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THE EFFECT OF SEED TREATMENTS ON THE GERMINATION OF DIFFERENT FABACEAE SPECIES OF A NATURAL MEADOW-LIKE ASSOCIATION

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ABSTRACT

The goal of our experiment is to compose a species-rich seed mixture suitable for soil covering in orchard floor management in organic fruit production systems. Besides selection of traditionally used grass and *Fabaceae* species we are focusing on the involvement of local fora elements, of the experiment site, approaching a natural meadow-like association.
Species of the following plant families are involved: Apiaceae, Asteraceae, Rosaceae, Linaceae, Polygonaceae, Dipsacaceae, Fabaceae, Poaceae. Seeds of selected species were tested to determine germination % before seeding, according to MSZ 6354-3:2008 standard in climate cabinet. Seed treatments (vernalisation, scarification) were carried out according to relevant standard.
There were differences in the germination% of commercial and wild collected seed items of *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus corniculatus* L, and *Achillea millefolium* L. The applied seed treatments resulted significant difference between the treated and non-treated seed items most of the tested species related their germination%. For example in case of *Anthyllis vulneraria* L it was effective. Scarification was effective for commercial hard seed species like *Lotus corniculatus* L in our case, but it was not effective for *Agrimonia eupatoria* L.
The aim of the treatments was to select those species which can be seed in the same time, will be easier applied to soil and climatic condition of the experiment site and to determine effect of pre-treatments on germination % of seeds of tested species.

Keywords: seed mixture, Fabaceae, hardseededness, seed germination, seed pre-treatments

1. INTRODUCTION

The application of ground cover plants has numerous advantages in ecological fruit production, where the ground cover represents an important criterion. The most important is the reduction of erosion and deflation effects, the weed management, the preservation and improvement of water and nutrient contents of the soil, and the reduction of nutrient leaching.
In fruit production the application of soil covering living mulch has an important contribution in weed regulation. The emphasis is on the prevention, and to keep the damage under the economic threshold level. To reach that goal it is an often suggested method to apply living or dead mulch, green manure, or to sow weed suppressing plant species. In the same time it is not allowed to use any kind of synthetic products, herbicides, or plastic mulch containing chlorine. [13]
The application of soil covering plant mixtures has advantageous (on soil compaction, structure, protection from erosion, water preservation, host plants for beneficials), and disadvantageous (competition for water and nutrient, host plats for pests) effects on soil properties, and in plant protection.
All of these multiple effect determine the selection of proper plant species fitting into the character of the orchard and ecological features of the site [9]. With the proper selection of the cover plants we can suppress dangerous weed species in the orchard system. [4] International research teams perform works on this field aiming to compose the optimal species assessment of the planted mixture for inter-row, and floor management of orchards. All of these experiments reinforce that application of the soil covering plant species results more positive effect for the orchard than disadvantages. [5]
Composition of suitable mixtures besides selection of traditionally used grass and Fabaceae species we are focusing on the involvement of local flora elements, of the experiment site, approaching a natural meadow-like association. From the local flora elements *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus*

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corniculatus L, and *Achillea millefolium* L, *Anthyllis vulneraria* L, and *Medicago lupulina* L are involved. Considering that species of seed mixtures should be sown in the same time, we have started focusing on those species which have some difficulties in germination. One of these problems is hardseededness, which can happen in *Fabaceae* species, like *Anthyllis vulneraria* L and *Lotus corniculatus* L.
From experiment results of Li, and Hill [8] it is clear that hardseededness is related to seed coat impermeability in *L. corniculatus*. Differences in hardseededness between seed lots appeared not to be caused by differences in their moisture content (range 6.9-7.1 % among seed lots). The percentage of hard seeds in different seed lots showed a trend with more hard seeds being found in more mature seed lots. The authors suggest that incomplete seed coat structure in immature seed lots was often responsible for the lower percentage of hard seeds. [8]
In the case of *Anthyllis vulneraria* L [1] different heat treatment was applied resulted average 10% increase in the germination of the seeds, and decreased the hardseededness of the species by 20-40 % comparing to control. To solve seed hardiness, at least 50°C is needed.
In further literatures temperature plays an important role in breaking seed hardiness and dormancy. From the suggested methods in our experiment we have selected those which can be easier implemented by farmers and growers too, like pre-cooling, pre-chilling and scarification. [6], [3], [2]
According to MSZ 6354-3:2008 standard for seed germination test involves the pre-cooling, pre-chilling treatments of seeds, aiming to increase the germination percentage of them.

2. THE AIM OF THE EXPERIMENT

The aim of the treatments was to select those species which can be sown in the same time, will easier applied to soil and climatic conditions of the experiment site. Further aim was to test the effect of different pre-treatments on influencing germination % of seed of the tested species.

