Interreg 2007-2013 - Central Europe

Project 1CE052P3 ”Semi-natural grassland as a source of biodiversity improvement” (SALVERE)

Work package 5 Report 1

by

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1 Introduction

A characterisation and a map of the donor site and the activities of work packages 5 are described below. For all sites, the involvement in the different actions is indicated. The Arrhenatherion donor site was harvested at the first of July. Reasons for the late harvesting were bad weather conditions. The project partner 2 (AREC Raumberg-Gumpenstein) is involved in the following actions:

Work package 5 seed harvesting and treatment in High Nature Value Farmland

⇒ assessment of the efficiency of different methods in harvesting seeds from different types of semi-natural grasslands

⇒ estimate the costs of the different harvesting methods

⇒ assessment of the effects of seed harvesting on the botanical characteristics of the donor site

⇒ comparison of methods which can be used to assess the quality of the seed mixtures

⇒ improvement of the methods to separate and conserving seed of single species from the seed mixtures obtained from threshing

⇒ synopsis and evaluation of information concerning seed harvesting (not part of this report)

2 Overview and characteristics of study sites on Arrhenatherion (compulsory) and Molinion (voluntarily) communities in the first study year

2.1 Description of the donor sites

Project partner	2	2
Country	Austria	Austria
Type of donor community	**Arrhenatherion**	**Molinion**
Use of material	For flood detention basin Stillbach/ donor site Gumpenstein II-B	Weißenbach Monitoring plots
Involved in Action	WP4, WP5, WP6	WP 5, WP6
Description of the site		
Location	Wels Airport (see Figure 2)	Weißenbach/Liezen
Natural landscape unit	Eferdinger basin	Flood plains of the Enns River
Longitude (° from Greenwich)	48° 18' 27" N	47°33'41" N
Latitude (°)	14° 03' 98" E	14°11'34" E
Altitude (m a.s..l.)	c. 310 m a.s.l.	c. 640 m a.s.l.
Aspect (0 °= North, 90 °=East,...)	plain	plain
Slope (%)	0 %	0 %
Use of the site	Nature reserve	Nature reserve
Extension (approx.)	1.5 ha	3 ha
Geology	Molassezone, fluvial terraces, tertiary accumulation gravel, sand, clay	northern limestone alps, Palaeozoic greywacke and crystalline schist; Werfner strata with gypsum deposits

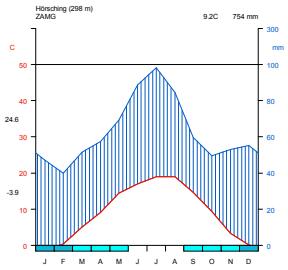
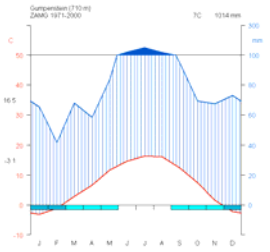
Description of the climate		
Mean yearly rainfall (mm) 1961-1990	753,8 mm	1014,1 mm
Mean rainfall in spring, summer, autumn and winter (mm)	192, 162, 344, 178	242, 271, 543, 232
Mean yearly temperature (°C) 1971-2000	8,8°C	7°C
Mean date begin vegetation period (mean daily temperature 5°C for sequently five days)	19.März	25.Mäz
Mean date end vegetation period (mean daily temperature 5°C)	7.November	4.November
Mean length of vegetation period	311	308
Climate chart		
Photographs June 2009		

Figure 1: Location of the donor site Welser Heide

Figure 2: Location of the donor site renaturation area old golf course, Ennstal valley

2.2 Soil survey of all donor sites

Soil of the study sites will be analysed in order to assess its physical and chemical properties and its fertility. On the 31st June 2009 the soil depth on the Arrhenatherion meadow was measured in each plot 5 times and it is shown in table 1. The measurement was done with a metal graduated stake up to a stone or rock. The measurement of the soil depth on the donorsite in Weißenbach will be done next year. The soil samples of the donor site Welser Heide and Weißenbach are collected at two layers (0-10 and 10-20 cm) and are currently analysed in the laboratory.

Table 1: The average values of the soil depth in block design.

	plot	soil depth [cm]
Block 1	1 GH	7,2
	2 OST	7,8
	3 NT	7,4
	4 OST 1	7
	5 SS	7,8
Block 2	6 OST	6,8
	7 NT	7,6
	8 GH	8
	9 OST1	6,8
	10 SS	7
Block 3	11 NT	7,8
	12 GH	6,4
	13 OST	8
	14 OST 1	7
	15 SS	6,6

Table 2: Parameters which are analysed from all donor sites

Description of the soil	**Results**
Gravel (%)	In progress
Sand (%)	In progress
Lime clay (%)	In progress
pH (in water/CaCl2)	In progress
Organic matter content (%)	In progress
Total Carbonate (mass-%)	In progress
Total Nitrogen (according to national rules) (mass-%)	In progress
Total Phosphorus (mass-%)	In progress
Total Potassium (mass-%)	In progress
Plant available phosphor mg per 100 g soil	In progress
Plant available magnesium mg per 100 g soil	In progress
Plant available potassium mg per 100 g soil	In progress

2.3 The efficiency from different harvesting methods of semi-natural grasslands.

2.3.1 Botanical survey

The botanical survey in Wels was done on 30th June 2009 on every plot in a subplot of 7x7m. The subplot is in the centre of the plot to avoid border effects. The projected cover of each layer, species and species group was visually estimated in percent. A survey of the phenological stadium of the meadow was done once just before harvesting. A list of all present species was made from the whole plot and the subplot.
Because of bad weather conditions and the late harvesting date, was not enough time for a complete botanical survey. If there is enough capacity it will be done next year 2010.

Figure 3: Doing the botanical survey in a subplot of 7x7m

2.3.2 Different methods of harvesting seeds

The best time of harvesting was estimated through phenological surveys of the main species. On the harvesting day the weather was very hot but cloudy. Based on the rain period it was humid with about 85 % humidity. The wind speed was low.

In general:
The ratio between surface donor site and surface receptor site depends on the seed production of the donor site. Therefore, for GH and OST, the extension of harvested donor site and extension receptor site must be determined. After determination of fresh and dry weight of the different materials it is possible to calculate:

- yield per ha on the donor site
- amount of applied material per ha on the receptor site
- ratio area donor site : receptor site

Not treated (NT)
On the not treated (NT) plots the data for Work package 4 will be collected during the following two years. After finishing the botanical survey the plot was mulched.

Green hay (GH)
To determine the ratio of seed production between donor site and extension receptor site one m^2 of the plot was cut and weighted. The weight of the material of the subplot for green hay was about 1.5 kg. Based on experience data and the weight of the subplot the ratio donor site to receptor site 1:2 is recommendable to make sure of a sufficient cover with plants and grasses on the experimental site. The size of the donor site 30x30 m compared to the experimental site with 12x14.5 m. Green hay, on-site threshing material and the material of the seed stripper was harvested on the 1st July 2009 one day after the botanical survey was done.
The green hay was cut with a mower, raked

Figure 4: View on the cut green hay plot at the Welser Heide

together, put it into big bags and transferred by truck from Wels to Gumpenstein. On the same day the green hay was applied at the experimental site in Gumpenstein.

On-site threshing (OST, OST1)

On-site threshing material was harvested on the same day as the green hay was harvested. The plots were harvested in two different methods The fields of the OST-variant (2, 6, 13) are used to implement the experimental site. The OST plots were threshed with a CLAAS 320 Tucano thresher. The variants OST1 (4, 9, 14) were threshed with the Wintersteiger classic thresher. This material will be used to define the quantity and the quality of the seed mixture. This data will be compared with the data of the seed stripper. The threshed material was dried for 3 days in a chamber at room temperature. Afterwards it will be cleaned and analysed.

