

Temperature Effect on Seed Germination and Seedling Growth of Medicinal Umbelliferae Plants

Seong-Kyu Choi and Sang-Uk Chon¹⁾

Department of Oriental Medicine Resources, College of Nature Science, Suncheon National University, Korea

¹⁾Department of Agronomy, University of Missouri-Columbia, USA

ABSTRACT

Umbelliferae medicinal crops have low germination under natural condition. Special objective of this study is to investigate morphological characteristics of seeds and effects of environmental factors such as light and temperature on their germination and seedling growth in Umbelliferae plants, using them as oriental medicine materials. Fruits of Umbelliferae are bi-partite type and form 2 seeds. Their oil canals and funiculus or carpaphore has apparently specific shape. Seed shape of *Buplerum falcatum*, *Ligusticum acutilobum* and *Foeniculum vulgare* are oblong, *Ledebouriella seseloides*, *Angelica dahurica*, *Angelica gigas* elliptic, and *Ostericum koreanum* ovate. Color of seed coats varied from yellow to dark brown. Seed size was 3.2 to 6.9 mm in length, 1.7 to 4.9 mm in width. One thousand-seed weight of *Buplerum falcatum* was lowest(at 1,660 mg) and *Ledebouriella seseloides* and *Angelica gigas* were relatively highest(at 3,970 mg) having larger size than any others. Optimum temperatures for seed germination and seedling growth ranged from 20 to 25° C and especially temperature at 25° C improved seed germinations of *Ledebouriella seseloides*, *Angelica dahurica* and *Ligusticum acutilobum* regardless of light condition.

Kew words : Umbelliferae, Morphological characteristics, seeds, medicinal plants, Early growth

INTRODUCTION

Increasing concerns about human's health with improvement of their living standard, consumption of oriental medicinal stuffs is continually increased and their import from China also is steadily increased. In most recent, statistical data indicated most of the imported medicinal stuffs belong to Umbelliferae medicinal plants.

Umbelliferae plants are mainly annual or perennial herbaceous but merely woody. The leaves are alternate and compound dividing pinnately 1 to 3 times. The petiole envelops stems in bundle shape. The stems are hollow and have nodes. The inflorescence is small, umbel or umbellulac, and bisexual. The ovary is inferior and has 2 parts. The plants grow naturally throughout the temperate area of the Northern Hemisphere. Nearly 125 genus and 2,900 species of Umbelliferae are distributed the world over(Lee et al., 1997), and about

Corresponding author: **Seongkyu Choi**, Department of Oriental Medicine Resources, College of Natural Science, Suncheon National University, 315 Maegokdong, Suncheon 540-742, Korea; E-mail: skchoi@suncheon.ac.kr

34 genus 85 species of them are found in the Korean peninsula. The best known of these and probably most abundant are *Buplerum falcatum*, *Ligusticum acutilobum* and *Foeniculum vulgare*, *Anethum graveolens*, *Ledebouriella seseloides*, *Angelica dahurica*, *Angelica gigas*, and *Ostericum koreanum*.

Germination capacity of seeds is strongly influenced by environmental factors such as temperature and water stress, which may interact in their effect (McGinnies, 1960; Tadmor et al., 1969). Light is required in some cases. Germination of most of plant was better at alternating temperature than at constant temperature. However, some crop plants have similar germination under alternating and constant temperature. Most of Umbelliferae plants are growing naturally and have low germination under natural environment due to heredity with wild character.

The purpose of this study was to determine optimum temperature for improving seed germination and early seedling growth of Umbelliferae plants. Little information is available for environmental influences on germination of Umbelliferae plants.

MATERIALS AND METHODS

Morphological characteristics of Seeds in medicinal plants of umbelliferae.

Buplerum falcatum, *Ligusticum acutilobum*, *Foeniculum vulgare*, *Ledebouriella seseloides*, *Angelica dahurica*, *Angelica gigas*, and *Ostericum koreanum* were used as test plants. Morphological characteristics including size, length, width, shape, 1000-seed weight, color, and pattern were measured.

Seed Germination and growth variation in medicinal plants of umbelliferae by environmental stress.

Effect of Temperature on Seed Germination and Seedling Growth Seeds of *Angelica dahurica*,

Ligusticum acutilobum and *Ledebouriella seseloides* were obtained from a field near Hamyang Medicinal Plant Experiment Station of Kyungnam Agricultural Research and Extension Services in October 1997 and 1998 and then stored at 4°C until used. Two layers of Whatman No.1 filter paper were placed in petri dish then 3ml of distilled water were pipetted onto the filter paper. Seeds were imbibed in distilled water for 24 hours at 20°C 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°C, respectively. Number of germinated seeds was determined at 8 weeks after seeding and transformed 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. When the F-test was significant ($p < 0.05$) means were separated on the basis of Duncan's multiple range test (DMRT) at the 0.05 probability level. Germination experiments were conducted following the procedure of "Research Investigation Standard of Agriculture" provided by Rural Development Administration. The experiment was conducted with 3 replicates.

