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Effect of Temperature on Seed Germination and Seedling Growth in Medicinal Plants of Campanulaceae

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ABSTRACT

The objective of this study is to investigate morphological characteristics of seeds and effects of environmental factors such as light and temperature on the germination and seedling growth of *Adenophora triphylla* var. japonica, *Codonopsis lanceolata, Platycodon glandiflorum*, Which belongs to Campanulaceae and useful for on oriental medicine materials. Seed shape of *Codonopsis lanceolata* is Elliptic. *Platycodon glandiflorum* is Oblong. Color of seed coats varied from yellow to dark brown. Seed size of *Adenophora triphylla* var. japonica is 1.37mm in length, 0.69mm in width. One thousand-seed weight of *Adenophora triphylla* var. japonica is 258mg. Seed size of *Codonopsis lanceolata* is 4.45mm in length, 2.11mm in width. One thousand-seed weight of *Codonopsis lanoceolata* is 1,278mg. Seed size of *Platycodon glandiflorum* is 2.31mm in length, 1.10mm in width. One thousand-seed weight of *Platycodon glandiflorum* is 988mg. Optimum temperatures for seed germination and seedling growth range from 20 to 25℃.

Key words **:** Campanulaceae, seeds, Morphological characteristics, germination light, temperature

INTRODUCTION

Increasing concerns about human's health with improvement of their living standard, consumption of oriental medicinal plants is continually increased and their import from China also is increased year by year. In most recent, statistical data indicated that the most of the imported medicinal plants belong to Umbelliferae and Campanulaceae species (Lee, 1996).

Campanulaceae plants are mainly annual or perennial herbaceous but nerely woody. The leaves are alternate. The inflorescence is bisexual and shape of bell.

Campanulaceae medicinal crops have low germination ability under natural condition. The plants grow naturally throughout the temperate area of the Northern Hemisphere. Nearly 50 genus and 650 species of Campanulaceae are distributed the world over, and about 8 genus 13 species of them are found in the Korean peninsula(Lee et al., 1997). The most common and abundant species are *Adenophora triphylla* var. japonica, *Codonopsis lanoceolata* and *Platycodn glandiflorum.*

Germination capacity of seeds is strongly influenced by environmental factors such as temperature, water stress and interactions of each environmental factors(McGinnies, 1960; Tadmor et al., 1969). Light is

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required in some cases. The seed germination promoted at alternating temperature than at constant temperature. However, some crop plants have similar germination under alternating and constant temperature.

A little information is available for environmental influences on germination of *Adenophora triphylla* var. japonica, *Codonopsis lanoceolata* and *Platycodn glandiflorum* in Campanulaceae plants.

The purpose of this study was to determine optimum temperature for improving seed germination and promoting early seedling growth of *Adenophora triphylla* var. japonica, *Codonopsis lanoceolata* and *Platycodn glandiflorum.*

MATERIALS AND METHODS

1. Morphological characteristics of seeds in medicinal plants of Campanulaceae

Adenophora triphylla var. japonica, *Codonopsis lanoceolata* and *Platycodn glandiflorum* were used as test plants. Morphological characteristics including size, length, width, shape, 1000-seed weight, color, and pattern were measured.

2. Seed germination and growth variation in medicinal plants of Campanulaceae by environmental stress.

Effect of temperature on seed germination and seedling growth seeds of *Adenophora triphylla* var. japonica, *Codonopsis lanoceolata* and *Platycodn glandiflorum* were obtained from a field near Hamyang Medicinal Plant Experiment Station of Kyungnam Agricultural Research and Extension Services in October 2001 and 2002 and then stored at 4℃ until used. Two layers of Whatman No.1 filter paper were placed in petri dish then 3㎖ of distilled water were pipetted onto the filter paper. Seeds were imbibed in distilled water for 24 hours at 20℃ and rinsed in new tap water at 12hour intervals. One hundred seeds were evenly placed on the wetted paper in each 9cm petri dish. The petri dishes were separately placed in growth chambers programmed at different temperatures. Temperatures tested were 5, 10, 15, 20, 25, 30, 35, and 40℃, respectively. The number of germinated seeds was determined at 8 weeks after seeding and calculated to percent germination for analysis. Plant height and number of leaf were measured at 8 weeks after germination and represented as 'bad', 'moderate', 'good', and 'excellent' on the basis of the data. Germination experiments were conducted following the procedure of "Research Investigation Standard of Agriculture" provided by Rural Development Administration(R. D. A.,1989). The experiment was conducted with 3 replicates.

