processes. In agriculture, a major effect of global warming has been the earlier arrival of spring, longer growing seasons, and consequently, altered seasonal patterns and biotic interactions of insects, birds, amphibians, and plants (Gignac**,** 2001).These processes could have extreme impact in agriculture production. Thus, the understanding of the plants response is required to better estimate and predict climate change impact on agriculture.

In plant kingdoms, bryophytes are the second largest group of higher plants after flowering plants, with approximately 15,000species worldwide (Hallingbäck and Hodgetts, 2000).Bryophytes grow in almost all environments where plants can be grown. The basic physiological response of bryophytes is not different from the other plants. Moreover, they offer the opportunity to perform extensive growth analysis experiments in the small areas of controlled environment because of their small size and simple morphology. Nowadays, the utilization of bryophytes to answer the question relative to climate warmingis of interest.In addition, they are useful objects for the investigation of stress-induced cellular responses in plant(Gignac**,** 2001).Hence, our main objective of this research was to study the effect that might occur in bryophytes where seasonal patternwas altered by extreme climate change.On the other hand, when the lower plants grew in condition of the duration of day/night (photoperiod) changed.

RESEARCH METHOD

*Taxithelium oblongifolium (Sull.&Lesq.) Z. Iwats*is a pleurocarp moss species that grows on rocks and tree barks. It is widespread in the south of Thailand and found only in Peninsular Malaysia. The samples were collected from the growing sites inYala Rajabhat University, Thailand.

This was a preliminary study. The experiment was designed as complete randomized designs (CRD) with 3 replications per treatment. *T. oblongifolium* were sampling under natural conditions. They were placed on floral foams as substratum in laboratory. The floral foams were laied down in the trays with adding water almost fully. The water level was set up constantly throughout the duration of the studies to control the humidity (60-70%) of floral foams in the control cabinet.These mosses were pre-treated by incubating at 25±3 ˚C under 2000 lux of light intensity in the controlled cabinet for 2 weeks before experiment. The incubated mosses were sprayed daily with water and 3 times per week with water plant fertilizer (N-P-K: 21-21-21). The day length in the controlled cabinets were designed as 0 h light/24 h dark (as control), 8 h light/16 h dark, 12 h light/12 h dark and 16 h light/8 h dark. At the beginning of the experiment an additional five individual shoots per treatment were harvested to obtain the initial dry biomass used in the growth analysis. Dry biomass of individual shoots was obtained after 48 h drying in an oven at 80°C, at 14 and 21 days that the mosses were harvested (Rincón, 1993). Mean relative growth rates were calculated as Hoffmann and Poorter’s approach (Hoffmann and Poorter, 2002).

For chlorophyll determination, the 5 replicated initial shoots per treatment were randomly selected. Tissue samples were placed in aluminum foil immediately following collection. Samples were on wet ice (4°C) prior to analysis. Samples kept in a darkened environment to prevent chlorophyll degradation.The tissue samples were extracted in 80 % ammoniacal acetone and absorbance at 646 and 663 nm read on a spectrophotometer. The absorbance of each solution was recorded at these wavelengths. Chlorophyll a, chlorophyll b and total chlorophyll concentrations were calculated (Marschall and Proctor, 2004).In this chlorophyll determination Arnon (1949) method was used for the chlorophyll estimation.

To test for the relative growth ratewe useda one-way ANOVA. The treatment means were compared using Tukey’s mean comparisons.Wilcoxon Signed Ranks Test were used to determine the significance levels of the changes of photosynthetic pigment content during cultivating at 14 and 21 days in the controlled cabinets.

