การย้ายปลูกไอซิเดียของ *Parmotrema tinctorum* และ ซอริเดียของ *P. praesorediosum* บนพืชอาศัย ณ อุทยานแห่งชาติเขาใหญ่ ประเทศไทย

Transplantation of lichen with isidia of *Parmotrema tinctorum* and soredia of *P. praesorediosum* on tree barks at Khao Yai National Park, Thailand

มงคล แผงเพ็ชร และ กัณฑรีย์ บุญประกอบ

Mongkol Pangpet and Kansri Boonpragob

Department of Biology, Faculty of Science, Ramkhamhaeng University, Bangkapi, Bangkok 10240, Thailand; e-mail address: golkol@hotmail.com, Fax: (662)310-8395

บทคัดย่อ : ไลเคนสามารถแพร่กระจายได้โดยใช้โครงสร้างสืบพันธุ์หลายแบบและเลือกเติบโตในที่อาศัยที่จำเพาะ การศึกษาการย้ายปลูกไลเคนในครั้งนี้ เพื่อ 1) ศึกษาวิธีที่เหมาะสมในการขยายพันธุ์ไลเคนโดยใช้ไอซีเดียของ *Parmotrema tinctorum* (Despr. ex Nyl.) Hale และซอรีเดียของ *P. praesorediosum* (Nyl.) Hale และ 2) อิทธิพลของภูมิอากาศเฉพาะแห่งที่มีต่อการเติบโตของไอซีเดีย และซอรีเดีย จากการย้ายปลูกไลเคนชนิดละ 580 ตัวอย่าง จากป่ารุ่นสอง ไปยังป่า 4 ชนิด ณ อุทยานแห่งชาติเขาใหญ่ โดยเริ่มในเดือนตุลาคม 2546 ถึงปัจจุบัน พบว่าหลังย้ายปลูก 34 เดือน มีไอซีเดียที่เติบโตเป็นโลบขนาดเล็กได้ 49 ตัวอย่าง และซอริเดีย 14 ตัวอย่าง โดยไอซีเดียสามารถปรับตัวและเติบโตได้ดีกว่าซอรีเดียมาก โดยพบการงอกและเติบโตได้ดีที่สุดในป่ารุ่นสองคือ ไอซีเดีย 33 ตัวอย่าง ซอรีเดีย 9 ตัวอย่าง รองลงมาคือป่าดิบแล้ง 9 และ2 ตัวอย่าง ป่าดิบชื้น 7 และ3 ตัวอย่างตามลำดับ ส่วนในป่าดิบเขาไอซีเดียและซอรีเดียสามารถเติบโตได้ใน 12 เดือนแรกและไม่มีการเติบโตต่อ เนื่องจากมีสาหร่าย Trentepohlia มาเติบโตแย่งที่อาศัย การที่ไอซีเดียและซอรีเดียในป่ารุ่นสองเติบโตได้มากที่สุด เนื่องจากลำต้นไม้ได้รับแสงในสามระดับใกล้เคียงกันโดยมีค่าเฉลี่ยสูงสุดประมาณ 308 $\mu mol\ m^{-2}s^{-1}$ ส่วนป่าดิบแล้งและป่าดิบชื้นบริเวณที่พบไอซีเดียและซอรีเดียเติบโตได้มาก คือ บริเวณกลางต้นถึงเรือนยอด เพราะได้รับแสงมากพอในเวลาเช้าในขณะที่สภาพแวดล้อมยังชื้น

Abstract: Lichens can be regenerated and distributed by means of vegetative structures, isidia and soredia. However, successful establishment depends on microhabitats and microclimate. The objectives of this study are 1) to explore the possibility to propagate lichens by using vegetative propagules, isidia and soredia, from *Parmotrema tinctorum* (Despr. ex Nyl.) Hale and *P. praesorediosum* (Nyl.) Hale and 2) to study the effects of microclimate on establishment and growth of the transplanted isidia and soredia. The study was performed by using five hundred and eighty samples of soredia and isidia, each from the lichens grew in the secondary forest. They were transplanted to 3 host trees in 4 different forest ecosystems at Khao Yai National Park in October 2003, and last to until present date. After 34 months, 49 isidia and 14 soredia developed into small thalli. The isidia showed higher ability to adapt and grew in the new environment better than the soredia. However, microclimate of the new habitats influenced the establishment and growth of these vegetative propagules differently. The most successful development of juvenile lobes was observed in the secondary forest, where 33 isidia and 9 soredia developed into thalli. Those transplanted to the dry evergreen forest had thalli developed from 9 isidia and 2 soredia and tropical rain forest from 7 isidia and 3 soredia. In the lower montane rain forest, the samples were able to grow in the first 12 months prior to be grown over by the algae *Trentepohlia*. The tree trunk in the secondary forest received an average intensity of light averaged 308 $\mu mol\ m^{-2}s^{-1}$ through all levels of the trunks, which seems

to be enough for growth. In the dry evergreen forest and the tropical rain forest, successful establishment and growth were generally found from mid-trunk to canopy. These levels were illuminated sufficiently in early morning, when the surroundings were moist.

Introduction: Many lichens produce numerous isidia and soredia. They consisted of photobiont and mycobiont associated in tiny packages. The isidia makes up of photobiont that bound by cortex layer composing of fungal mycelium on the outer surface, whilst the soredia consists of loosely pack photobiont and hyphae of mycobiont. They serve as vegetative propagules of lichens, and are efficient means for distribution of lichen naturally. When isidia and soredia are broken from thalli and transport to appropriate habitats, they are ready to regenerate and grow (1). Usually lichens that possess isidia do not have soredia and vice versa.