Figure 5: The CLAAS 320 Tucano thresher

Figure 6: The Wintersteiger classic thresher

Seed stripper (SS)

The fields of the SS-variants (5, 10, 15) were harvested with a pull-type seed stripper model no. 610, serial no. 0440806 imported from Canada (Prairier habitats Inc.) drawn by the Wintersteiger classic thresher at a speed of 3 km/h. Due to the advanced phenological stage on-site, it was decided to fix the brush axes at 15 cm to get enough seeds from herbs, resulting in getting stems from grasses into the harvested material (see figure 9). The SS plots have the same assignment as the OST1 plots. These plots are harvested to test the quality of the seed mixture. The material of the seed stripper was dried for 3 day in a chamber at room temperature, weighted, cleaned and analysed.

Figure 7: pull-type seed stripper Model No. 610 imported form Canada

Figure 8: Harvested material from the pull-type seed stripper

2.4 First results of the botanical survey

The following figures and tables show the first results of the donor sites Welser Heide (Arrhenatherion meadow) and Weißenbach (Molinion meadow) in the first project year.

2.5 Arrhenatherion meadow Welser Heide (compulsory)

The materials from the donor site (Arrhenatherion - grassland from Welser Heide) are used to set up the experimental site Gumpenstein II-B. The donor site was harvested in July 2009. The green hay variant was immediately implemented after cutting on the experimental site. The on-site threshing material was threshed on the 25th August 2009. All harvesting trials GH, OST, NT, OST1 and SS are carried out in block design with replications in order to allow statistical analyses. To manage the experimental trails the mowing regime depends on the plant community, one or two cuts according to the usual management. In the first year, the green hay was mown once to control the unwanted weeds. The materials from the harvesting techniques OST 1 and SS are to be analysed in the laboratory and to question if the harvesting method has any influence on the meadow.

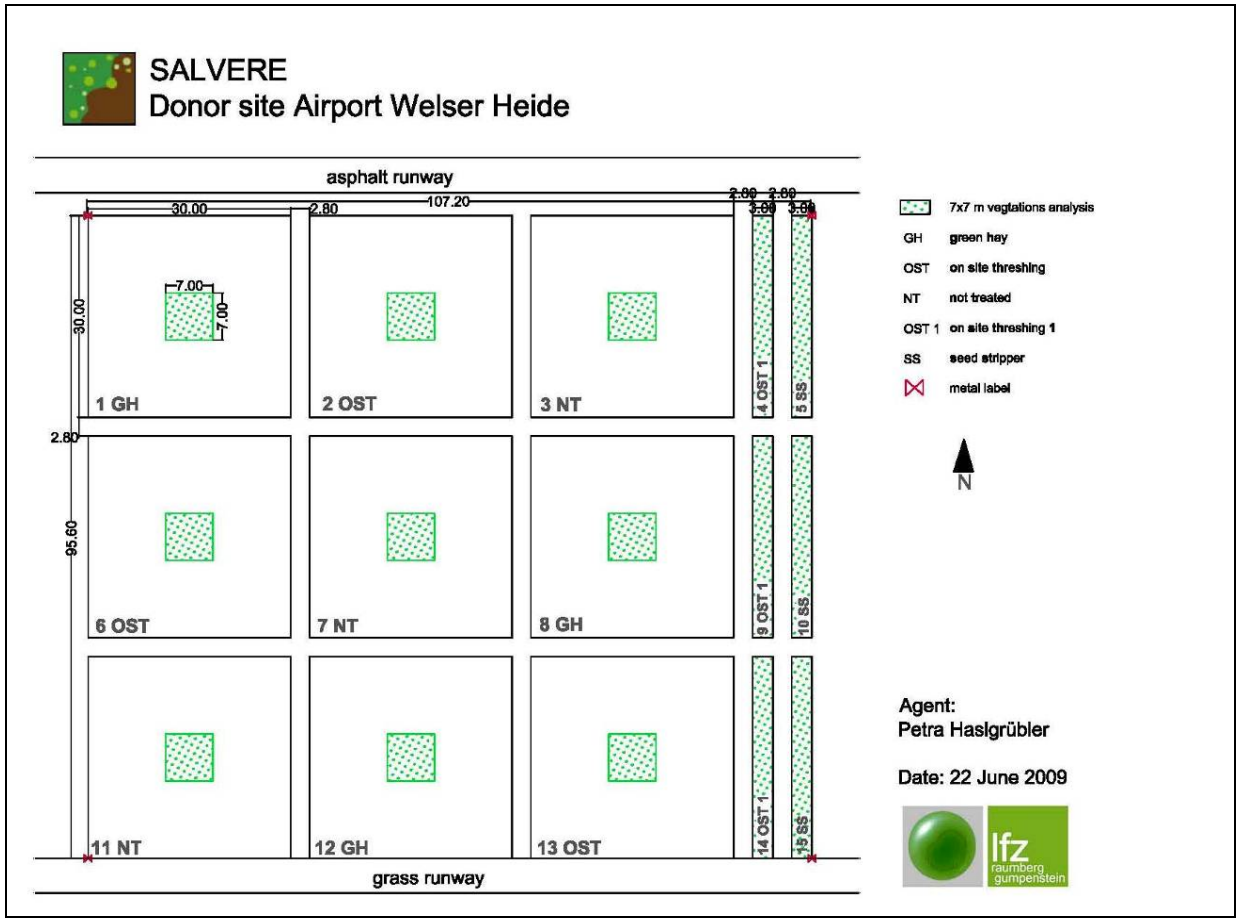


Figure 9: Map of the donor site Welser Heide

2.5.1 Results of the botanical survey

On each plot before harvesting (first and second cut), the percent coverage of each layer, species group and species was visually estimated.

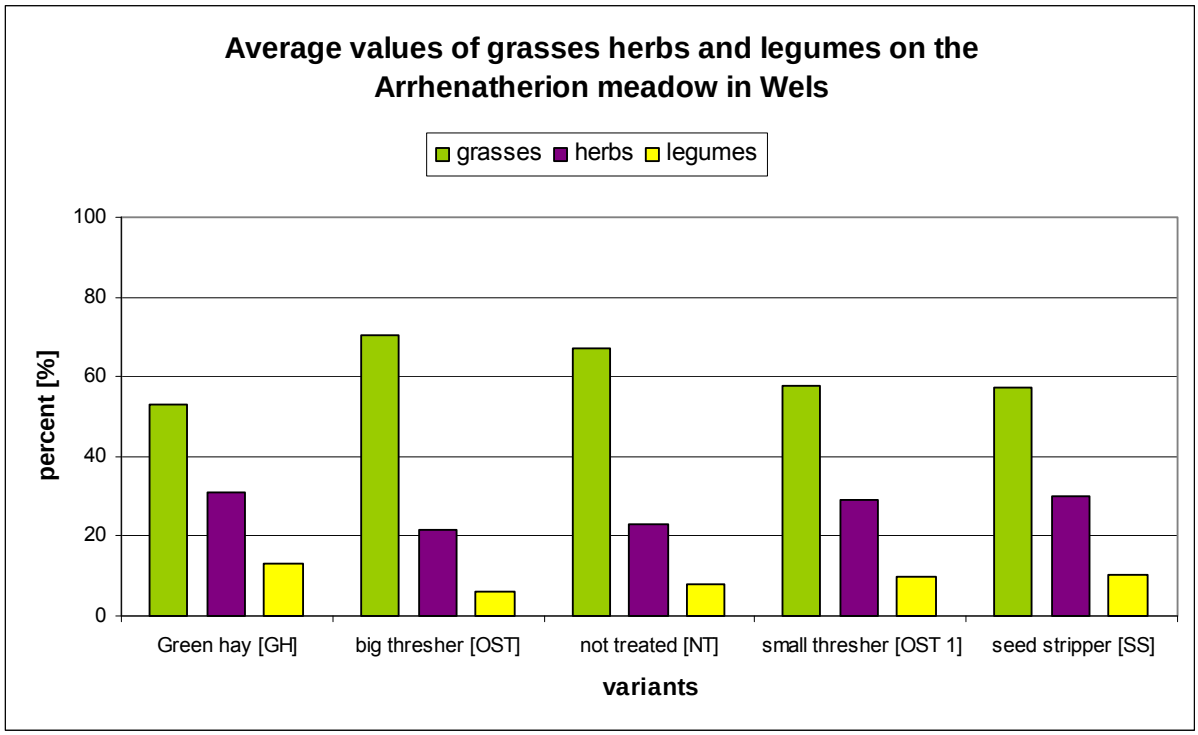


Figure 10: Average values of the vegetation analysis on the Arrhenatherion meadow of the different harvesting techniques.

