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The Effect of Different Temperatures and Durations on the Dormancy Breaking of Black Locust (*Robinia pseudoacacia* L.) and Honey Locust (*Gleditsia triacanthos* L.) Seeds

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Abstract

In order to break seed dormancy, different temperatures (20, 30, 40, 50, 60, 70, 80 and 90° C) and durations (10, 20 and 30 minutes) were applied to black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditsia triacanthos* L.) seeds, in the Seed Laboratory of Dicle University - Faculty of Agriculture in 2009. According to the research results, the highest germination rate for black locust seeds was obtained in the case of 90° C for 30 minutes pre-treatment (94.5%), whilst the lowest value was obtained for the 40° C for 10 minutes pre-treatment (7.5.0%). For honey locust the highest value was obtained at 50° C for 30 minutes (25.5%) and the lowest value was obtained in the case of control sample (6.8%).

Keywords: black locust, honey locust, dormancy breaking, seeds

Introduction

Black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditsia triacanthos* L.) originated from North America and were spread to large areas throughout the world for various purposes (Cronk and Fuller, 1995; Singh *et al.*, 1991). These species are legume trees which are drought resistant, light lover, thorny and show moderate to fast growth speed (Danso *et al.*, 1995; Burner *et al.*, 2005). The wood of these species has various utilizations: firewood, sawn timber, poles for fences, wind-breaking, erosion control, forage crops and the species are important in beekeeping (Burner *et al.*, 2005; Singh *et al.*, 1991; Sefik, 1995).

In general, the production of black locust (*R. pseudoacacia* L.) and honey locust (*G. triacanthos* L.) is from seeds. Without pre-treatments seed germination rate is low because of the physiological dormancy induced by the hard seed coats (Geneve, 2008, Singh *et al.,* 1991). In order to increase germination rate, various heating pre-treatments are applied: Masaka and Yamada (2009) obtained the highest germination rates (45.3%) for their heat shock application to black locust seeds by keeping them at 60°C for 3 hours. Bolin (2009) in his heat applications to *Galactia regularis (Fabaceae), Lupinus perennis (Fabaceae)* and *Rhus copallinum* seeds, obtained the highest germination values by keeping the seeds at 80°C (*G. regularis* and *L. perennis*) and 90°C (*R. copallinum*) for 10 minutes. Khadduri *et al.* (2002), by soaking black locust (*R. pseudoacacia*) seeds in hot water (98°C) for 24 hours, achieved 41% germination rate. Basbag *et al.* (2009) have obtained seed germination rates between 8.39 and 29.52% for caper (*Capparis ovata*) seeds by applying different temperatures and durations.

The aim of this study is to assess the increase in the germination rates of black locust and honey locust seeds by applying pre-germination treatments of different durations and temperatures.

Materials and methods

The study was performed in 2009 in Dicle University - Faculty of Agriculture Seed Laboratory. Black locust (*R. pseudoacacia*) and honey locust (*G. triacanthos*) seeds were collected from trees within the campus of Dicle University (elevation: 700 m, latitude: N37°55´27.3″ and longitude: E40°17´05.1″), on the 21st of November 2009. Seeds separated from pods were washed in water and empty, puny ones were removed. The weight of 1000 seeds was 15.6 g for black locust and 165.7 g for honey locust.

In order to break dormancy, seeds were kept within the drying cabinet (ULM-800) in different temperature environments (20, 30, 40, 50, 60, 70, 80 and 90°C) and for different durations (10, 20 and 30 min.). Germination experiments were performed in Petri dishes (using paper towels and distilled water) and for each treatment 50 seeds were used with 4 replications. The Petri dishes were placed in a germination cabinet (Growth Chamber, GC 400), at 25°C temperature and 70% humidity, and the cabinet was programmed to be under light for 12 hours (flourescent, 1500 Lux) and 12 hours under darkness. The 4 replications of the no-pretreatment control sample were placed in the germination cabinet, under the same conditions. The ger-

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minated seeds were counted periodically starting from the 7th day until the 30th day. Germination percentage (%) was calculated according to the below formula (Pieper, 1952);

$$GR = \frac{(n1 \times t1) + (n2 \times t2) + (n3 \times t3) + (ni \times ti)}{T}$$

GR: Germination (%)
ni: Number of count days
ti: Number of germinated seeds at each count
T: Total number of germinated seeds

The germination values for each pre-treatment were compared, after angle transformation (Zar, 1999) with MSTATC statistical package software (Michigan State University, East Lansing, MI) according to the Randomised Blocks Design.

