Contribution for the Selection of Mediterranean Indigenous Forbs as a New Ornamental Crop

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Keywords: Mediterranean, ornamental, wildflowers, meadows, biodiversity, sustainability

Abstract

In Portugal, as well as in all the nearby mediterranean countries, there are no nurseries to produce indigenous forbs to be used in ornamental wildflower meadows. The selection of mediterranean indigenous forbs, suitable for this ornamental use, is the main issue of the presented research project conducted in the University of Évora since 2006. It aimed at allowing the development of a new ornamental crop with low water demanding plants. In zones with a Mediterranean climate, the amount and timing of rainfall is often the limiting factor in choosing the species, the best choice being those preferring dry land to meadowland. The reintroduction of native plants reduces the cost of establishing and maintaining and increases the sustainability of urban green spaces.

As a result of a previous research project, nine forbs were chosen to be tested in five different pre-treatment for seed dormancy break (witness, pre-chilling at 8°C for seven days; pre-heating at 35°C for five days; 0,2% KNO_3 solution; boiling water). The nine species are: *Anchusa azurea, Cichorium intybus*, *Chrysantemum coronarium*, *Echium plantagineum*, *Hypericum perforatum* (*Hp*), *Lupinus angustifolium*, *Papaver rhoeas*, *Scabiosa atropurpurea* (*Sa*), *Tolpis barbata* (*Tb*). They were chosen by their ornamental potential and different blooming seasons. The tests were made using the rules defined by the International Seed Testing Association. Seeds were harvested one year before, in natural grassland in the Alentejo region of Portugal, namely in Évora and Portalegre districts.

The results revealed significative effect of species and interaction species x pre-treatment, but not effect of pre-treatment. The three species – *Hp*, *Sa*, *Tb* – had over than 70% germination. The other species had below 30% germination. In the case of *Hp* the percentage of germination increased progressively in time achieving the maximum four weeks after the beginning of the tests. This species better treatment was pre-heating, having 100% germination. In the case of *Sa* and *Tb* the germination percentage was almost maximum one week after the beginning of tests and there were not main differences between the different treatments. Although the best results were obtained for *Sa* in the KNO_3 treatment and for *Tb* in the pre-chilling treatment.

INTRODUCTION

This research project, conducted at the University of Évora since 2006 and during 2006 to 2009 in collaboration with the Agronomic Superior School of Elvas – Polytechnic Institute of Portalegre, Portugal, is a part of a major study that intends to evaluate the possibilities of using indigenous herbal species in wildflower meadows, in large dimension framing zones of the green spaces, especially urban green spaces. We hope to contribute to increase the value of our spontaneous flora, creating more sustainable mediterranean grasslands in the urban green spaces, using their multi-functionality - mainly plastic, contemplative and aesthetic, functions - and reducing both environmental and economical costs of these spaces.

The Portuguese research about this subject is non-profitable and there are no nurseries that produce mixtures of wildflowers that can be used in meadows as an alternative to traditional lawns with high costs of maintenance (mowing, destruction of

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weeds, and application of fertilisers). It must be underlined that this alternative is already used in other European Countries, like, for example, England and Germany (Wathern and Gilbert, 1978; Harvey, 1989). In Portugal experiences were made to substitute the classic turf grass areas by wildflowers meadows but the mixtures of seeds used were normally imported and the species showed a difficult adjustment to our conditions (Castro et al., 2008). The commercialized mixtures are composed by gramineous and leguminous plants with some exotic plants, not very well adapted to mediterranean conditions, risking becoming aggressive to the landscape.

This project intends to evaluate the possibility of using indigenous forbs in wild-flower meadows, as a way of increasing the value of our spontaneous flora and reducing economical costs of these spaces.

A study about the region of origin of herbaceous species seeds used for ecological compensation in large agricultural areas, done in Switzerland in the late 90's, shows us there is a reduction in their germination ability with their distance from the original region, because of differences in weather and soil conditions. Reduction in germination ability values influenced soil coverage percentage and, consequently, the plantation success (Keller and Kollmann, 1999). This same study, that used seeds from several European regions, said that it did not used seeds from the Mediterranean region, as well as from Scandinavia, because there is no production of this type of seeds in countries from these two geographic areas.