Table 3: species list of the Arrhenatherion meadow shown in block design and percent

	Block 1					Block 2					Block 3				
	1 GH	2 OST	3 NT	4 OST1	5 SS	6 OST	7 NT	8 GH	9 OST1	10 SS	11 NT	12 GH	13 OST	14 OST1	15 SS
grasses															
Agrostis gigantea			2			4									
Anthoxanthum odoratum												0,3			
Arrhenatherum elatius	15	12	11,5	13,7	14	9,8	13,5	19	19	8,3	14,5	17,4	21	14	14
Avenula pubescens	14,5	19	19	13	12	11,3	14,7	9,5	9,5	9,5	17,5	7,5	13,5	11,5	9,5
Bromus erectus		4	2	3	4	2	3	2	3	9,5	1	3	3	11,5	5
Bromus inermis										1				2	3
Bromus sterilis						2	0,3			0,7					0,5
Dactylis glomerata	2	2	2	3	3	2	3	3	3	3	3	2	2	2	4
Elymus repens			2				1								
Festuca pratensis	3	3	2	3	3	6	4	5	3	5	6	4	5	4	4
Festuca rubra	5	8	8	8	6	9,8	9	7	6	5	8	6	7	7	7
Festuca rupicola		3	5	1	2	9,8	3	3	3	2	5		3	1	3
Phleum pratense	2	2	2	0,3		0,3	2	2	1	1			1	2	0,5
Poa angustifolia	2	1	3			3	4	1			2	3		1	1
Poa annua												0,3			
Poa pratensis	5	14,5	8	5	8	8	6	5	7	9,5	10	4	5	6	8
Trisetum flavescens	3	2	1	4	2	2	1	2	1	2	2	1	1	2	2
legumes															
Anthyllis vulneraria	1	1	1	3,3	3		1	2	1	1			0,5		
Lotus corniculatus	3,5	4		2,7	1	2	1	1	0,3	1	1	2			1
Medicago falcata				2	1		1	0,3	1		1,3	3	8	2	1
Medicago lupulina				0,3	0,7		1			0,7		1			0,3
Securigera varia	1		5	2,7	3,3		1	6,4	4	2,6	2	5,5	1	1	4,2
Trifolium campestre	1		1	1	1	1	2	2	0,7	0,7		2	2	1	1
Trifolium pratense	1	1	1	1	1	1	2	3	2	2	0,7	3	3	1	1
Trifolium repens		2	1	1	2		1	0,3	1	1		1	0,5	1	
herbs															
Achillea millefolium	3	4,1	3	2,7	3	4,5	3,5	2	5	2	8	3,7	3,8	3	2
Acinos arvensis	0,5	0,7	0,3	0,3	1	0,7	1	0,3	1		0,7	1	0,3	1	0,3
Campanula patula													0,3		
Centaurea jacea	1	0,7	1	1	1	1	1		2	1		2	1	1	1
Centaurea stoebe				1			1		0,3	2		1	0,3		
Cerastium holosteoides							0,7								
Convolvulus arvensis	1				0,3					2	0,3				1
Daucus carota	1			1								1			
Dianthus carthusianorum	2	2	1	2	2	0,7	3	2	2	2	1	3	1	1	1
Echium vulgare					0,3				0,3				0,8	1	
Erigeron annuus				0,7											
Euphorbia esula	2	1	1												1
Fallopia sp_												0,3			
Foeniculum vulgare				0,3	0,3				1	0,3		0,3			0,3
Fragaria sp_											0,3				
Galium album	11,2	3	3,5	6	4	7,8	3	5,3	7,2	5,8	5	3,7	3,7	7	7,1
Galium verum				1	1							1		1	1
Hypericum perforatum					1				1						
Knautia arvensis	1	1	2	1	1	1	2		1	1	1	1			1
Leontodon hispidus				2						1	2				
Mentha sp_														0,3	
Pastinaca sativa	2	2			1	2		2	1	1		2		1	2
Pimpinella major			1					0,4							
Plantago lanceolata	1	1	2	2	2	0,3	1	0,7	2	1	1	1	1	1	1
Plantago media						0,7				0,7					
Potentilla erecta	2		0,3			2	0,5	0,3			1	1	1	0,3	
Potentilla recta					3										
Rhinanthus sp_					0,7									0,3	
Rumex acetosella							0,3			0,3		1			
Salvia pratensis	6	1	3	3	3,7	3	3,7	5	4	6,1	3	3	2	3	4
Sanguisorba minor	0,3						0,3	0,5				1		0,7	
Sedum sexangulare		1		1	1			1	0,7	1				0,4	
Silene vulgaris	1		1	1	1	0,3	1	2	1	2	1	1	2	2	3
Taraxacum officinale		0,7													
Thymus praecox	3	1	2	2	3,7		0,7	3	2	3		2	3	2	0,3
Veronica chamaedrys		0,3					0,3		1		0,7	1	1	1	1
Veronica serpyllifolia			0,4							0,3			0,3		

2.5.2 Lab analyses seed quantity/quality

Subsamples of every harvesting method of 1x1 m^2 in three replicates were taken and weighted. The different weights of the plots are shown in table 4.

Table 4: Size and average weight of harvested plots on the Arrhenatherion meadow in Wels

average weight - harvesting plots - donor site

	plot size [m^2]	moit mass [g]	dry mass [g]	chaff [g]	pure seeds [g]
NT		the NT variant was mulched			
GH	900	470400	91500	86446	5054
OST	900	0	9950	6044	3906
OST1	90	2597	1377	770	607
SS	90	1350	776	581	195

In the lab the harvested material was dried. Half of the material was conserved in a cooling chamber with 2-3 °C and 40 % humidity and the other half is in the storage room under normal conditions with room temperature. We try to find out if the storage in the cooling chamber has any influence on the germination of the seeds. The following analyses were done block per block and regard the seed quantity and the quality. All seed samples (GH 50g, OST 50g, OST1 5g and SS 5g) are separated, counted and weighted. In the following diagram the results in percent of the analysis are shown.

