African Journal of Biotechnology Vol. 8 (21), pp. 5838-5841, 2 November, 2009
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB09.1110
ISSN 1684–5315 © 2009 Academic Journals

Full Length Research Paper

The effects of different warm stratification periods on the seed germination of some *Rosa* taxa

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Accepted 11 September, 2009

In this study, the effects of different warm stratification periods on the seed germination of some *Rosa* species such as *Rosa heckellana* ssp. *vanheurckiana*, *Rosa canina*, *Rosa pulverelanta* and *Rosa dumalis* naturally grown in the Van region were investigated. In 2007, seeds of these species were kept at 25°C warm stratification for 10, 11 and 12 weeks, and then transferred to 5°C for cold stratification till the initiation of germination. Germination response to treatments of *R. heckellana* ssp. *vanheurckiana* seeds was different compared to the other species. The seeds of *R. heckellana* ssp. *vanheurckiana* germinated in a short time (when they kept in warm stratification followed by cold stratification between 1 - 3 weeks). The seeds of the other species required 5 months of cold stratification after warm stratification to overcome seed dormancy. The overall germination percentage were 18.80% in *R. canina,* 13.80% in *R. pulverelanta and* 13.53% in *R. dumalis* at 25°C of warm stratification followed by 5°C cold stratification. We determined that for these three taxa, the most appropriate method of stratification was 11 week warm stratification followed by cold stratification.

Key words: *Rosa* ssp., germination, warm stratification, cold stratification, Van Lake.

INTRODUCTION

In recent years, scientific studies justified that rose hip has very attractive fruit characteristics both for human health (Ercisli, 2007). However the taxa are under threats because of human activities in particular Eastern part of Turkey (Ercisli, 2004).

Some rose taxa for example *Rosa Rosa villosa* has unique genetic characteristics among plant kingdom therefore they can be propagated by seeds to obtain homogeny plant materials. Therefore seed propagation can be the easiest method for these two species (Ercisli et al., 2007). However the seed germination within these taxa are not easy because of endogenous and exogenous dormancy (Baskin and Baskin, 1998; Uggla, 2004; Hosafcı at al., 2005; Alp at al., 2008; Werlemark, 2009).

Pericarp and endocarp thickness of the rose seed- an achene- can limit germination. This thickness is controlled by environmental factors, especially temperature during the maturation of achiness and genetic factors (De Vries and Dubois 1987; Gudin at al., 1990). The germination in rose seeds varies widely from year to year. High temperature and excessive light during this period result in considerably higher germination compared with low temperature and less light (Gudin et al., 1990; Werlemark at al., 1995).

Rose achene is surrounded by a thin testa and a hard bony pericarp. To ensure germination, it is necessary to weaken the pericarp by some way, e.g. by acid treatment or supplying high temperature (Gudin et al., 1990; Werlemark et al., 1995). Warm plus cold stratification appears to be another effective method to break dormancy in rose achenes (Semeniuk and Stewart, 1966; Svejda, 1968; Werlemark et al., 1995; Zhou at al., 2009).

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Table 1. Comparison results of germination at different periods of warm stratification.

Time (weeks)	N	Mean	SE Mean	Minimum (%)	Maximum (%)
10	15	13.53 B	3.39	0.00	39.00
11	15	22.80 A	1.99	10.00	36.00
12	15	9.80 B	1.40	4.00	20.00

* The difference between different averages which has different letters is significant ($p < 0.05$).

Table 2. Germination percentage of the descriptive statistics of three-rose-taxa.

Variety	N	Mean	SE Mean	Minimum	Maximum
R. canina	15	18. 80 A	2.96	1.00	39.00
R. pulverelanta	15	13. 80 A	2.81	2.00	36.00
R. dumalis	15	13.53 A	2.43	0.00	34.00

Nybolm (1986) reported that germination of *R. canina* achenes was only 50% when seeds kept 5-6 months at 20°C and 5-6 months at 5°C. Suszka and Bujarska-Borkowska (1987) obtained the best germination in *R. canina* after a period of 16 weeks at 25°C and 16 weeks at 3°C (Werlemark et al., 1995).