Method: Isidia of *Parmotrema tinctorum* (Despr. ex Nyl.) Hale and the soredia of *P. praesorediosum* (Nyl.) Hale from the Secondary forest in Khao Yai National Park were transplanted into four types of ecosystems: tropical rain forest (TRF), dry evergreen forest (DEF), lower montane rain forest (LMF) and secondary forest (SF). A surface of double-face glue tape (DFGT) was spread with isidia or soredia separately, whilst another surface was attached on bark of host trees with the aid of metal stapled to ensure fastening of DFGT. Transplants were performed from the base to the canopy with 1.5 meters intervals, facing north, east, south and west. A total of 20-24 pieces of the tape holding isidia or soredia were transplanted to each tree. The microclimate (temperature, light and humidity) were measured and recorded every 5 minutes for 24 hour in every 2 months, using Data logger Campbell 21X and LICOR–1400. Light intensity was measured at tree base, mid-trunk and canopy. Temperature and humidity were measured at tree base and canopy. Development of isidia and soredia in to lichen lobes were examines with the aid of hand magnifier, and photograph taken.

Result discussion and conclusion: Transplantation of lichen by using isidia and soredia on double-face glue tape initiated in this study is the first of its kind, and proved to be effective. Out of 580 samples, 8% of isidia and 3% of soredia were able to develop into small lobes of 0.5-2 mm. diameter, baring rhizine, as shown in Figure 1 (A, B and C) and Table 1.

Table 1. The number of juvenile lobes developed from transplanted isidia and soredia on double-face glue tape in 4 forest types at Khao Yai National Park.

Forest types	Numbers of thalli								
	Tree 1		Tree 2		Tree 3		TOTAL		
	I*	S*	I*	S*	I*	S*	I*	S*	I+S
SF	5	1	14	6	14	2	33	9	42
DEF	2	1	7	1	0^{D}	0^{D}	9	2	11
TRF	6	2	1	2	0^{D}	0^{D}	7	3	11
LMF	0^{D}	0^{D}	0^{D}	0^{D}	0^{D}	0^{D}	0	0	0
SUM							**49**	**14**	**64**
%							**8**	**3**	**6**

(I* = isidia, S* = soredia, ^{D} = dead)

Isidia and soredia grew best on mid-trunk to canopy as the areas were illuminated with average light intensity of 207 μmol $m^{-2}s^{-1}$ during 6:00 to 9:00 am in the tropical rain forest and the dry evergreen forest. In the secondary forest, largest number of isidia and soredia grew into thalli. The trunks were thoroughly exposed to the same intensity of light as those observed in the TRF and DEF from the mid-trunks to the canopies.

In the lower montane rain forest, isidia and soredia developed into small lobes after 6-12 months of transplantation, as shown in Figure 2A (2). Retreat of the juvenile thalli by invasion of the alga *Trentepohlia* (Figure 2B) in the LMF was observed after 12 months, which was probably due to microclimate of this habitat. The host tree received light intensity of 270

μmol $m^{-2}s^{-1}$, with relative humidity of approximately 90%, which was higher than those in other forests. The temperature was lower then the other forest measured approximately 21 ^{o}C. This condition might favor algal growth, which also found growing on the tapes in other forest types, but less invasive. This experiment indicated that 1) isidia and soredia can be used for transplantation of lichens for increasing productivity. 2) Transplantation can be successful in the area where light intensity is more than 200 μmol $m^{-2}s^{-1}$ during early morning 3) High humidity and low temperature favor growth of the invading alga *Trentepohlia*.

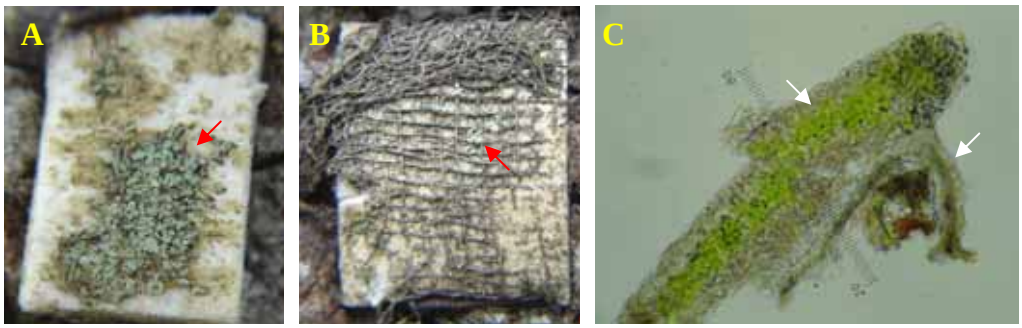

Figure 1. Juvenile lobes developed from isidia and soredia on double-face glue tape **(A)** Isidia of *P. tinctorum* **(B)** Soredia of *P. praesorediosum* (C) Cross-section of newly-developed thallus with rhizine and algal layer.

Figure 2. Juvenile lobes of *P. tinctorum* growing on double-face glue tape in the Lower mountane rain forest **(A)** isidia growing into small lobes after 8 months of transplantation **(B)** algae *Trentepohlia* grew over double-face glue tape previously hold isidia.

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