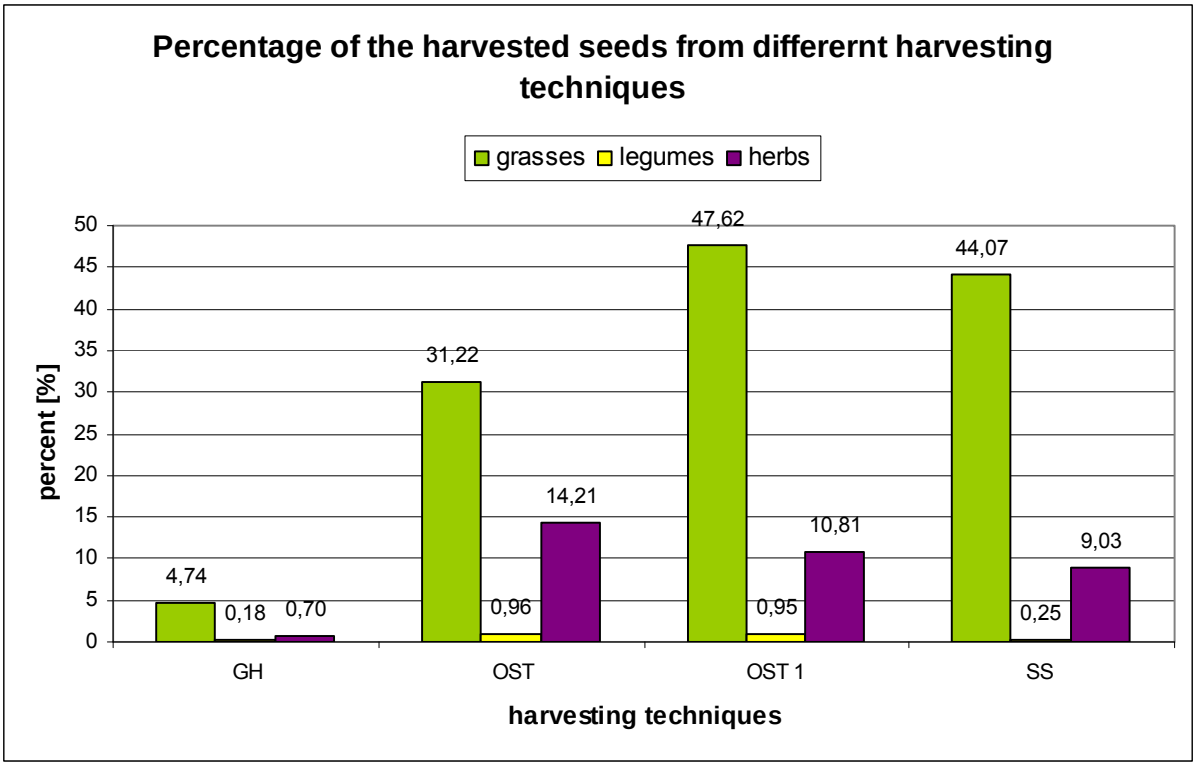


Figure 11: Percentage of the harvested seeds from the different harvesting methods after the seed separation

For five important species, the quality of the harvested seed will be tested. Four replicates of at least 50 mature seeds for each harvesting methods will be prepared. On the seeds a pre-germination treatment according to ISTA or our own experience will be applied. The germination will be done on the Jacobsen Apparatus. A tetrazolium test will be done if the seeds not germinated in the germination trial. The total viability will be the sum of germinability.

2.6 Molinion meadow Weißenbach (voluntarily)

The threshed material of the donor site Weißenbach was used to set up the area with the nine Monitoring fields in Weißenbach right next to the golf course. The material was harvested in 2006. During the summer 2009 vegetation analysis were done and also subsamples with the small thresher and the seed stripper were taken. The tasks are voluntarily and will be done in the laboratory if there is enough time and working capacity. The Molinion meadow S2 the tall sedge swamp was harvested in August 2009. S1 the *Molinion caerulea* rich litter meadow and S3 *Iris sibirca* rich litter meadow were harvested in the middle of September.

Figure 12: Map of the donor site Weißenbach

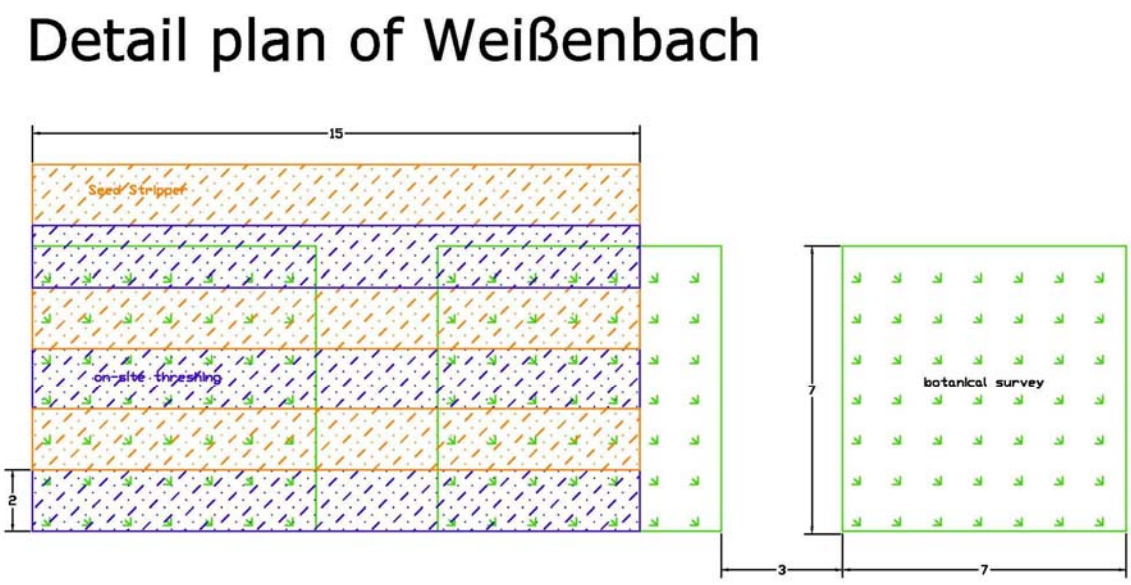


Figure 13: detail plan of the donor site in Weißenbach; botanical survey and subsamples of the harvesting techniques

2.6.1 Results of the botanical survey

On each plot before harvesting (first and second cut), the percent coverage of each layer, species group and species was visually estimated. The following diagram shows the results of the first botanical survey.