These meadows can be used in intensive used zones, for example between a turf grass area to play free sports and a children playground, or in forest zones to get a herbaceous stratums with production of colour, or in Golf Courses in the areas between holes, or even in the areas adjacent to the city walls. Besides the increasing of biodiversity and visual variety, these meadows present attractive flowers, textures and sizes, and they may grow in different substrates with low nutrient soil, where exotic plants usually need a substrate of relatively fertile top soil and a suitable watering. They also can protect the soil from erosion, and can proportionate passive leisure areas (informal sports areas) and framing to building elements, contributing to increase their value in landscape design (Castro, 2008).

According to Tsalikidis and Athanasiadou (2007) turf grass requires three times more water than others herbaceous covertures. In order to reduce economical costs herbaceous plants adapted to installation region weather and soil conditions should be used (Manso, 2001).

In this work we use nine species that were selected because of their ornamental potential and blooming seasons (Table 1), and because in Alentejo (a region in the south of Portugal) they produce different coloured fields. Using the rules defined by the International Seed Testing Association, five treatments were tested for promoting germination (pre-treatments): witness; pre-chilling (at 8ºC for seven days); pre-heating (at 35ºC for five days); potassium nitrate (a 0,2% KNO_3 solution); and boiling water (soaking seeds with boiling water). The seeds were harvested in natural grassland. Tests were made one year after harvest.

MATERIAL AND METHODS

Seeds were harvested from May until September 2007 in different natural places in the district of Évora and in the district of Portalegre. Seeds were cleaned in the laboratory and conveniently stored for one year. The material used was: 50 seeds of each species per Petri box, 180 Petri boxes, Cotton, Filter paper, a KNO_3 0,2% solution, Refrigerator, Oven, Germination chamber – ARALAB – S600PL.

Tests were made in August 2008. The seeds of each forb were tested in four Petri boxes per pre-treatment, containing 50 seeds each, arranged in a randomized block design. These essays were done according to the International Seed Testing Association rules. The pre-treatments used for seed dormancy break, were: Witness (using distilled water), KNO_3, Boiling water, Pre-chilling (7 days in 8ºC temperature) and Pre-heating (5 days in 35ºC temperature). The germination temperature was 20ºC with 8 h light and

16 h dark. Petri boxes were used, with cotton and filter paper as a substrate for the seeds. For the witness, the pre-chilling, the pre-heating, and the boiling water treatments, distilled water to soak the filter paper was used. For the potassium nitrate treatment a 0,2% KNO_3 solution was used to soak the filter paper. All Petri boxes were previously sterilized.

The seeds were distributed in each box with four repetitions for each species. The boxes were closed, identified and putted in a germination chamber. In the pre-chilling treatment the preparations were in the refrigerator at 8ºC for seven days, before being moved to the germination chamber. In the pre-heating treatment the seeds were in a stove at 35ºC for five days before being putted in Petri boxes and being moved to the germination chamber. In the potassium nitrate treatment a 0,2% KNO_3 solution was used to soak the filter paper when the preparation of the Petri boxes was done to put them in the germination chamber. In boiling water treatment seeds were soaked with boiling water and rested until the temperature went down. Them the preparations were made as described and putted in Petri boxes in the germination chamber. The germination data were subjected to analysis of variance (MSTATC Program), considering two factors (species and pre-treatment). Mean separations were conducted by Newman-Keuls test at the 5%.

RESULTS AND DISCUSSION

From the analyses of the results there was significative effect of species and interaction species x pre-treatment, but not significative effect of pre-treatment (Table 2). The species with the best germination was *Hp* with a mean of 95%, significantly higher than all other. But there are three species: *Hp*, *Sa*, *Tb* that show a good response to the germination conditions with more than 70% in all but one pre-treatments tested (Table 3 and Fig. 1). The next fourth species with better results was *Cichorium intybus* with germinations nearby 30%. The other species have results near to zero. *Papaver rhoeas* had the worst result. In the case of *Hp* the best pre-treatment was pre-heating, having 100% germination.