Results and discussion

Different temperatures and different durations of the pre-germination treatments applied to black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditsia triacanthos* L.) seeds had a statistically different effect on seed germination (Tab. 1 and 2). For black locust seeds, the average germination values varied between 7.5% and71.8%, according to the different temperatures applied during the pre-germination treatment. The highest rate of germination was obtained at 90°C and the lowest rate was obtained for the control sample (no treatment). Considering the dual effect of temperature and duration the germination values varied between 7.5% and 94.5%.The highest germination value was obtained at 90° C and 20 minutes duration, whilst the lowest germination value was obtained for the control sample (7.5%).

For honey locust seeds, the average germination values varied between 6.8% and 19.3%, according to the different temperatures applied. The highest percentage of germina-

Tab. 1. The effect of different temperatures and durations on germination rates of black locust (*Robinia pseudoacacia* L.) seeds

Black locust (*R. pseudoacacia* L.)							
Temperature (°C)	Duration (minute)						Mean
	10		20		30		
Control	7.5	jk	7.5	jk	7.5	jk	7.5
20	11.5	h-j	15.0	h-j	15.5	g-ı	14.0
30	11.5	j	12.0	j	13.5	h-j	12.3
40	9.5	k	12.0	ı-j	11.5	ı-j	11.0
50	27.0	c	33.5	b	21.0	de	27.2
60	22.5	de	20.5	fg	23.5	d	22.2
70	15.5	h-j	17.5	f-h	16.5	f	16.5
80	16.5	fg	19.0	e	32.5	b	22.7
90	30.5	c	94.5	a	90.5	a	71.8
Average	16.9		25.7		25.8		
LSD (p<0.05)			2.06				
CV			5.95				

Tab. 2. The effect of different temperatures and durations on germination rates of honey locust (*Gleditsia triacanthos* L.) seeds

Honey locust (*G. triacanthos* L.)							
Temperature (°C)	Duration (minute)						Mean
	10		20		30		
Control	6.8	o	6.8	o	6.8	o	6.8
20	12.0	h-l	13.0	g-j	13.5	e-h	12.8
30	14.0	g-j	14.5	f-ı	18.5	b-d	15.7
40	10.5	no	13.5	c-f	20.0	bc	14.7
50	15.0	g-k	17.3	d-g	25.5	a	19.3
60	17.0	c-f	18.0	c-e	19.5	ab	18.2
70	11.0	ı-l	9.5	j-m	11.5	g-k	10.7
80	10.0	l-n	11.5	j-m	9.5	k-n	10.3
90	8.0	no	9.3	m-n	13.5	g-j	10.3
Average	11.6		12.6		15.4		
LSD (p<0.05)			2.35				
CV			8.40				

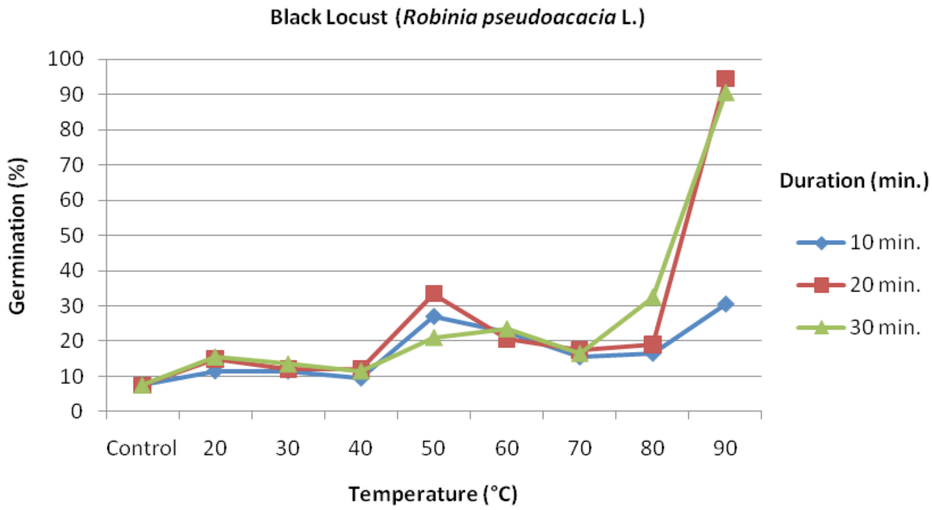

Fig. 1. The effect of different temperatures and durations on germination rates of black locust (*Robinia pseudoacacia* L.) seeds