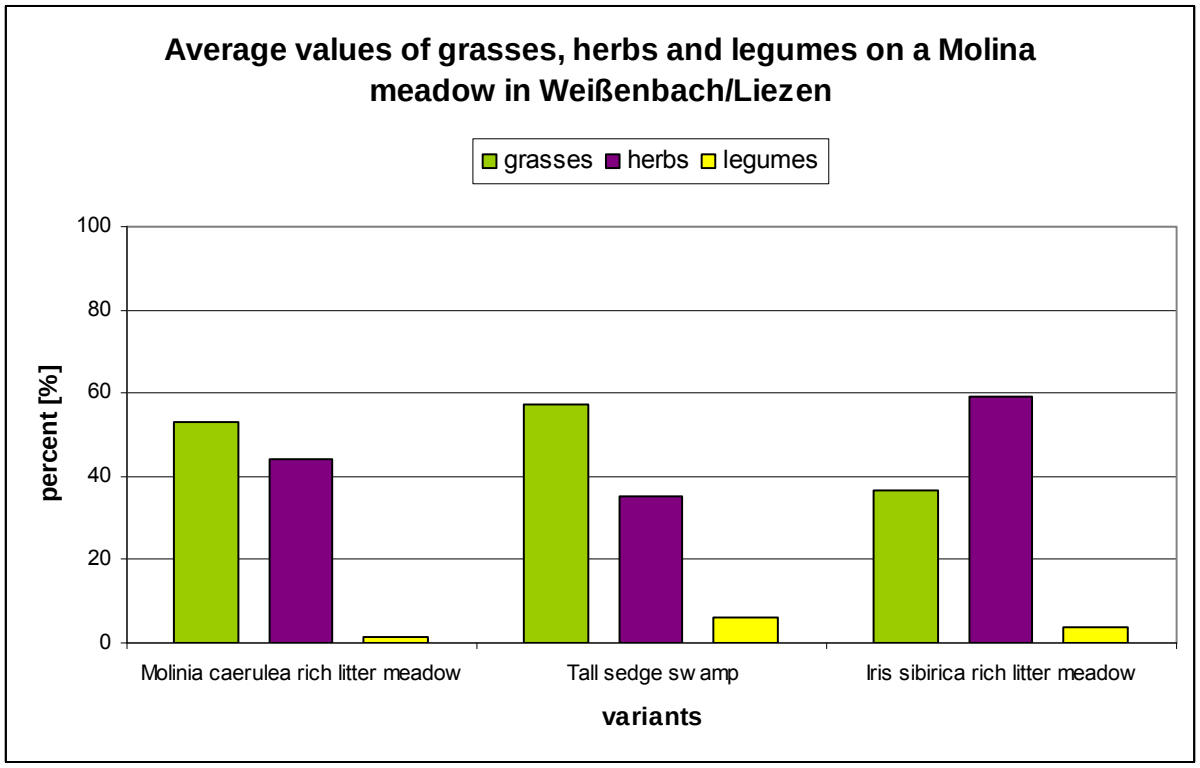


Figure 14: Average values of the vegetation analysis on the Molinion meadows

Table 5: species list of the Molinion meadow shown in block design and percent

plots	Molinia caerulea rich mitter meadow			Tall sedge swamp			Iris sibirica rich litter meadow		
grasses [%]									
Agrostis capillaris				1				1	
Agrostis gigantea							0,3	3	
Agrostis stolonifera						0,3			
Alopecurus geniculatus							2	0,3	0,3
Anthoxanthum odoratum				0,7	0,7	0,3			
Avenula pubescens				1	0,3	0,7			
Briza media				2	3	3			
Carex flava	2	2	1	2	2	3	0,3		
Carex lepidocarpa	6			1	2	1			
Carex pendula			3	4	2	5			
Carex riparia						0,3	0,7	0,3	1
Carex sp_	1			8	14,4	8,5	4	2	3
Dactylis glomerata							2	1	3
Deschampsia cespitosa				1	0,7	2			
Elymus repens							2	1	1
Festuca pratensis					2	0,3		0,4	
Festuca rubra				2	0,3	2	3,1	5	3
Glyceria fluitans						0,3	2	2	3
Holcus lanatus				1	0,3	0,3			
Juncus arcticus				2	2	3			
Juncus articulatus		3	1	7,7	5	6			
Juncus inflexus				2	6	3			
Juncus sp_				3	4	1			
Lolium perenne							4	3	2
Molinia caerulea	24	20	20	2	5	10	0,3	3	2
Phalaris arundinacea							0,3		
Phleum pratense		2	2	5	4	2	7	5	6,7
Phragmites australis				0,3		1			
Poa pratensis				2	0,3	1	3	3	2
Poa trivialis				0,3			4	2	3
Scirpus sylvaticus	23	23	26,7	5	5	6	5	3	5
legumes [%]									
Lathyrus pratensis	2	0,7	0,3	2	1	1,3	1,5	3,5	2,7
Lotus corniculatus	0,5			2	1	0,5			
Lotus pedunculatus							0,5	1	
Medicago lupulina				0,5					
Trifolium hybridum				1	3	0,3			
Trifolium pratense				1	1	0,3			
Trifolium repens				1	1	0,3			
Vicia cracca	0,5	0,3		0,5	1	0,3	1	0,5	0,3
herbs [%]									
Achillea millefolium	2		0,7				4	3	2
Aegopodium podagraria	0,7			1	2	0,3	0,7	0,3	0,3
Alisma plantago-aquatica								0,3	
Angelica sylvestris	2	3	2	3,7	3	2	2	0,3	
Artemisia vulgaris							1		
Caltha palustris	0,3			2	1	0,3			
Cardamine pratensis						0,3		0,7	
Carum carvi	3			3	2	5			
Centaurea jacea	3	3	2	1	0,3	1	3	2,3	0,3
Cerastium holosteoides				0,3					
Cirsium arvense							5	3	5
Cirsium oleraceum	2	1	1	2	0,3	2	2	3	2
Cirsium palustre	1						0,3	0,3	
Equisetum palustre	1	0,3	0,3	2	0,4	0,7			
Eupatorium cannabinum						1	0,3		
Euphrasia sp_				0,7	0,3	0,3			
Filipendula ulmaria	2	1	7	3,7	3,4	1	6	5	4
Galium palustre	2	0,3		1	2	3	0,3		
Galium sp_		1	0,7				3	4	3
Galium verum						0,3		0,3	0,3
Geranium sp_	0,3	1	1			0,7		0,7	
Glechoma hederacea		0,3	0,3				0,3		
Hypericum sp_			0,3						
Hypericum tetrapterum						0,7			
Iris sibirica	10,7	20,5	16,5	5	3,4	1	9,3	22	31,5
Leucanthemum vulgare				1	2	4			
Lychnis flos-cuculi					0,7	0,3			
Lysimachia nummularia					1				
Lysimachia vulgaris	1	2	0,3	0,7	0,3	1	4	1	5
Lythrum salicaria	2	3	1	1		4	2	2	0,3
Mentha aquatica			0,3		0,7	0,3	0,3	0,7	0,7
Myosoton aquaticum					0,3				0,3
Pedicularis sylvatica								0,1	
Peucedanum palustre	1	3	1	2	2	0,3	0,3		
Pimpinella major			1	1			1	1	1
Pimpinella saxifraga							0,3	0,3	
Plantago lanceolata				1				0,7	
Potentilla alba									0,3
Potentilla erecta	0,7	0,3	0,7	1	2	2			
Prunella grandiflora			0,3	1	0,3	0,5			
Prunella vulgaris				0,3			0,3		
Ranunculus acris	0,3	0,3	0,3	1	1	1	1		
Ranunculus auricomus agg_			0,3						
Ranunculus repens				1	0,3			0,7	
Rorippa palustris							0,7		0,7
Rorippa sp_							0,3	0,3	
Rubus caesius								2	
Rumex crispus							0,7	1	0,3
Rumex obtusifolius							0,3		
Sanguisorba minor									0,7
Scopolia carniolica							1		
Scrophularia umbrosa					0,7	0,3	0,3		0,3
Scutellaria galericulata					0,3		0,3		0,3
Serratula tinctoria			0,7	0,3	1	1			
Silene latifolia ssp_alba				0,3	0,3				
Sonchus oleraceus							2	0,3	
Stachys palustris								1	
Stellaria graminea									0,7
Taraxacum officinale agg_							0,3		
Thalictrum aquilegiifolium	1	2	0,3				0,7	0,7	
Thalictrum lucidum	4	6	5	1	1	0,7	4	2	2
Valeriana officinalis			1						1

2.6.2 Sample lab analyses seed quantity/quality

The Molinion meadow is owned by a farmer and also mown by him. The tall sedge swamp was mown on 25th August 2009 and the Molinion caerulea rich litter meadow and the Iris sibirica rich litter meadow were mown on the 15th September 2009. Subsamples of the harvesting method OST1 and SS were taken at the end of August, dried and stored. The seed separation, germination, viability and the 1000 seed weight will be done next year. The material is stored in the cooling chamber by 2-3°C with 40 % humidity. The seed separation in the exact fractions will be done next year.