In the case of *Sa* and *Tb* there were not main differences between the different treatments. Although the best results were obtained for *Sa* in the KNO_3 treatment, with 81% germination, and for *Tb* in the pre-chilling treatment, with 100% germination.

In the case of *Hp* the percentage of germination increased progressively in time achieving the maximum four weeks after the beginning of the tests (Fig. 2).

In the case of *Sa* and *Tb* the germination percentage was almost maximum one week after the beginning of tests and there were not main differences between the different treatments (Figs. 3 and 4).

This study has produced preliminary results showing that, globally speaking, *Hp*, *Sa* and *Tb* are the most interesting of those nine species, regarding success in the installation flower meadows, because they had the higher germination percentage, in average and in witness treatments, that is a situation near the one expected to find in most meadows for installation.

This study didn't reveal main differences between pre-treatments. However the objective of this analysis was not to study the seed dormancy break methods *per si*, but only to use these methods to allow increasing the germination percentage of the studied species.

Besides seeds germination, many other aspects should be studied for the implementation of flower meadows in Portugal to have successes. Aspects like seeds production, how to collect these seeds and the minimum numbers of cuts to assure a good management, not forgetting visual impact of flowering plants, must be considered for assuring that flower meadows will fulfill the function for which they have been projected. Harvesting the produced seeds will be an important challenge, because those plants, due to their strategies for spreading seeds coming from indigenous species, keep their seed for a very short time, making the harvest difficult. More species must be studied for the best use of Portugal indigenous flora.

There is a lot to be done in Portugal, regarding flower meadows, and investment is needed in the study of both agronomic aspects (the present is our contribution) and landscape aspects. Involving local population would be a key issue for the success of future research and investment, Teaching people – who enjoys green urban spaces mainly populated by indigenous species – about flower meadows, and their seasonal changes is an important and also challenging task.

We believe this research to be just the initial step toward the introduction of a new ornamental crop in flower meadows, that could be important not only in Portugal but in all nearby countries with similar climate.

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Tables

Table 1. Dates of flowering of the species in study along the months of the year. (Raimundo and Cadete, 1991; Malato-Beliz and Cadete, 1982).

	Months of a year											
	J	F	M	A	M	J	J	A	S	O	N	D
Anchusa azurea				■	■	■	■	■				
Chrysanthemum coronarium				■	■	■	■	■				
Cichorium intybus			■	■	■	■	■	■				
Echium plantagineum			■	■	■	■	■					
Hypericum perforatum					■	■	■	■	■			
Lupinus angustifolium			■	■	■							
Papaver rhoeas				■	■	■	■					
Scabiosa atropurpurea				■	■	■	■	■	■	■		
Tolpis barbata				■	■	■	■					

Table 2. Analysis of variance output for the effect of species, seed pre-treatment and interaction species x pre-treatment on the seed germination.

Factors	Germination
Species (sp)	(%)
Anchusa azurea (Aa)	2.65 E
Cichorium intybus (Ci)	28.20 C
Chrysanthemum coronarium (Cc)	3.10 E
Echium plantagineum (Ep)	13.40 D
Hypericum perforatum (Hp)	81.40 B
Lupinus angustifolium (La)	13.50 D
Papaver rhoeas (Pr)	0.20 E
Scabiosa atropurpurea (Sa)	76.80 B
Tolpis barbata (Tb)	94.90 A
Significance	***
Pre-treatment (Pret)	
Witness	34.28
KNO_3	34.89
Boiling water	33.89
Pre-chilling	36.14
Pre-heating	35.33
Significance	ns
Species x Pre-treatment (a)	
Significance	***

ns - non significant p <0,05; *** significant at p <0,001; (a) the mean separation is in Table 3.
Averages followed by the same letter or letters do not differ significantly between them according to Newman-Keuls test at the 5% level.

Table 3. Average percentage of germinations per species and per treatment (interaction).