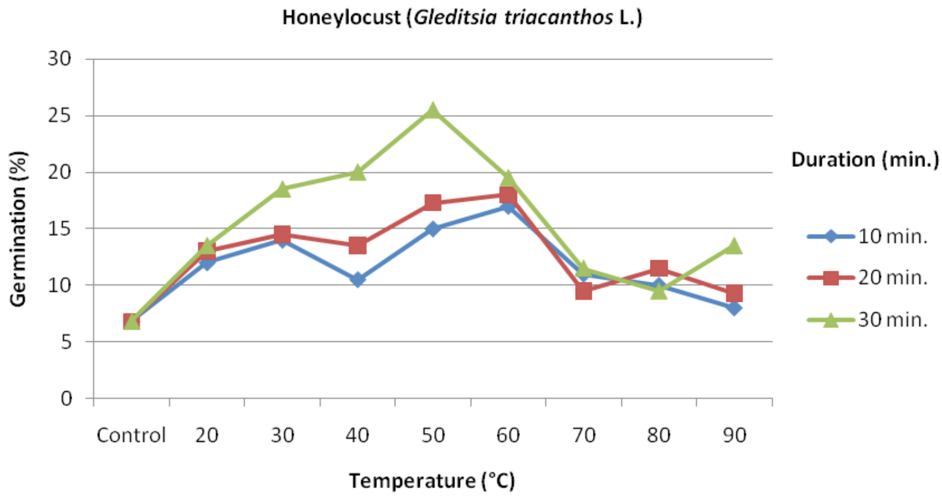

Fig. 2. The effect of different temperatures and durations on germination rates of honey locust (*Gleditsia triacanthos* L.) seeds

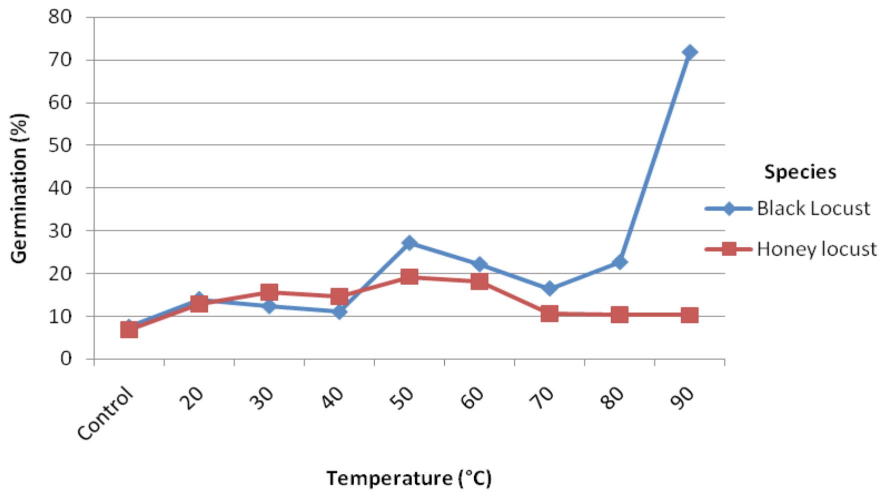

Fig. 3. The effect of different temperatures and durations on germination rates of black locust (*Robinia pseudoacacia* L.) and honey locust (*Gleditsia triacanthos* L.) seeds

tion was obtained at 50°C and the lowest percentage was obtained when no pre-germination treatment was applied. The germination values varied between 6.8% and 25.5% when both temperature and duration were considered. The highest germination value was obtained at 90°C and 30 minutes of duration; the lowest germination value was obtained for the control sample.

Conclusions

Despite the fact that there are no published studies in the region on the same species, relatively similar results to our findings were obtained in similar studies undertaken for different species of the same family (Bowen and Eusebio, 1981; Bolin, 2009) and on different species of different families (Basbag *et al.*, 2009).

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