Table 6: Size and average weight of harvested plots on the Molinion meadow in Weißenbach

			average weight of the suplots			
	size [m^2]	variant	moit mass [g]	dry mass [g]	seeds [g]	chaff [g]
Iris sibirica rich litter meadow	22,5	OST1	3107	1367	1020	347
	22,5	SS	1040	473	200	273
Molina caerulea rich litter meadow	22,5	OST1	973	493	347	147
	22,5	SS	470	253	113	140

3 Harvesting costs

In this chapter the harvesting costs are explained. First the harvesting times from the different meadows are shown. Next is a table with results of the literature research of harvesting costs. The prices are from the ÖKL Homepage Austria and were researched in August 2009. At the end is a table with the real harvesting costs.

3.1 Harvesting Times

The Arrhenatherion meadow Welser Heide was harvested on the 1st of July 2009. The Green hay was implemented right after harvesting and the on-site threshing material was sown on the 25th August 2009. The materials from the harvesting techniques OST 1 and SS will be analysed in the laboratory and to question if the harvesting method has any influence on the meadow. The Molinia meadow S2 (the tall sedge swamp) was harvested in August 2009. S1 (the *Molinion caerulea* rich litter meadow) and S3 (*Iris sibirca* rich litter meadow) were harvested in the middle of September.

	Welser Heide	Weißenbach
GH	1st July 2009	
OST	1st July 2009	
OST 1	1st July 2009	
SS	1st July 2009	
silage		S2: 25th August 2009 S1, S3: 15th September 2009

3.2 Harvesting cost from the literature research

Table 7: Calculated costs from the ÖKL Homepage in August 2009

Variante 1 Green Hay					
Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
standard tracotr with rear wheel drive 60 kW (82 PS)	21,14	0,00	10,00		31,14
double rotary mower 165 cm	8,28				8,28
self-loading bale trailer - 6 cutsites 20 m³ (13,1 m³ after DIN)	20,35		10,00		30,35
10% addition green hay self-loading bale trailer					3,04
harvest / apply the green hay from 2 persones		20,00			20,00
Total price for 1 €/ha GH	49,77	20,00	20,00		**92,81**

Variante 2 Green Hay					
mower 5,8 kW (8 PS)	27,08	10,00			37,08
standard tractor with rear wheel drive 60 kW (82 PS)	21,14		10,00		31,14
trailer to transfer t/h oneaxialdumper 25 km/h 5,0 t	5,20				5,20
harvest / apply the green hay 2 persones		20,00			20,00
other costs					0,00
Total price for 1 €/ha GH	53,42	30,00	10,00		**93,42**

On Site Threshing					
Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
harvester-thresher incl. chopper 60 kW (82 PS)	127,03		10,00		137,03
fourwheel tractor with rear wheel drive 120 kW (163 PS)	48,78		10,00		58,78
trailer to transfer t/h oneaxialdumper 25 km/h 8,0 t Tandem	9,53				9,53
drying				150,00	150,00
cleaning				70,00	70,00
storage bigpack 3 months					20,00
other costs					0,00
Total price for 1 €/ha OST	185,34	0,00	20,00	220,00	**445,34**

Not Treated (hay making)					
Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
standard tractor with rear wheel drive 60 kW (82 PS)	21,14		10,00		31,14
trailer to transfer t/h oneaxialdumper 25 km/h 5,0 t	5,20				5,20
mulch per ha					0,00
other costs					0,00
Total price for 1 €/ha NT	26,34	0,00	10,00	0,00	**36,34**

small thresher

Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
harvester-thresher incl. chopper 55 kW (75 PS)	106,84				106,84
standard tractor with rear wheel drive 60 kW (82 PS)	21,14		10,00		31,14
trailer to transfer t/h oneaxialdumper 25 km/h 5,0 t	5,20				5,20
drying				150,00	150,00
cleaning				70,00	70,00
storage bigpack 3 months					20,00
other costs					0,00
Total price for 1 €/ha OST 1/SS	133,18	0,00	10,00	220,00	**383,18**

Seed stripper

Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
Seed stripper	30,04				30,04
standard tractor with rear wheel drive 60 kW (82 PS)	21,14		10,00		31,14
trailer to transfer t/h oneaxialdumper 25 km/h 5,0 t	5,20				5,20
drying				150,00	150,00
cleaning				70,00	70,00
storage bigpack 3 months					20,00
other costs					0,00
Total price for 1 €/ha OST 1/SS	56,38	0,00	10,00	220,00	**306,38**

fieldpreparation GUMPII/B

Activity / Machine	price per Hour [€/h]	working hour [€/h]	tractordriver per hour [€/h]	€/ha	total
fourwheel tracotr with rear wheel drive 120 kW (163 PS)	48,78		10,00		58,78
drainage plough, 1scharig 70 - 120 cm depth	3,68				3,68
other costs					0,00
Total price for 1 €/ha OST	52,46	0,00	10,00	0,00	**62,46**

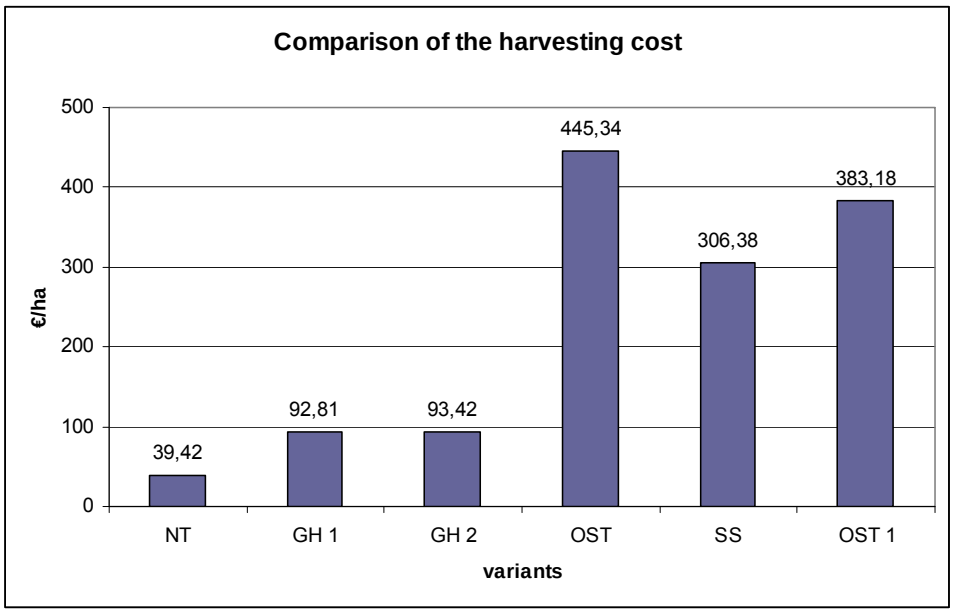


Figure 15: Comparison of the different harvesting costs researched on the ÖKL Homepage in August 2009

3.3 Real harvesting costs

Table 8: List of the real harvesting costs per unit.