3. MATERIAL AND METHOD

Seed germination test were carried out according to MSZ 6354-3:2008 standard in climate cabinet. Seed treatments (vernalisation: pre-cooling, pre-chilling, and scarification) were carried out according to relevant standard.
Duration of incubation was different: *Anthyllis vulneraria* L was 10 days, *Lotus corniculatus* L was 12 days, *Medicago lupulina* L was 10 days, and *Agrimonia eupatoria* L was 60 days.

Methods of storage and treatments:
1. storage on 20-25°C on room temperature
2. pre-cooling on 5°C 6 weeks
3. pre-chilling on -16°C for 12 weeks
4. scarification – with sandpaper abrade the seed coat
5. pre-cooling on 5°C 6 week + scarification
6. pre-chilling on -16°C 6 week + scarification

Materials: Seed species from the Fabaceae family: *Anthyllis vulneraria* L, *Lotus corniculatus* L, *Medicago lupulina* L originated from commercial seed producers in Hungary.
Wild collected seed items of *Agrimonia eupatoria* L, *Ajuga genevensis* L, *Lotus corniculatus* L, and *Achillea millefolium* L. were also tested according to MSZ 6354-3:2008 standard.
The applied statistical method to evaluate the data of the experiment was one-way ANOVA test along with Games-Howell and Tukey post hoc tests running with IBM SPSS Statistics ver. 22.

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4. RESULTS OF THE TREATMENTS

Germination test of *Anthyllis vulneraria* L can be followed on Fig 1. The figure shows the average number of germinated seeds according to 1, 2, 3, treatments and in relation to storage time on different temperature. Explanation of symbols on the diagrams: lower case letter indicate the significant difference of treatments inside one species according to daily evaluation: a, b, ab and ns.

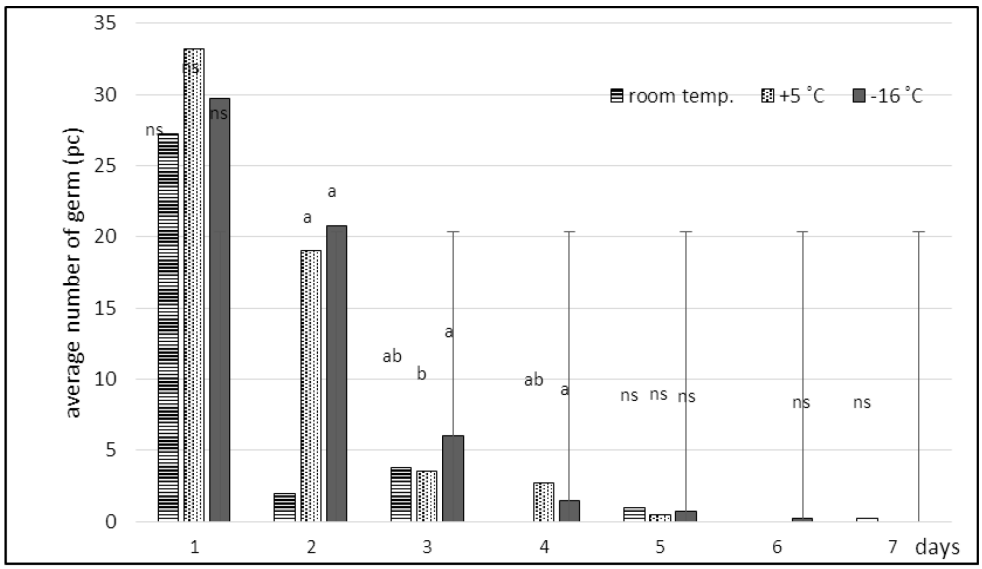

Figure 1. Anthyllis vulneraria L germination test (2016).

Germination test of *Lotus corniculatus* L can be followed on Figure 2. The diagram sows the average number of germinated seeds according to storage and treatments 1, 2, 3 on different temperature.