The aim of this study is to determine the most appropriate warm stratification period for germination of some *Rosa* taxa.

MATERIALS AND METHODS

The plant materials were *Rosa heckeliana* Tratt. ssp. *vanheurckiana* (Crépin) Ö. Nilsson, *Rosa canina* L., *Rosa pulverelanta* Bieb. and *Rosa dumalis* Bechs. The main fruit characteristics of the taxa are reported in previous published paper (Çelik at al., 2009). The fruits of taxa were collected during the technologically maturated stage occurred in October 2007. Seeds were removed, cleaned and dried in the shadow. A total 500 seeds (5 replicate per taxa) were divided into groups and placed a plastic bag including pumice medium. The three different warm stratification periods (10, 11 and 12 week) at 25°C were applied. After keeping the seeds at 25°C in the climate chamber for 10, 11 and 12 weeks, seeds were transferred in plastic bags including pumice medium and left at 5°C. After complete dormancy, seeds were transferred to climate room at 22°C for germination.

Statistical analysis

The data were analyzed using two-way (factorial) ANOVA. Significant differences were used to determine Duncan's Multiple Range Test. For statistical analysis of the date, the angel transformation values to narrow the variation of the date were used (Sokal and Rohlf, 1995). Statistical calculations were carried out in MINITAB statistical package program (Anonymous, 2003).

RESULTS

The seeds of *R. canina, R. pulverelanta and R. dumalis* stratified for 10 weeks in warm temperature germinated after 21 week-long cold-stratification. Those seeds which were stratified in warm temperature for 11 weeks germinated after 20 weeks cold-stratification. Similarly, those seeds which were stratified in warm temperature for 12 weeks germinated after 19 weeks cold stratify-cation. The seeds of these three species germinated in a total of 31 weeks and germination completed within approximately 7 days.

As stated in Table 1, warm stratification at different periods has statistically led to significant differences in the germination percentage of 3 rose taxa ($p < 0.05$). The average germination percentage of seeds kept in warm stratification for 10, 11 and 12 weeks were 13.53, 22.80 and 9.80%. The highest germination percentage in warm stratification was obtained at the 11 week-long warm stratification (Table 1). The difference between seed germination percentage was not statistically significant between 10 and 12 week-long warm stratification periods.

As it can be seen in Table 2, whilst the best germination average was seen in *R. canina* with 18.80%, average germination rates regarding species of *R. pulverelanta and R. dumalis* were found close to each other but the differences between species have not been found significant.

When examining the interaction between taxa and warm stratification, *R. canina* has the highest germination percentage as 23.40% and followed by *R. pulverelenta* (25.20%) and 19.80% in *R. dumalis* with 11 week-long warm stratification period. However, the interaction between the taxa and warm stratification period was not found statistically significant ($p < 0.05$).

On the other hand *R. heckellana* ssp. *vanheurckiana* showed different germination pattern among taxa. Some seeds of this taxa germinated after 25°C of warm stratification followed by 5°C cold stratification and some of seeds goes back to dormancy. This indicates that *R. heckellana* ssp. *vanheurckiana* has a different pattern of

Table 3. Germination average of the first period of germination of *R. heckellana* ssp. *Vanheurckiana.*

Warm stratification period (weeks)	Germination percentage (%)		
	16 February	21 February	26 February
10	0.2	3.4	16.8
11	0.2	1.6	6.6
12	0.0	0.4	0.8

Table 4. Descriptive statistics for seed germination of *R. heckellana* ssp. *vanheurckiana* in different warm stratification periods.