Harvesting Method	**Green hay**
Number of trial	1
Type of Community:	Arrhtenaterion
Harvesting date	01. Jul 09
Size of harvested surfaces	900 m^2
Harvesting time per harvesting trail	30 min
Raw weight of harvested propagation material	1,47 kg/ m^2
Pure seed obtained	
Costs per unit harvested surface (ha)	
Costs per unit harvested weight of raw propagation material (t)	€/t
Costs per unit harvested pure seed (kg)	€/kg

Harvesting Method	**On Site Threshing**	
Number of trial	1	1
Type of Community:	Arrhenaterion	Molinion
Harvesting date	14.Jul.09	
Size of harvested surfaces	120 m²	
Harvesting time per harvesting trail	35 min/ha	
Raw weight of harvested propagation material	290kg/ha	
Pure seed obtained	81 kg/ha	
Costs per unit harvested surface (ha)	€ 120/ha	
Costs per unit harvested weight of raw propagation material (t)	€ 414/t	
Transport overall per kg	€ 0,20/kg	
Costs per unit harvested pure seed (kg)	4,39kg	
Manipulations costs		
Drying per ha	€ 150/ha	
Cleaning per ha	€ 70/ha	

Harvesting Method	**Seed stripper**	
Number of trial	1	1
Type of Community:	Arrhtenaterion	Molinion
Harvesting date	01. Jul 09	
Size of harvested surfaces	90 m^2	
Harvesting time per harvesting trail	20 min	
Raw weight of harvested propagation material	1,35 kg	
Pure seed obtained		
Costs per unit harvested surface (ha)	120 €/ha	120 €/ha
Costs per unit harvested weight of raw propagation material (t)	€/t	
Costs per unit harvested pure seed (kg)	€/kg	
Manipulations costs		
Drying per ha	€ 150/ha	€ 150/ha
Cleaning per ha	€ 70/ha	€ 70/ha

4 Quality of the seed mixture

The analysis foreseen in action 5.4 will be done in 2010. The harvesting methods which will be considered at AREC are the materials from the small thresher OST 1 (compulsory) and the Seed stripper SS (voluntarily). The germination of the two harvesting methods (OST1 and SS) will be done in the greenhouse under defined conditions.
The seed mixture will be separated into grasses, legumes and herbs. The germination will be done in spring, as the germination trials foreseen for the Actions 5.1 and 4.2.
The treatments will be replicated three times. During the germination trial, the germinating seeds will be counted and divided at least into grasses, other monocots and dicots (if possible into single species). Moreover, a viability test on the not germinated seeds (a sample divided into the three species groups) will be carried out if it is possible. The material will be treated as defined in ISTA 2009.

5 Seed separation and Conservation

The harvesting methods considered will be OST1 and SS. The seed separation into single species will be done with laboratory seed cleaning machinery and afterwards by hand. The Assessment of the quality of separated seeds, the germination and the purity assessment, will be done under controlled conditions following the International Rules of Seed Testing (ISTA).

Workflow from threshing - seed separation to conservation

1. Thresher 2 shaking sieves in different sizes
2. Drying in the air chamber by cold/hot air - not over 37°C because of germination capacity
3. Intermediate storage in the cooling chamber with 2-5°C and 40% humidity
4. Depending on the weight; cleaning with the right machine
5. testing the purity of a sample (technical purity from the ISTA)
6. Storage in the cooling chamber in a defined system

5.1 Drying of the harvested material

At AREC the harvested material will be dried with hot or cold air. Hot air should not be more than 37°C because afterwards the germination capacity of the seeds will be destroyed. Normally the material will be dried by room temperature for at least three days. It depends how wet the material is.

Figure 16: Drying of the harvested OST1 material by room temperature

Figure 17: Drying of harvested SS material by room temperature

Figure 18: The drying system of AREC

5.2 The Machines to clean seed samples in small and big fractions

5.2.1 Röber Mini-Petkus

The MINI-PETKUS has been designed as a laboratory machine; it meets all requirements of a modern seed cleaning machine, performing all necessary functions. The built-in fan provides a large air volume for the suction in the vertical main aspiration. The sieves are cleaned by means of an automatic vibrator unit. Efficient operation and compactness result from the built-in indented cylinder arrangement. Also very quick and easy changed of the indented cylinders. Only a extremely short time required for changing type of sorting to suit change in varieties or grains. All grading operations are clearly visible when the machine is in operation and can be adjusted quickly and easily if required. The machine is self- emptying within a very short period of time. The machine is manufactured in standard units – separate items such as deawner, indented cylinder and support table can be added as required. The support table is equipped with a holder for interchangeable sieves. The grading result is in correspondence with that achieved in practical operation with a high- capacity seed cleaner and grader. The RÖBER MINI-PETKUS therefore is the ideal machine for use in laboratories of scientific institutes, seed breeding and testing stations. (Source: Waldenburg Catalogue 2009)

Technical data

Sieve Area	1 upper sieve

	1 lower sieve approx. 0.38 m^2
Indented Cylinder	1 indented cylinder 375 mm Ø, 325 mm length Grading area 0.35 m^2
Drive	230/ 400 V, 50 Hz, Enclosure IP 54 Insulation class B 1.5 kW (De- awner 0.37 kW)
Dimensions	length 2477mm Width 701 mm Height 1150 mm with support table 2078 mm Weight: 220 kg

Figure 19: Röber mini pectus from the company Baumann

Figure 20: Detail of the two sieves on the Röber mini pectus

5.2.2 Seed cleaner for small samples – SCHLINGMANN

The small sample cleaner SCHLINGMANN was developed with a feeding pipe with flap, wooden catch container with plastic pane and ventilator with switch and transformator for infinitely variable air stream. The seeds are put in the feeding channel. Depending on the desired cleaning intensity of the seeds it is possible to regulate the air stream speed of the ventilator with the transformator or by opening the flap of the feeding pipe. The heavy seeds fall down through the feeding pipe; the lighter seeds go in the wooden container, where they can be removed by the drawer. (Source: Waldenburg Catalogue 2009)

Advantages

- constant stream of material
- variable, adjustable
- with adjustable funnel
- maintenance- free, CE- conform

Technical data:

Dimensions:	40 x 50 x 50 cm
Weight:	10 kg
Width of the groove	40 mm
Volume of the funnel	2,8 l

Figure 21: Seed cleaner SCHLINGMANN for smal samples

Figure 22: Detail of the seed cleaner SCHLINGAMNN

5.2.3 Air separator

Figure 23: Air separator

The “Saugluft- Stufensichter” type 2 (small type) and type 3 (bigger type) are suitable for plant breeding stations where exact wind separation is required. Separation into 1st (heavy), 2nd (medium) and 3rd (light) grade is done. The infinitely adjustable air separation enables in many cases fine sorting out of germinating and not germinating seeds and grains. The “Saugluft- Stufensichter” works exclusively with air separation and is equipped with a vibration feeder as accessory or a big plastic funnel, permitting a proportionate filling-in of the material. The front side of both machines is covered with easily removable windows, which permit the observation of the grading process in the uniflow air channel. Even in case of fine seeds there is no danger of mixing. It has to be considered that the capacity is dependent on the soiling of the seed and the cleaning result required. Strictly speaking, the most important effect of these machines is not to reach a high capacity per hour, but to achieve exact cleaning results by simultaneous elimination of the danger of mixing of seeds or grains. (Source: Waldenburg Catalogue 2009)

5.2.4 „ALLESDRESCHER“ Universal Threshing Machine,

Figure 24: The Universal Thresching machine

This Machine is suited for threshing and grating of cereals, clover and grass, vegetable legume and other seeds. The threshing process takes only a few seconds. The “Allesdrescher” work fast and is easy to operate. Large, detachable windows at the front side of the threshing drum and of the precision-air-separator permit observation of the threshing and the separation process and give full survey into the interior of the threshing drum and the separator. There is no damage to seed and grains because of smooth walls and rubber like beaters; correctly chosen threshing baskets (for very sensitive material rubber baskets) and infinitely adjustable speed control. No mixing of seeds and grains because steep walls prevent leftover seeds and grains, and large detachable windows permit observation of the threshing drum and the separator. Hundred percent yield of threshing because the material remains in the threshing drum until completely threshed out. No loss of seeds and grains because all seeds and grains get into the separator through the openings of the threshing basket. (Source: Waldenburg Catalogue 2009)

