

#### **SALVERE German workshop** Bernburg, 18/5/2011

#### Semi-natural grassland as a source of native seed: comparison of different harvesting methods



University of Padova (Italy) Department of Environmental Agronomy and Crop Production





#### Main strategies to obtain seed of native species and ecotypes

1. Cultivations specialising in seed production



2. Harvesting from semi-natural grassland











## Harvesting seed directly from semi-natural grassland Main methods available

		Materials	% of seed in		
Method	Seed	Stems/leaves/flowers		Soil, roots	the harvested
		Residuals	A11		material
On site-threshing	X	X			25-60 %
Dry hay threshing	X	X			25-60 %
Seed-stripping	X	X			30-45 %
Hay flower (seed-rich chaff)	X	X			10-20 %
Vacuum harvesting	X	X			> 50 % (?)
Raking	X	X	-	-	?
Green hay harvesting	X	-	X	-	0.2-2 %
Dry hay harvesting (haymaking)	X	-	X	-	0.2-2 %
Topsoil stripping	X	-	X	X	0.010-0.065 %
Turfing	X		X	X	0.003-0.021 %
Threshing	X	(X, but	-		> 80 %
	On site-threshing Dry hay threshing Seed-stripping Hay flower (seed-rich chaff) Vacuum harvesting Raking Green hay harvesting Dry hay harvesting (haymaking) Topsoil stripping Turfing	On site-threshing X Dry hay threshing X Seed-stripping X Hay flower (seed-rich chaff) X Vacuum harvesting X Raking X Green hay harvesting X Dry hay harvesting (haymaking) X Topsoil stripping X Turfing X	Method  Seed Stems/leave Residuals  On site-threshing X X Dry hay threshing X X Seed-stripping X X Hay flower (seed-rich chaff) X X Vacuum harvesting X X Raking X X Green hay harvesting X X Dry hay harvesting (haymaking) X Topsoil stripping X X Turfing X X  (X but	Method         Seed         Stems/leaves/flowers Residuals         All           On site-threshing         X         X         X           Dry hay threshing         X         X         X           Seed-stripping         X         X         X           Hay flower (seed-rich chaff)         X         X         X           Vacuum harvesting         X         X         X           Raking         X         X         X           Green hay harvesting         X         X         X           Dry hay harvesting (haymaking)         X         X         X           Topsoil stripping         X         X         X           Turfing         X         X         X	Residuals   All



- + type of re-vegetation methods, which can be used
- + <u>cost</u> for conservation, transport and distribution

# "The best method" to harvest seed from semi-natural grassland

(Morgan and Collicutt, 1994)

- 1) efficiency at collecting seed of specific species and mixes
- 2) flexibility in terms of timing and location of the collection
- 3) minimal impact on the prairie being harvested

#### Harvesting efficiency

#### **Definition**

- + <u>amount of seeds</u> harvested as compared to the standing seed production
- + <u>number of species</u> harvested as compared to the standing vegetation

#### Main factors affecting efficiency

- + re-growth and harvesting time within the re-growth
- + <u>vegetation layer</u> interested
- + species and seeds characteristics

Factors affecting harvesting efficiency Re-growth **Arrhenatherion** 50000 Standing seed N. of species with 60 40000 yield at the cut mature seed 50 of seeds m--2 **Medium** 30000 40 30 fertilized, 20000 20 125 m a.s.l. 10000 10 ż Re-growth Re-growth ■ Grasses ■ Legumes and forbs ■ Grasses ■ Legumes and forbs 50000 Standing seed N. of species with 60 40000 yield at the cut mature seed of seeds m-<sup>-2</sup> 50 30000 40 20000 fertilized, 20 10000 435 m a.s.l. ż Re-growth

Factors affecting harvesting efficiency

#### Harvesting time

Arrhenatherion, medium fertilized, 1125 m a.s.l. First re-growth

Re-growth

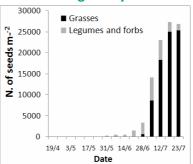
■ Grasses ■ Legumes and forbs

#### N. of species present as seed

#### 50 45 Meadow species, 43 40 of species 35 ■ Grasses 25 ■ Legums and forbs ż 15 10 5 19/4 3/5 17/5 31/5 14/6 28/6 12/7 23/7 Date

#### Standing seed yield

■ Grasses ■ Legumes and forbs



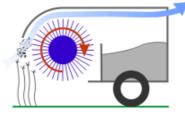
#### Species not maturing seed at the Ist re-growth

- + I grass (out of I3)
- + 10 legumes and forbs (out of 30)

#### Factors affecting harvesting efficiency

#### Vegetation layer interested

#### Seed stripping



Vegetation	Arrhenatherion	Festuco-Agrostion
Brush height	100 cm	45 cm
N. of seeds per sqm	4333 (20%)	5673 (73%)
N. of species	16 (50%)	25 (78%)
N. of grasses	9 (82%)	11 (85%)
N. of legumes and forbs	7 (33%)	14 (74%)

From Ecological restoration, Scotton et al., 2009.