	Average percentage of germinations				
	Witness	KNO_3	Boiling water	Pre-chilling	Pre-heating
Anchusa azurea	4 jk	1 k	0 k	4 jk	4 jk
Cichorium intybus	21 ghij	24 fghi	34 fg	36 f	26 fgh
Chrysanthemum coronarium	4 jk	7 ijk	2 k	2 k	2 k
Echium plantagineum	16 hijk	18 hijk	16 hijk	2 k	15 hijk
Hypericum perforatum	76 de	78 de	71 e	83 bcde	100 a
Lupinus angustifolium	14 hijk	10 hijk	12 hijk	21 ghij	11 hijk
Papaver rhoeas	0 k	1 k	0 k	0 k	0 k
Scabiosa atropurpurea	78 de	81 cde	79 de	78 de	69 e
Tolpis barbata	97 ab	95 abc	92 abcd	100 a	92 abcd

Averages followed by the same letter or letters do not differ significantly between them according to Newman-Keuls test at the 5% level.

Figures

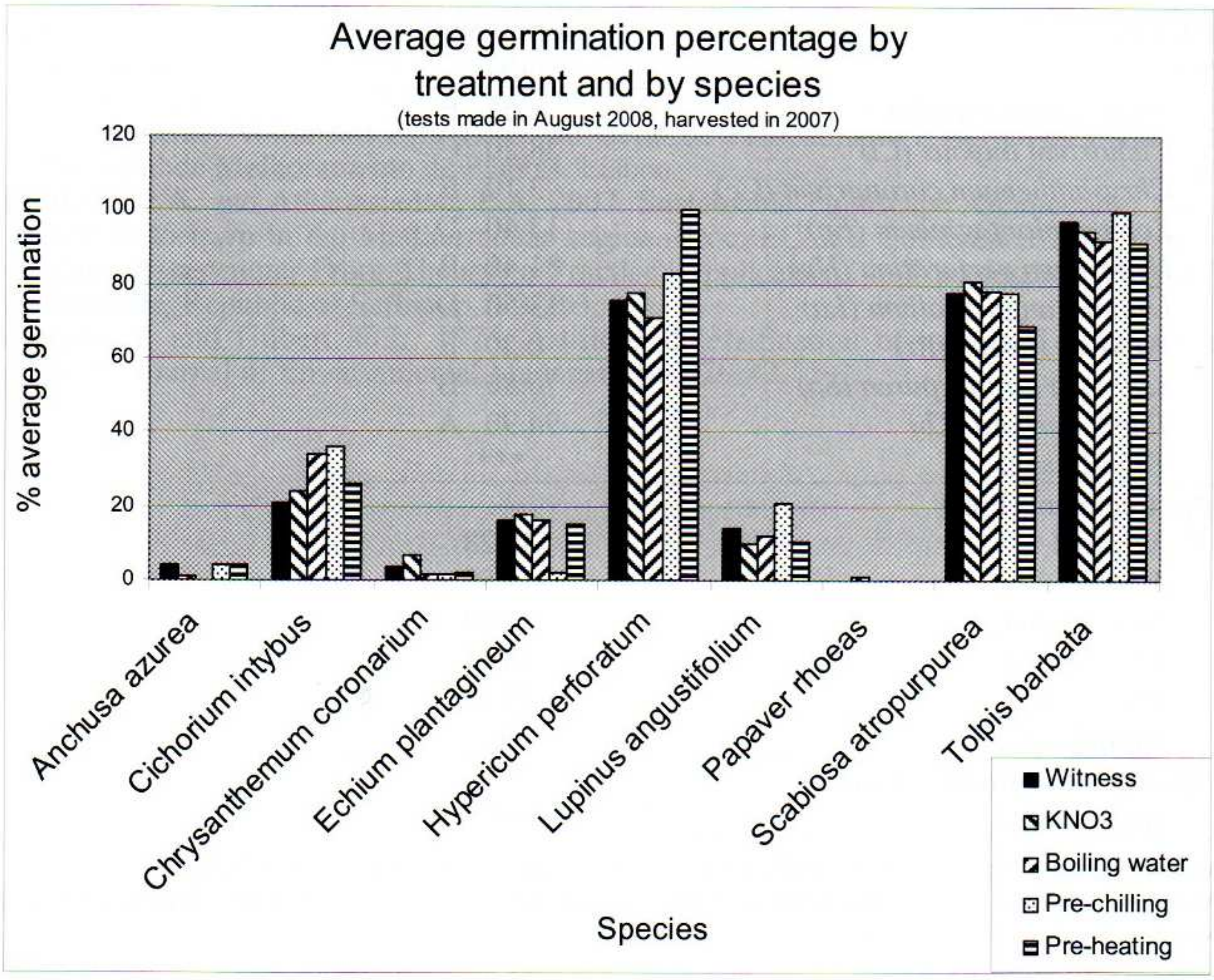

Fig. 1. Germination percentage by treatment and by species.