5.2.5 The Cimbria Delta 100-Series

Figure 25: The Cimbria delta cleaner type 101

The Cimbria Delta Super cleaners ensure excellent efficiency and purity in the cleaning all kinds of crops such as garden seeds, grass seeds, flower seeds, corn, leguminous seeds etc. It is easy to operate with it because all adjustments are placed at a suitable height and all operating handles are on the same side as the outlets. The air Lifting channel eliminates light seeds in the variable expansion chamber. Chaff, dust etc, are led with the airflow to the after suction system. The air lifting sieve screen forces the product under passage to turn its biggest surface against the air flow in order to obtain optimal separation. The air Lifting Unit is capable - by means of staggered fans and air guides – of giving a completely uniform air pressure from beneath the product when it leaves the cleaner. The finished product has a high quality because it is clearly illustrated by the difference between the cleaned seed/product and the discarded light product over the air lifting system (Source: www.cimbria.com/files/CAS_brochure_cleaner_GB.pdf

5.2.6 Retsch separations sieves

Figure 26: A Retsch sieve

RETSCH analytical sieve shakers are used in research and development, quality control and production monitoring. Main areas of application are Chemicals, coal, coffee, fertilizers, fillers, flour, metal powders, minerals, sand, seeds, soils, washing powder, cement clinker.The patented electromagnetic drive of the sieve shakers AS 200 control, AS 300 control and AS 450 control produces a 3-D throwing motion which ensures optimum use of the open sieve area and lets the sample move equally over the whole sieving surface. These instruments feature digital amplitude adjustment which allows for sharp fractionizing of the sample even after very short sieving times. All sieve shakers of the series “control” come with an inspection certificate and can be calibrated. (source:www.retsch.de/de/produkte/sieben/analysensiebe)

5.3 Seed separation by hand

Sometimes it is not possible to separate the harvested material with a cleaning machine. In this case the material will be sieved by hand in the laboratory. The sieves from the different machines are used for it. After the sieving the seed separation has to be done with hand lenses, a pair of tweezers and a binocular microscope. It depends on the size of the sample and the homogeneousness of the seed mixture how long it takes but mostly between 3-6 days.

Figure 27: Sieving by hand

Figure 28: Chaff of the seed stripper material

Figure 29: Seeds of the seed stripper material

Figure 30: seed separation in the laboratory with binocular microscope and hand lenses

Figure 31: seed separation in the laboratory with a pair tweezers

5.4 Germination

The germination at AREC Gumpenstein will be done with the Jacobsen apparatus. The Jacobsen apparatus mainly consists of a germination plate being temperature-conditioned by means of the water basin below. The water bath is equipped with an automatic temperature control. The germination spirals being equipped with a paper substrate which is placed on the germination plate. The wick is being led through slots in the germination plate and reaches into the water bath below, thus supplying the required humidity and the desired temperature to the paper substrate. The circular filter papers are covered with a transparent or dark cover dome to provide the air humidity being required for the germination. A small hole in the upper end of the dome ensures sufficient supply of fresh air and minimum evaporation at the same time. Units being executed with active cooling allow day-night temperature alternation, as well as any temperature profile (ISTA 2009).

Figure 32: Jacobsen apparatus

5.5 Storage of the harvested material

The assessment of the influence of storage to be germination rate will be done by storing threshed material and pure seed under controlled conditions of 2-5 °C and 40% humidity and under defined conditions in a freezer container. The assessment of seed germinability of the materials (threshed material and pure seed) will be done after 1 and 2 years stored under this different conditions.

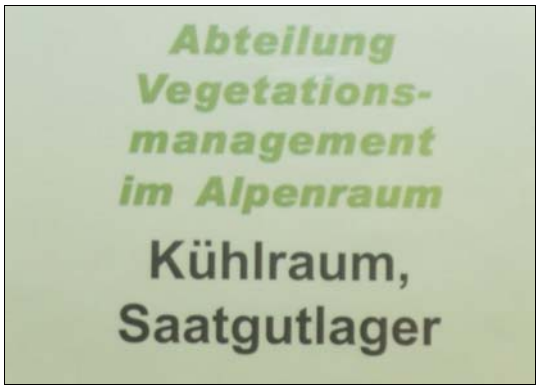


Figure 33: Entrance to our cooling chamber


Figure 34: cooling chamber of the project partner AREC

5.6 Results of the seed separation

The table below shows the results of the seed separation from the harvesting methods OST1 and SS. The samples were separated as described before. Sieved and afterwards with hand lenses, a pair of tweezers and a binocular microscope.

Table 9: separated harvesting sample from OST 1

species	number	[g]	[%]
Alopecurus pratensis	1	0,001	0,016
Arrhenatherum elatius	-	2,497	16,643
Avenula pubescens	59	1,163	7,751
Bromus erectus	37	0,768	7,675
Dactylis glomerata	57	0,266	1,774
Festuca pratensis	36	0,701	4,672
Poa pratensis	-	0,122	0,815
Trisetum flavescens	93	0,078	0,521
Festuca sp.	-	1,163	7,753
grasses	**283**	**6,758**	**47,619**
Anthyllis vulneraria	**23**	**0,086**	**0,864**
Medicago lupulina	3	0,004	0,042
Trifolium pratense	1	0,001	0,016
Trifolium repens	3	0,002	0,030
legumes	**30**	**0,093**	**0,952**
Achillea millefolium	11	0,001	0,024
Campanula patula	10	0,000	0,002
Cerastium arvense	16	0,001	0,009
Centaurea jacea	2	0,001	0,028
Dianthus carthusianorum	117	0,070	0,467
Galium sp.	-	1,304	8,693
Knautia arvensis	7	0,032	0,214
Myosothis	4	0,001	0,006
Plantago lanceolata	1	0,000	0,002
Salvia pratensis	119	0,126	0,843
Salvia nemorosa	49	0,013	0,089
Sanguisorba minor	3	0,013	0,131
Silene vulgaris	51	0,024	0,161
Ranunculus acris	1	0,003	0,062
Taraxacum officinale	1	0,001	0,016
Thymus praecox	8	0,001	0,003
Veronica chamaedrys	7	0,001	0,022
unbekannt	7	0,004	0,041
herbs	**414**	**1,598**	**10,813**
all seeds	**727**	**8,448**	**56,320**
chaff	**-**	**6,552**	**43,680**
whole sample [g]	**-**	**15**	**100**

Table 10: separated harvesting sample from SS

species	number	[g]	[%]
Arrhenatherum elatius	-	3,16	21,08
Avenula pubescens	132,00	0,24	1,61
Bromus erectus	8,00	0,68	6,81
Bromus inermis	21,00	0,05	0,96
Dactylis glomerata	27,00	0,22	1,49
Festuca pratensis	39,00	0,50	3,34
Poa pratensis	-	0,33	2,22
Trisetum flavescens	-	0,18	1,17
Festuca sp.	-	0,81	5,39
grasses	**227,00**	**6,17**	**44,07**
Anthyllis vulneraria	1,00	0,00	0,07
Lotus corniculatus	3,00	0,00	0,02
Medicago lupulina	3,00	0,00	0,07
Trifolium pratense	3,00	0,00	0,08
Trifolium repens	1,00	0,00	0,02
legumes	**11,00**	**0,01**	**0,25**
Achillea millefolium	2,00	0,00	0,00
Dianthus carthusianorum	81,00	0,09	0,58
Galium sp.	-	1,13	7,56
Knautia arvensis	7,00	0,02	0,14
Salvia nemorosa	20,00	0,01	0,04
Ranunculus acris	4,00	0,01	0,20
Hypericum quadrangulum	1,00	0,01	0,14
Salvia pratensis	38,00	0,04	0,25
Silene vulgaris	23,00	0,01	0,11
Veronica sp.	3,00	0,00	0,00
unbekannt	1,00	0,00	0,01
unbekannt	1,00	0,00	0,00
herbs	**181,00**	**1,31**	**9,03**
all seeds	**419,00**	**7,50**	**53,35**
chaff	**-**	**7,50**	**49,98**
whole sample [g]	**-**	**15**	**100**