CHAPTER I

INTRODUCTION

1.1 Background of the study

Limnophila aromatica (Lam.) Merr. (Phak Kha Yaeng) and *L. geoffrayi* Bonati (Ka Om) are famous edible herbaceous plants used by Thai people who live in the northern and northeastern parts. Both species are used as spices in fish soup and eat as raw vegetables with chili paste. *Limnophila aromatica* is hardly seen as a natural population but is usually propagated as a cultivated crop. While *L. geoffrayi* thrives as natural population but has never been successful in agricultural production. Both species belong to the same genus of Plantaginaceae the comparative morphology of *L. aromatica* and *L. geoffrayi* is shown in Table 1.1. Sometimes there is a mixing between the local names.

Limnophila aromatica is an exotic plant introduced to cultivate as plot plant and vegetable crop in Thailand. It is distributed from India to Australia and to Japan, except Myanmar, Thailand, and Cambodia (POWO, 2025). Its scent is similar to *L. geoffrayi*. So, the local people use both species as same propose. It is also used as a medicinal purpose (Table 1.2). Thai people cultivate *L. aromatica* as a crop substitute to rice especially in Ubon Ratchathani including Ayutthaya, Nakhon Pathom, and Yasothon provinces. It is an export vegetable to Europe with value up to 2 million baht per year (The Office of Agriculture Regulation, 2009).

Limnophila geoffrayi prefers to grow in wet and open areas, distributed in the Indochina region. In Thailand, it has been found in northern, northeast, and eastern regions (Smitinand, T. and Larsen, K., 1990). It is a native herbaceous plant that occurs naturally and especially in rice fields and open and wet glass land. It can be propagated via seeds in nature, but it has not been planted as an agricultural crop. Villagers must wait to harvest them only in the late rainy season and dry for use all year. It has a pungent aroma and is also a medicinal plant (Table 1.2). This plant species can be potentially developed being a new agricultural crop. However, in the current situation, farmers usually use herbicide in rice field led to reducing *L. geoffrayi* populations. Moreover, the higher temperature caused by the global warming phenomenon affects the flowering of plants (Geissler, C., Davidson, A., and Niesenbaum, R. A., 2023). Rainfall changing due to El Niño may cause drought in the middle of the rainy season and may affect to herbaceous survival. At present, *L. geoffrayi* has currently vanished from several localities.

Table 1.1 The comparative morphology of *Limnophila aromatica* and *L. geoffrayi*. (Smittinand, T. and Larsen, K. (1990), eFloras (2008), and based on my observations)

Characters	*Limnophila aromatica*	*Limnophila geoffrayi*
Plant height	30-70 cm	10-35 cm
Leaves arrangement	mainly 3 in whorls	Mainly opposite
Leaf shape	ovate-lanceolate to lanceolate-elliptic	oblong-lanceolate, oblong, or ovate-elliptic
Leaf apices	acute	acute to obtuse
Leaf bases	semiamplexicaul	attenuate
Leaf margins	serrate	crenate-serrate
Leaf size	1-5 x 0.3-1.5 cm	1–3 x 0.3–1 cm
Inflorescence type	terminal branches, usually solitary	axillary or terminal racemes with 2-10 flowers
Flower size	1-1.3 cm long	0.1-1.3 cm long
Flower surfaces	Outside: pubescens Inside: white villous	Outside: glabrous Inside: villous posteriorly
Flower shape	campanulate-funel and slightly bilabiate	campanulate-funel and slightly bilabiate
Flower color	violet	white, dark violet, or purplish pink
Capsule	ovoid, ca. 6 mm long	ellipsoidal, 3 x 1.5 mm long

Table 1.2 The comparative benefits of *Limnophila aromatica* and *L. geoffrayi*.

	Benefit
Limnophila geoffrayi	1. antipyretic, expectorant, and galactogogue qualities as medicinal properties, used as a traditional medicinal herb, used as an antidote for toxin detoxification (Thongdon, A. J., and Inprakhon, P., 2009). 2. antimycobacterial and antioxidant properties (Suksamrarn, A., Poomsing, P., Aroonrerk, Punjanon, T., Suksamrarn, S., and Kongkun, S., 2003).
Limnophila aromatica	1. For exhibiting diuretic, muscle relaxant, and antispasmodic properties with little toxicity, kidney stones, excruciating cramps, wounds, ulcers, and wound care (Do, Q. D., Angkawijaya, A. E., Tran-Nguyen, P. L., Huynh, L. H., Soetaredjo, F. E., Ismadji, S., and Ju, Y.-H., 2014). 2. antibacterial activities (Rattanasena, P., 2012).