RESULTS AND DISCUSSION

Morphological Characteristics of Seeds

Seed shape of *Buplerum falcatum*, *Ligusticum acutilobum* and *Foeniculum vulgare* were oblong, *Ledebouriella seseloides*, *Angelica dahurica* and *Angelica gigas* were elliptic and *Ostericum koreanum* was ovate. The results were supported by earlier report of Lee et al. (1997) that Umbelliferae plants forms 2 seeds as a schizocarp and their seeds are elliptic, oblong or ovate.

Table 1. Morphological characteristics of seeds seven species in Umbelliferae

Species	Shape	Color	Length (mm)	Width (mm)	1,000-seed weight (mg)
<i>Ostericum Koreanum</i>	Elliptic	Brown	6.3	3.2	2,980
<i>Ledebouriella seseloides</i>	Ovate	Brown	6.1	3.1	3,970
<i>Angelica dahurica</i>	Ovate	White-yellow	6.9	4.9	2,580
<i>Buplerum falcatum</i>	Oblong	Brownish black	3.8	1.9	1,660
<i>Ligusticum acutilobum</i>	Oblong	Brown	3.2	2.1	2,190
<i>Angelica gigas</i>	Ovate	Yellowish brown	6.9	4.9	3,970
<i>Foeniculum vulgare</i>	Oblong	Brown	5.6	1.7	3,260

Color of seed coats varied from yellow to dark brown. Seeds of *Ostericum koreanum*, *Ledebouriella seseloides*, *Ligusticum acutilobum* and *Foeniculum vulgare* were mainly brown, *Angelica dahurica* was white-yellow, *Buplerum falcatum* was brownish black, and *Angelica gigas* was brown, respectively.

Seed size was ranged from 3.2 to 6.9mm in length and from 1.7 to 4.9mm in width. Seed size of *Buplerum falcatum* and *Ligusticum acutilobum* were smallest, the length were 3.8 and 3.2mm, and the width 1.9 and 2.1 mm, respectively, while seed size of *Ledebouriella seseloides* and *Angelica gigas* were largest and over 6mm in length and over 3mm in width. One thousand-seed weight of *Buplerum falcatum* was lowest(at 1,660 mg) and *Ledebouriella seseloides* and *Angelica gigas* relatively highest(at 3,970 mg).

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These results corroborate report that in the study on morphological characteristics of Umbelliferae seeds 1000-seed weight of *Buplerum falcatum* was lowest and *Angelica gigas* highest.

Germination degree

Germination rate of *Ledebouriella seseloides* was 92%(highest) at 25 °C, over 90% between 20 and 25 °C, and minimum by 74%(lowest) at 5 °C. This result indicates that optimum temperature for seed germination of *Ledebouriella seseloides* was between 20 and 25 °C. Germination percent for *Angelica dahurica* and *Ligusticum acutilobum* were similar to *Ledebouriella seseloides*.

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

Medicinal plants	Germination(%)							
	5 °C	10 °C	15 °C	20 °C	25 °C	30 °C	35 °C	40 °C
<i>Ledebouriella seseloides</i>	74a*	82a	85a	91a	92a	89a	87a	50a
<i>Angelica dahurica</i>	63ab	71ab	83a	89a	88a	85a	73ab	51a
<i>Ligusticum acutilobum</i>	57b	64b	63b	65b	68b	67b	61b	43a

* 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

Medicinal plants	Degree of early growth ^{x)}							
	5℃	10℃	15℃	20℃	25℃	30℃	35℃	40℃
<i>Ledebouriella seseloides</i>	+	++	++	+++	++++	+++	++	+
<i>Angelica dahurica</i>	+	++	++	+++	++++	++++	++	+
<i>Ligusticum acutilobum</i>	+	++	++	+++	++++	++++	++	+

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

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

Early seedling growth

Plant height and number of leaf of medicinal plants tested were adversely affected at very low temperature. Seedling growth of *Ledebouriella seseloides* was poorest at 5°C, intermediate between 15 and 20°C, and optimized at 20 and 30°C, respectively. Early seedling growth of Umbelliferae plants was maximized at 25°C. Maximum growth for *Angelica dahurica* and *Ligusticum acutilobum* occurred between 20 and 25°C and at 30°C. However their growth was poor at 5°C.

Therefore it is assumed that optimum temperature for seed germination and seedling growth of Umbelliferae plants ranged from 20 to 25°C and especially temperature at 25°C 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 photoperiod, and fertilization.

This study will be available for improving germination capacity, for better understanding the mechanism of germination of native Umbelliferae plants and for obtaining fundamental information for more in-depth studies.

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