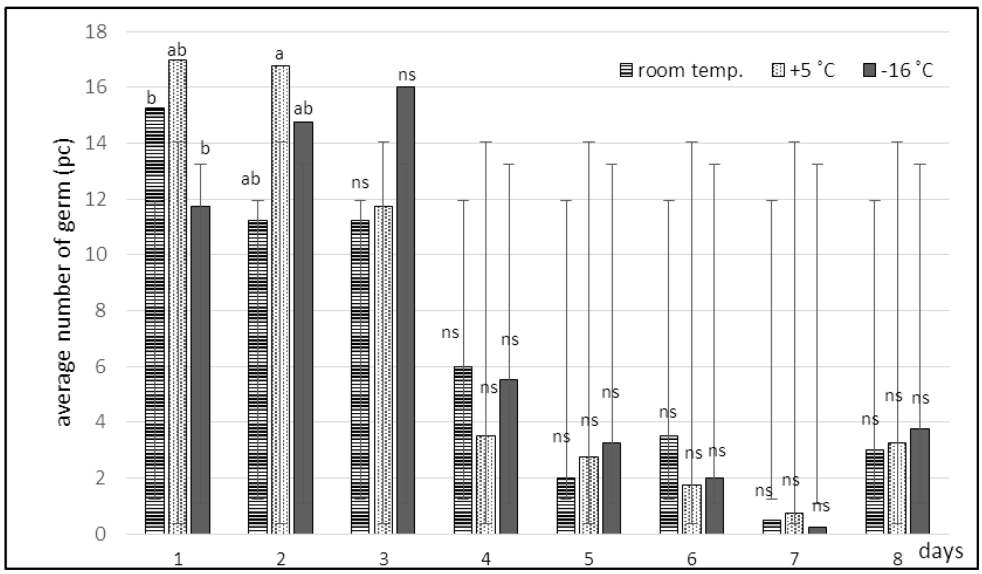

Figure 2. Lotus corniculatus L germination test (2016).

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Germination test of *Lotus corniculatus* L can be followed on Figure 3. The diagram sows the average number of germinated seeds according to storage and treatments 4, 5, 6 on different temperature.

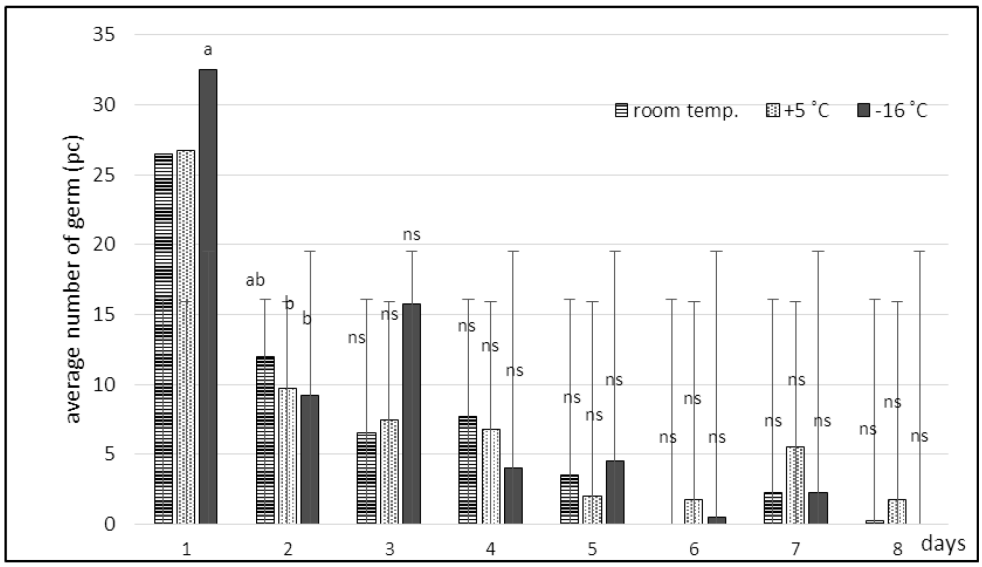

Figure 3. Lotus corniculatus L germination test – after scarification (2016).

Germination test of *Lotus corniculatus* L can be followed on Figure 3. The figure sows the average number of germinated seeds according to storage and treatments 1, 2, 3 on different temperature.