RESULTS AND DISCUSSION

1. Morphological characteristics of campanulaceae seeds in medicinal plants

Seed shape of *Adenophora triphylla* var. japonica is ovate. *Codonopsis lanceolata* is elliptic. *Platycodon glandiflorum* is oblong. The results were supported by earlier report of Lee et al. (1997) that Campanulaceae plants forms many seeds as a capsule and their seeds are

Table 1. Morphological characteristics of seeds in medicinal plants of umbelliferae

Species	Shape	Color	Length(mm)	Width(mm)	1,000-seed weight(mg)
Adenophora triphylla var. japonica	Ovate	Yellowish brown	1.37	0.69	258
Codonopsis lanoceolata	Elliptic	Brown	4.45	2.11	1,278
Platycodn glandiflorum	Oblong	Yellowish brown	2.31	1.10	988

elliptic, oblong or ovate.

Color of seed coats varied from yellow to brown. Seed size was ranged from 1.37 to 4.45mm in length and from 0.69 to 2.11mm in width.

One thousand-seed weight of *Adenophora triphylla* var. japonica was 2580mg, *Codonopsis lanceolata* was 1,278mg and *Platycodon glandiflorum* was 988mg. The results were supported by earlier report of Choi and Chon(2000) that 1000-seed weight of *Adenophora triphylla* var. japonica was lowest and *Codonopsis lanceolata* highest in Campanulaceae.

2. Germination degree of campanulaceae seeds in medicinal plants

Germination rate of *Adenophora triphylla* var. japonica was 74%(highest) at 25℃, over 70% between 20 and 25℃, and minimum by 12%(lowest) at 5℃. *Codonopsis lanceolata* was 90%(highest) at 25℃, over 89% between 20 and 25℃ , and minimum by 34%(lowest) at 5℃. *Platycodon glandiflorum* was 88%(highest) at 25℃, over 84% between 20 and 25℃, and minimum by 38%(lowest) at 5℃. Germination percent for *Codonopsis lanceolata* was highest and *Adenophora triphylla* var. japonica was lowest in Campanulaceae plants. This result indicates that optimum temperature for seed germination of was between 20 and 25℃.

They were well germinated between 20 and 25℃ but were poorest germination at 5℃ Choi and Lee (1994) reported that temperatures ranged from 20 to 25℃ improved seed germination of medicinal plants. However, it is thought that more in-depth experiments on effects of alternating temperatures would needed.

3. Early seedling growth of campanulaceae three species in medicinal plants

Plant height and number of leaf of medicinal plants tested were adversely affected at very low temperature. Seedling growth of *Adenophora triphylla* var. japonica, was poorest at 5℃, intermediate between 15 and 20℃, and optimized at 25 and 30℃, respectively. Early seedling growth of campanulaceae plants was maximized at 25℃. Maximum growth for *Codonopsis lanceolata* and *Platycodon glandiflorum* occurred between 20 and 25℃ and at 30℃. However their

Table 2. Effect of temperature on seed germination of medicinal plants

Species	Germination(%)							
	5℃	10℃	15℃	20℃	25℃	30℃	35℃	40℃
Adenophora triphylla var. japonica	12b*	15b	28b	70b	74b	51b	42b	20a
Codonopsis lanceolata	34a	62a	71a	89a	90a	72a	63a	27a
Platycodon glandiflorum	38a	59a	66a	84a	88a	70a	59a	23a

*Means followed by the same letters indicate are not significantly different at the 5% level

Table 3. Effect of temperature on seedling growth of medicinal plants

Species	Degree of early growth							
	5℃	10℃	15℃	20℃	25℃	30℃	35℃	40℃
Adenophora triphylla var. japonica	+[x)]	+	++	+++	++++	+++	++	+
Codonopsis lanoceolata	+	++	++	+++	++++	+++	++	+
Platycodn glandiflorum	+	++	++	+++	++++	+++	++	+

x) +: bad, ++: moderate, +++: good, ++++: excellent

growth was poor at 5℃. Choi and Yun (2002) reported that temperatures ranged from 20 to 25℃ and improved seedling growth of campanulaceae in medicinal plants.

It is considered that optimum temperature for seed germination and seedling growth of *Adenophora triphylla* var. japonica, *Codonopsis lanceolata, Platycodon glandiflorum* in campanulaceae plants ranged from 20 to 30℃ and especially temperature at 25℃ improved seeding growth. However, it was thought further detail researches on effects of other environmental factors such as light including light intensity, light quality, and photo period, and fertilization.

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