RESULT AND DISCUSSION

The plants use the length of day and night (photoperiod) as a pivotal environmental cue to program their seasonal patterns of dormancy, migration, development, and reproduction. In angiosperms, flowering is often induced by the duration and timing of light and/or dark periods. In bryophyte, the day length is known to control growth rates, specifically the growth rate of the sporophyte (Hughes, 1962). Moreover, photoperiod is known to affect moss gene expression and development (Shimizu et al., 2004). Nevertheless, most moss species are thought to be day-neutral plants. Therefore, they have been considered non-respondent to photoperiod (Lee et al., 2010). Interestingly, the result from the relative growth rate showed that photoperiodism was also an important factor that influenced the vegetative growth of *T. oblongifolium*. Maximum relative growth rate were observed for the 8-hour day length after incubating 14 and 21 days (p<0.05) (Figures 1). By this reason, the cultured moss in 8h day/16 h dark had the ability to grow quicker than the others. This suggested that the length of day/night (photoperiod) affected their gametophyte development.Whereby, the minimum relative growth rate was detected under 0 h light/24 h dark condition. Moreover, the severity of the dried leaves were observed in this condition. There were two approachs for these events. Firstly, continuous dark caused some mosses to use up their energy reserves (Goffinet and Shaw, 2009). So, the store photosynthate in the moss leaves might move from older tissues to the new growing tissues in accordance with almost Tracheophytes. Secondly, this drying might be due to the loss of photosythesis rate when the duration of nightlength was not enough.This might because night length is an important time for water absorption in bryophytes (Csintalan et al., 2000).Hence, photosynthesis might be limited by water availability.

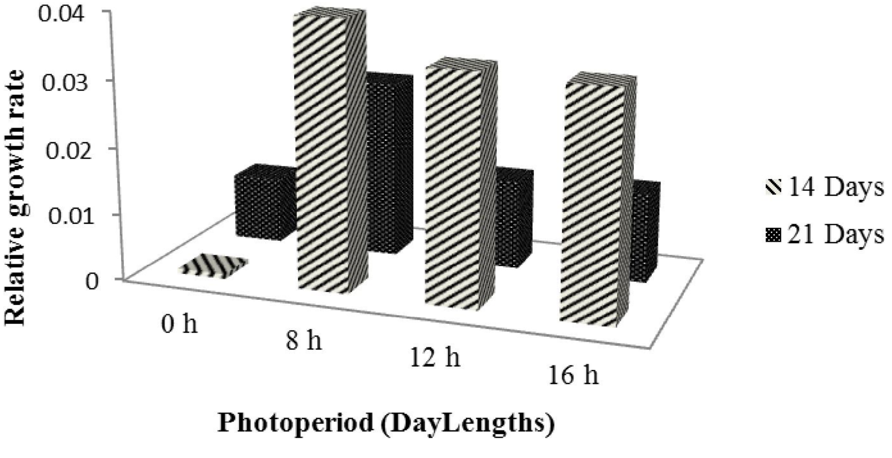

Figure 1 The average relative growth over the period of 14 and 21 days in the various daylength.

Chlorophylls in bryophytes are light-harvesting pigments integral to the photosynthetic process like tracheophytes. Chlorophyll concentration data will provide information on a plant's photosynthetic potential. The most important of these pigments of chlorophyllsare Chl *a* and Chl *b*. They are thus virtually essential for the oxygenic conversion of light energy to the stored chemical energy that powers the biosphere. Moreover**,** low concentrations of chlorophyll can directly limit photosynthetic potential andhence primary production (Filella et al.,1995). In sun leaveshave a higher Chl *a*: Chl *b* ratio than shade leaves (Larcher, 1995). This suggest that the relative concentrations of pigments are known to change with abiotic factors such as light. So, quantifying these proportions can provide important information about relationships between plants and their environment (Devmalkar et al., 2014).