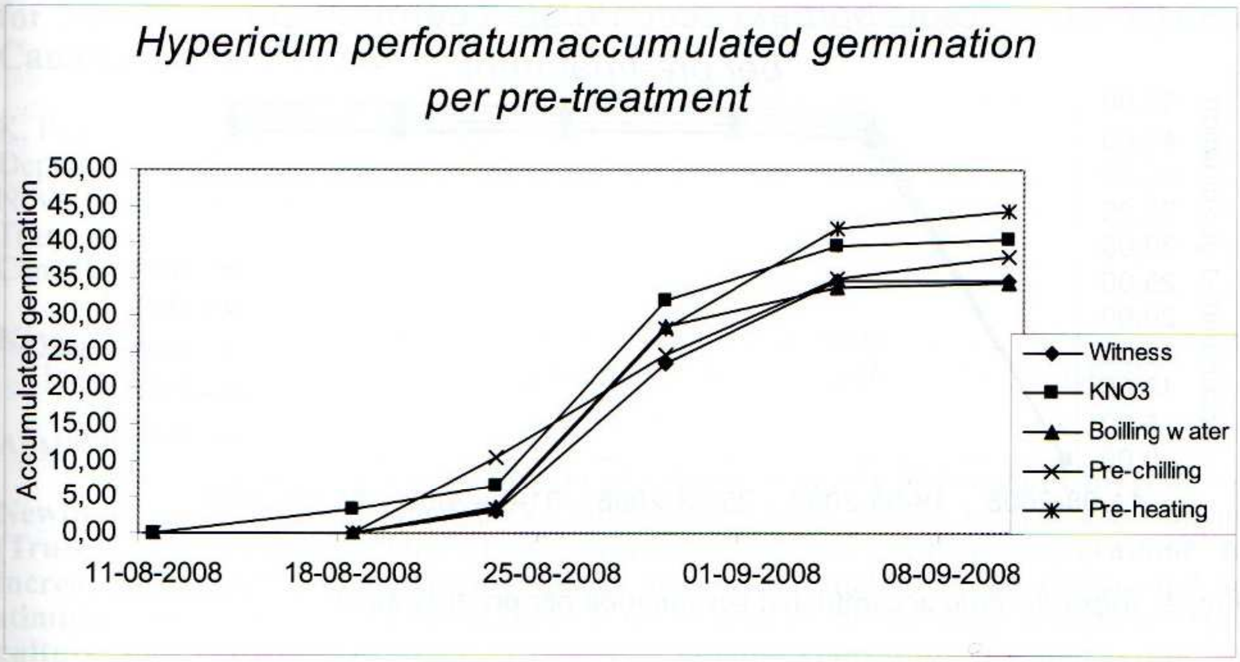

Fig. 2. *Hypericum perforatum* accumulated germination per pre-treatment.