Time (weeks)	N	Mean	SE Mean	Minimum (%)	Maximum (%)
10	10	18.80	2.49	5.00	31.00
11	10	17.80	3.68	4.00	37.00
12	10	9.00	3.07	0.00	26.00

Table 5. Descriptive statistics for different periods of seed germination of *R. heckellana* ssp. *vanheurckiana.*

Time (weeks)	N	Mean	SE Mean	Minimum (%)	Maximum (%)
1	15	9.73	2.52	0.00	31.00
2	15	20.67	2.16	5.00	37.00

Table 6. Statistics according to week and germination time for 4 types of germination rate used in study.

Time (weeks)	Germination period	N	Mean	Standard Error	Minimum (%)	Maximum (%)
10	1	5	A 20.00 a	4.38	5.00	31.00
	2	5	A 17.60 b	2.84	10.00	26.00
11	1	5	B 8.00 b	1.48	4.00	11.00
	2	5	A 27.60 a	3.26	18.00	37.00
12	1	5	B 1.20 b	0.37	0.00	2.00
	2	5	A16.80 b	3.46	5.00	26.00

germination than the other taxa of *Rosa* ssp.

Seeds of these taxa kept in warm stratification for 10, 11 and 12 weeks began to germinate after 19, 11 and 6 days (Table 3). In addition, seeds kept in warm stratification for 10 weeks continue to germinate rapidly and germination percentage increased up to 16% in 6 days (Table 3).

The average seed germination percentage kept in warm stratification for 10, 11 and 12 weeks were 18.80, 17.8 and 9.00%, respectively (Table 4).

In the first germination period of *R. heckellana* ssp. *vanheurckiana*, the average germination rate was determined as 9.73%. In the second germination period, this rate was found as 20.67% (Table 5). The interaction between germination time and germination period of *R. heckellana* ssp. vanheurckiana was found statistically significant.

The highest germination percentage of seeds has been obtained in 11 weeks and second period of germinations as 27.60%. This is followed by 20% in 10 weeks and first period of germination. The lowest germination rate was obtained in the first period and 12 week-long warm stratification time (Table 6).

The difference between the average of different small letters within the same week is important ($p < 0.05$). Similarly, in the same period of germination the differences between the averages of different capital letters are important ($p < 0.05$).

DISCUSSION

It was determined that 25°C warm stratification period had positive effect on seed germination percentage to eliminate dormancy in *R. canina, R. pulverelanta* and *R. dumalis.* However, the reactions of these taxa towards the germination rates and stratification applications were different. In order to release seed dormancy of these three species, warm stratification followed by 5 month-long cold stratification was required. These results are consistent with the results which Werlemark et al. (1995) obtained.

Germination behaviors of *R. heckellana* ssp. *vanheurckiana* used in the study are different compared to the other taxa. The seeds of *R. heckellana* ssp. *vanheurckiana* began to germinate after a long warm stratification period which was followed by 1-3 week-long cold stratification. In fact, the seed characteristics of the taxa may be different than the other taxa.

It has also been determined that when the seeds of *R. heckellana* ssp. *vanheurckiana* were kept in warm stratification longer than required, the seeds would germinate poorly and go back to dormancy (Table 3). For the re-germination of these seeds, long time cold stratification is required (Table 4). In order to overcome the seed dormancy in *R. heckellana* ssp. *vanheurckiana*, it has been determined that in addition to appropriate stratification temperature, appropriate heat duration is more important compared to other species (Tables 3 and 4). Previously, seeds of some rose taxa were stratified for 3 months at 20°C followed by cold stratification for 3 months at 5°C and consequently germination was obtained between 3.3-18.8% depending on the taxa (Werlemark et al., 1995). The average germination percentage of three taxa used in the study varied from 13.53 to 18.8%. We obtained higher germination percentage than above literature which can be explained by different taxa and environment used.

It can be concluded that seed germination within rose taxa is very difficult because of genetic properties, and warm stratification followed by cold stratification is proven to be an effective method of germination despite having different effects on removing dormancy from seeds.

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