The response of the photosynthetic pigments to photoperiod changing displayed in Fig. 2.Their chlorophyll content (total chlorophyll, chl *a* and Chl *a*: Chl *b* ratio) which extracted from the moss leaves did not show significant variations ($p<0.05$) among the various photoperiod. These results designated that some photosynthetic pigments of the moss leaves were maintained, particularly in continuous dark treatment, although the cellular morphological integrity was affected. These were the same as reported in the desert moss *Syntrichia caninervis* (Xu et al., 2009) and the leafy liverwort *Plagiochila asplenioides* (Suleiman and Lewis, 1980). However, the chl *b* quantity was only statistically different significance ($p<0.05$). These might because the moss leaves was one cell-thick, no epidermis, little or no waxy cuticle, and no stomata. Therefore, the photosynthetic cells directly exposed to light for photosynthesis. When the photoperiod changed such as seasonal changes, bryophytes cannot change their leaf thickness but possible for the changes in chlorophyll concentration. By this reason, the light directly effected on chlorophyll molecules and affected on the chlorophyll concentration amount (Devmalkar et al., 2014).

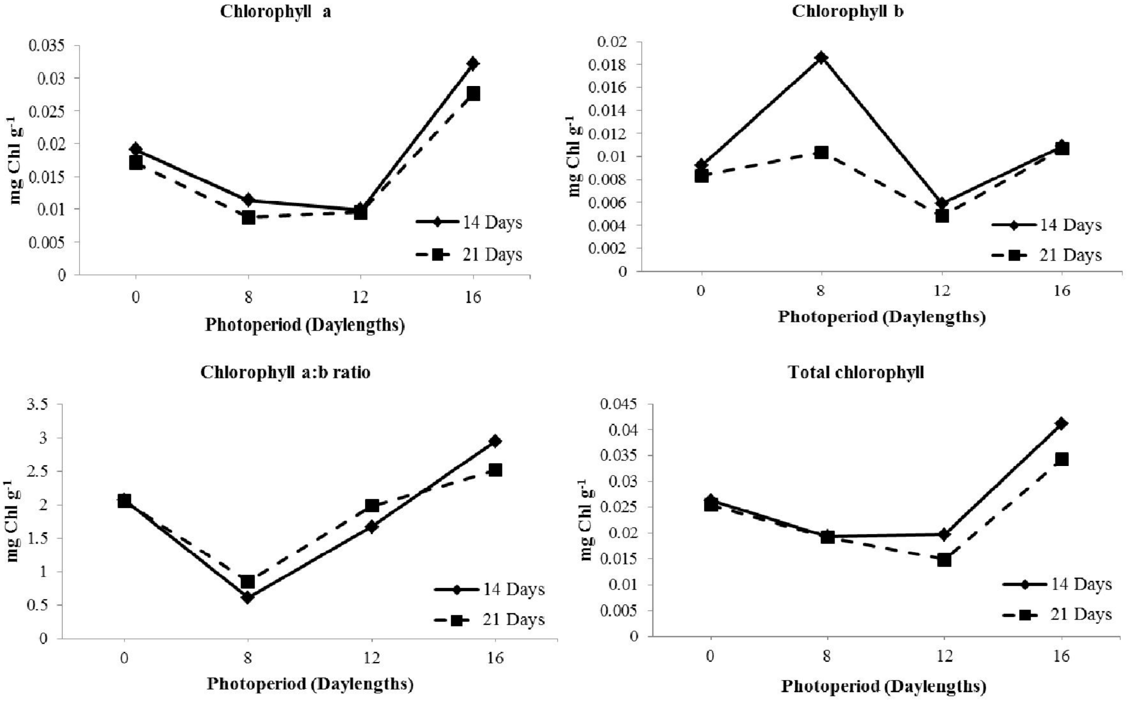

Figure 2 Photosynthetic pigment content during cultivating at 14 and 21 days in the various photoperiod.

CONCLUSION AND SUGGESTION

To sum up, the alternation of day and night or photoperiod changing affected the gametophyte development and some photosynthetic pigmentation of the shoots in *T. oblongifolium*. Interestingly, chlorophyll b might be feasibility indicator of the ability of this species to contrasting photoperiod regimes. However, there is no reason to expect that all species will behave the same way. Thus, future work is needed to determine whether the mechanism of photoperiod control found for *T. oblongifolium* is unique to this species or is found in other mosses. Moreover, the question of whether they really occur extensively *in vivo*, are also interesting to become the further investigation**.**

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