Plant reproductive biology focuses on investigating the mechanisms and processes involved in both sexual and asexual reproduction in plants. The field of study may include the examination of pollination methods, gene flow, genetic, variation and the spread of propagules both without and within populations (Simpson, M. G., 2019). The reproductive system covers the various events and characteristics associated with the activities that take place from pollination to embryo development (Cardoso, J. C. F., Viana, M. L., Matias, R., Furtado, M. T., Caetano, A. P. D. S., Consolaro, H., and Brito, V. L. G. D., 2018).

Reproductive biology is an important information for conservation and agricultural practice. Understanding of biological information of *L. geoffrayi* including blossoming, fruiting, breeding systems and pollination are the main factors that enables plant to endure in the nature. Moreover, promoting the threatened plant species as an agricultural crop is an optional conservation practice. So, I am interested to study

and reveal more information about floral phenology, breeding system, pollination, and propagation via seed and tissue culture of *L. geoffrayi* which is a native plant in Thailand to understand its biological information. Additionally, it is interesting to compare the reproductive biology of *L. geoffrayi*, a native plant and *L. aromatica*, which is exotic and cultivated plant in Thailand to understand their life for applying to their conservation and agricultural management.

1.2 Research objectives / Purposes of the study

3.1 To compare the floral morphology, floral phenology, pollination, and breeding system of *Limnophila aromatica* and *L. geoffrayi*.

3.2 To study seed germination and seed dormancy after seed pre-treatment of *L. aromatica* and *L. geoffrayi*.

3.3 To study the effect of 6-benzylaminopurine (BAP) on the shoot generation of *L. geoffrayi*.

1.3 Scope and limitations

I am interested in promoting *L. geoffrayi* as ornamental plot plant and an agricultural crop, which has never been done before. The basic information on reproductive and reproduction is the key information to fulfill my interest. Thus, this study is focused on the reproductive biology and reproduction of *L. geoffrayi* population in Thailand. In addition, *L. aromatica* is selected for comparative study because it is similar species based on morphology and traditional use. This study then shall be compared the reproductive biology of both species for (1) floral morphology, (2) floral phenology, (3) pollination, and (4) breeding system to understand more about their life. Additionally, I examine (5) seed germination to find out the suitable seed germination practice and to answer if it can be kept via seed banking or not and (6) the effect of BAP to shoot regeneration of *L. geoffrayi* nodes *in vitro* to find out the better practice of cloning propagation. I exclude the effect of BAP on its shoot generation of *L. aromatica* because it has been done by Dogan, M. (2019). Moreover,

L. aromatica is easily propagated by cutting but *L. geoffrayi* has never succeeded in asexual reproduction before. The scope of this study is shown in Figure 1.1.

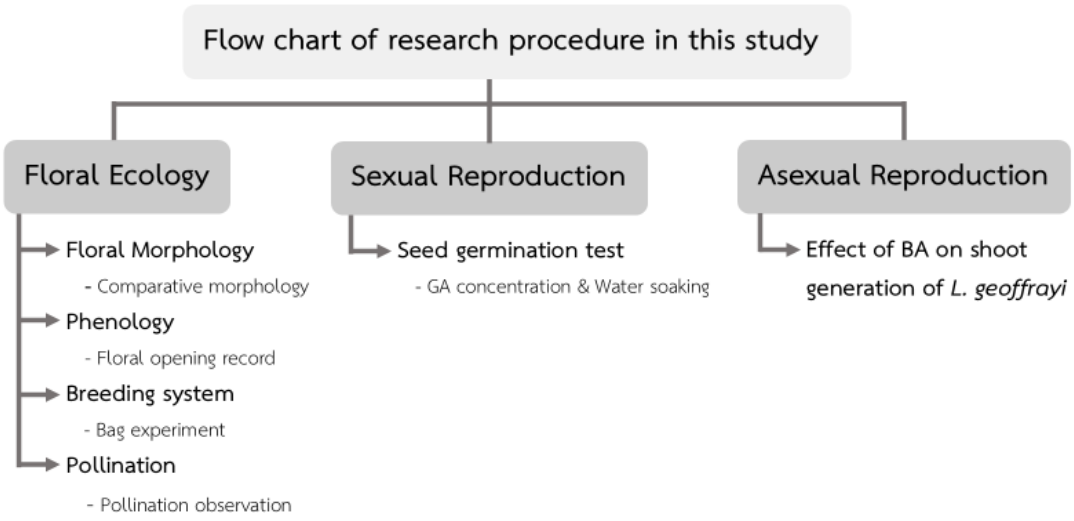

Figure 1.1 Flow chart of research procedure in this study.