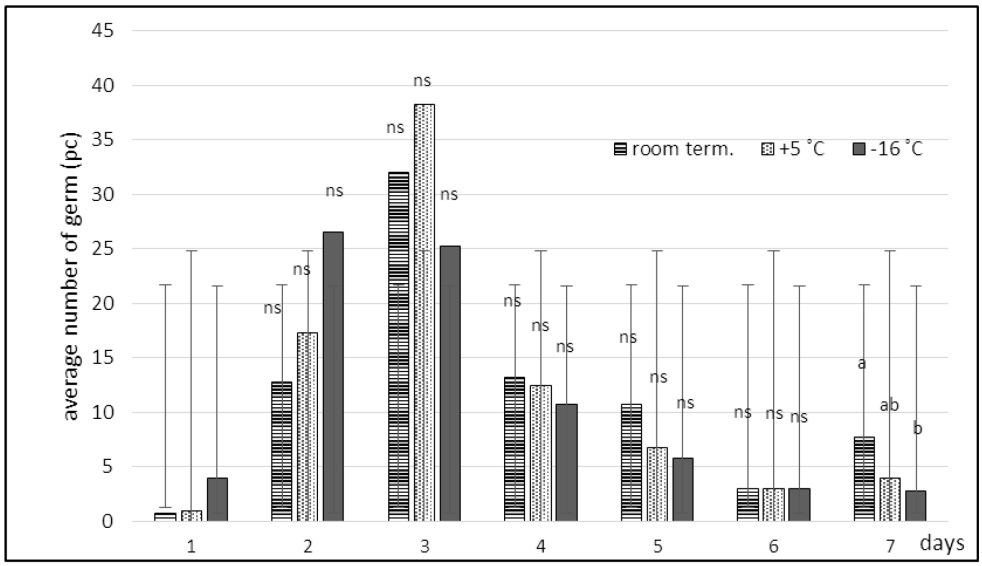

Figure 4. Medicago lupulina L germination test (2016).

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Germination test of *Megicago lupulina* L can be followed on Figure 4. The diagram sows the average number of germinated seeds according to 1, 2, 3 storage and treatments on different temperature.

5. DISCUSSION

5.1. Reaction of species to the treatments

According to post-hoc tests, there were significant difference of the germination % according to different treatments. Considering *Anthillis vulneraria* L the effect of treatment 2. and 3. resulted significant difference comparing to treatment 1. (room temperature).
In the case of *Lotus corniculatus* L treatment 2, and 3 had significantly positive effect on germination, treatment 1. (room temperature) was partly significant.
Treatment 4. 5. and 6. had a positive effect on *Lotus corniculatus* L and the most effective treatment was the 6. pre-chilling and scarification, which significantly divided from treatment 1.
The effect of treatments 1, 2, 3 did not result a significant difference in germination data of *Medicago lupulina* L.

5.2. Effects according to treatments

Treatment 1. (20-25°C room temperature) was most effective on *Lotus corniculatus* L, *Medicago lupulina* L, and less positive effect was on *Anthyllis vulneraria*. Treatment 2. (pre-cooling on on 5°C 6 weeks) was most effective on *Medicago lupulina* L, the other two species also reacted positively but lesser extent. Treatment 3. (pre-chilling on -16°C for 12 weeks) was most effective on *Medicago lupulina* L and on *Anthyllis vulneraria* L. Treatment 4. (scarification) was applied only on *Lotus corniculatus* L resulting higher seed germination, similarly to treatment 5. (pre-cooling on 5°C 6 week + scarification). Treatment 6. (pre-chilling on -16°C 6 week + scarification), was the most effective on *Lotus corniculatus* L. significantly divided from treatment 1.

Table 1. Differences between treatments according to species (signed: lower case letter) and according to treatments (signed: upper case letter)

Species	Anthyllis vulneraria L.			Lotus corniculatus L.			Medicago lupulina L.		
Treatments	Mean	SD	Effects	Mean	SD	Effects	Mean	SD	Effects
1	34,25	5,252	bB	52,75	7,544	bA	80,25	6,994	nsA
2	59	2,582	aB	57,5	7,853	abB	81,2	8,349	nsA
3	68	6,481	aAB	57,25	5,795	abB	79	2,646	nsA
4				58,75	7,228	ab			
5				61,75	6,652	ab			
6				68,75	6,397	a			

According to data Table 1. treatments had significant effect on all of the species involved in the experiment.
Lower case letters inside the columns indicating significant difference on $p \leq 0,05$ level according to treatments. Upper case letters inside the rows indicating significant difference on $p \leq 0,05$ level according to species.

5.3. Conclusion

There are several literature suggesting pre–treatments before sowing, aiming to increase of germination % of certain Fabaceae species. The problem is species specific and different pre-treatment methods can be effective at different species. In our case *Anthyllis vulneraria* L reacted positively to pre-cooling and the best to pre-chilling treatment. *Lotus corniculatus* L reacted positively to scarification pre- treatment, in our

case the treatment 6. (pre-chilling+scarification) has the best effect on increasing seed germination %. Considering *Medicago lupulina* L there was not significant difference between the treatments on germination % of treated seeds.

Wild collected species failed to germinate according to MSZ 6354-3:2008 standard in climate cabinet in treatments 1, 2, 3. For their involvement in the experiment, alternative pre-treatment methods need to be developed.

During our research of composing species rich ground cover seed mixture it is very important to determine the germination ability of the applied species. We can conclude that some of the species like *Lotus corniculatus* L and *Anthyllis vulneraria* L need pre-treatments before sowing to reach proper germination performance and development after sowing on the experiment sites in the developed mixtures.

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