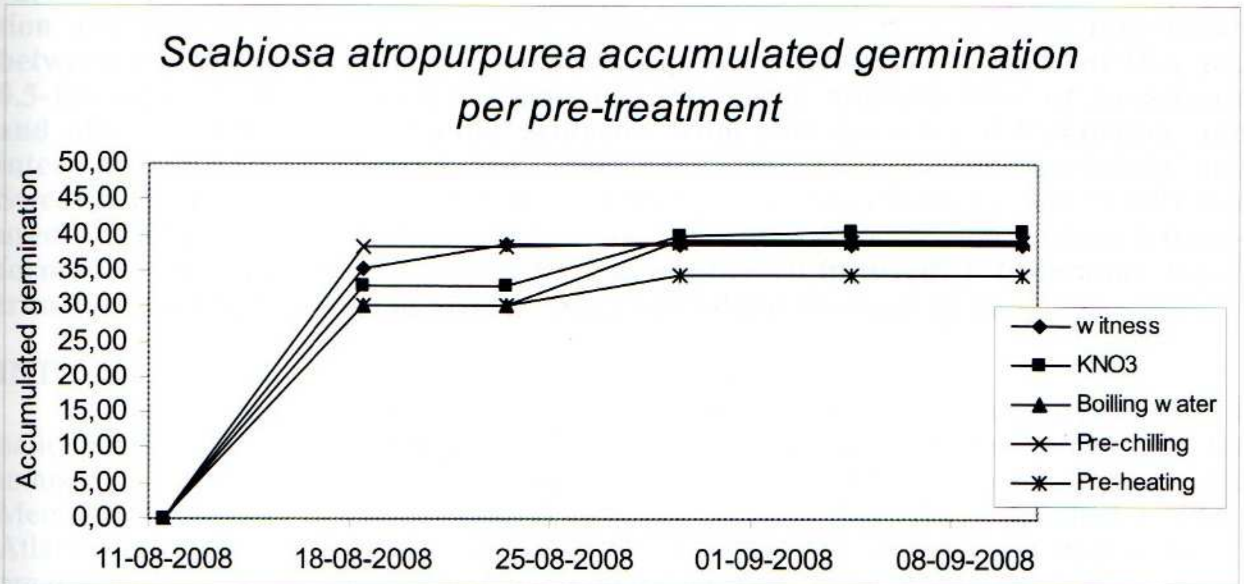

Fig. 3. *Scabiosa atropurpurea* accumulated germination per pre-treatment.

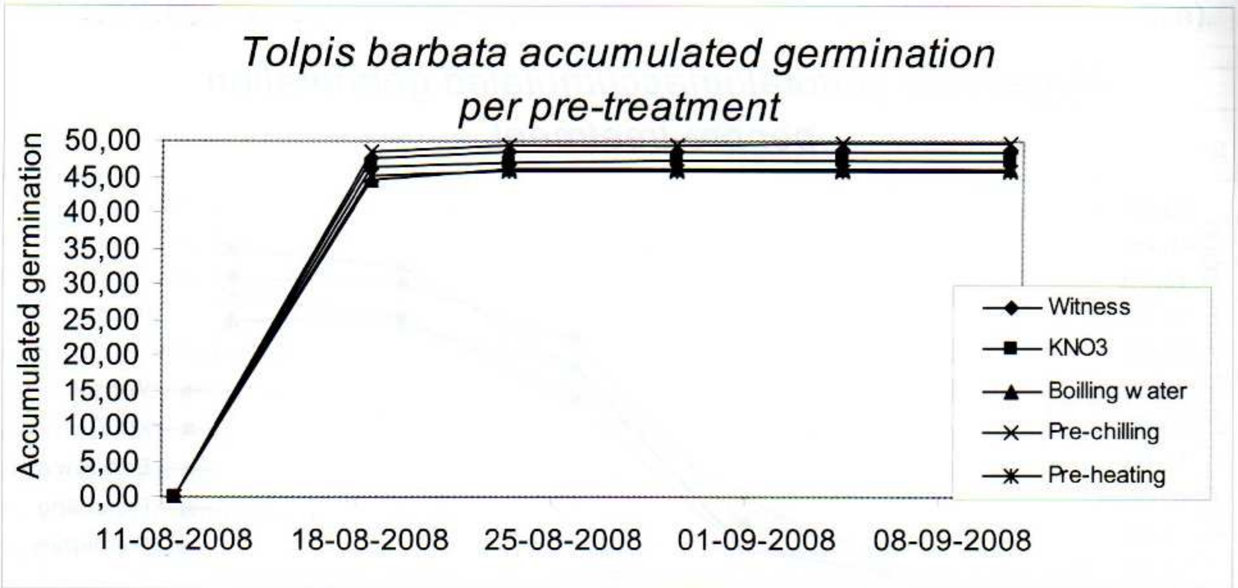

Fig. 4. *Tolpis barbata* accumulated germination per pre-treatment.