#### Factors affecting harvesting efficiency

#### Species and seeds characteristics

# Seed retention, shattering and shedding

Species	Seed retention on the plant	Seed remains attached to the plant after shattering	Reason	
Trisetum flavecens	short			
Avenula pubescens	short	X	long, bent and toothed awn	
Arrhenatherum elatius	short			
Briza media	short			
Anthoxanthum odoratum	middle			
Festuca pratensis	middle			
Holcus lanatus	middle	X	seed enclosed within glumes	
Festuca rubra	middle			
Molinia caerulea	middle			
Dactylis glomerata	long			
Brachipodium pinnatum	long			
Bromus erectus	long			
Lolium perenne	long			
Agrostis capillaris	long	X	seed enclosed within glumes	

### Factors affecting harvesting efficiency Species and seeds characteristics

#### Seed retention, shattering and shedding

SEEDS CHARACTERISTICS	HARVESTING EFFICIENCY			
SEEDS CHARACTERISTICS	Haymaking	Seed stripping	Threshing	
Seeds easy to detach and without			1	
retention mechanisms	-	Т	Т	
Seeds with retention mechanisms,				
includig fluffy seeds	+	-	-	

# Mean values of seed amount harvesting efficiency (%)

HARVESTING METHOD	Green hay	Dry hay	On- site Thre- shing		Seed st down- ward *	ripping up- ward *
min	90	30	30	15	55	20
max	100	50	80	30	75	50

<sup>\*</sup> Direction of brush motion at the leading edge.

#### Main features of the methods available

#### Green hay harvesting

#### Dry hay harvesting





#### Green hay harvesting

- + seed amount harv. effic.: high
- + species number harv. effic.: high
- + necessary equipment already available
- + low harvesting cost
- + high transport cost
- + seed and mulch at the same time
- + no conservation possible
- + site must be accessible to vehicles
- + good if receptor sites are close

#### Dry hay harvesting

- + seed amount harv. effic.: medium low
- + species number harv. effic.: medium high
- + necessary equipment already available
- + medium harvesting cost
- + medium transport cost
- + seed and mulch at the same time
- + conservation possible
- + site must be accessible to vehicles
- + good for every receptor site

#### On site threshing



#### Dry hay threshing



#### On site threshing

- + seed amount harv. effic.: medium high
- + species number harvesting efficiency: medium
- + necessary equipment often not available
- + low harvesting cost
- + low transport cost
- + supplementary mulching necessary
- + conservation possible
- + site must be accessible to vehicles
- + good for every site

#### Dry hay threshing

- + seed amount harv. effic.: low
- + species number harv. effic.: medium
- + threshing equipment usually not available
- + medium high harvesting cost
- + medium transport cost
- + supplementary mulching necessary
- + conservation possible
- + site must be accessible to vehicles
- + good for every site



#### Seed stripping hand held

#### Seed stripping pull type



Seed stripping				
hand-held type	pull type upward	pull type downward		
+ seed amount harv. effic.: low	+ seed amount harv. effic.: medium - low	+ seed amount harv. effic.: medium - high		
+ species number harv. effic.: medium - low	+ species number harv. effic.: medium - low	+ species number harv. effic.: medium - high		
+ equipment often not available but of low cost	+ equipment often not available but of low cost	+ equipment often not available but of low cost		
+ high harvesting cost	+ low harvesting cost	+ low harvesting cost		
+ low transport cost	+ low transport cost	+ low transport cost		
+ supplementary mulching necessary	+ supplementary mulching necessary	+ supplementary mulching necessary		
+ conservation possible	+ conservation possible	+ conservation possible		
+ good for every site, also unaccesible to vehicles	+ site must be accessible to vehicles	+ site must be accessible to vehicles		
+ good for every receport site	+ good for every receport site	+ good for every receport site		



hand-held type

#### Vacuum harvesting



#### Vacuum harvesting

#### + species number harv. effic.: medium - low + equipment often not available but of low cost + high harvesting cost + low transport cost + supplementary mulching necessary + conservation possible

- + good for every site, also unaccesible to vehicles + site must be accessible to vehicles
- + good for every receport site

+ seed amount harv. effic.: low

- + seed amount harv. effic.: medium low
- + species number harv. effic.: medium low
- + equipment often not available but of low cost
- + medium harvesting cost
- + low transport cost

vehicle mounted type

- + supplementary mulching necessary
- + conservation possible
- - + good for every receport site

# Topsoil stripping

#### **Turfing**



#### Topsoil stripping

- + seed amount harv. effic.: high
- + species number harv. effic.: high
- + necessary equipment available
- + high harvesting cost
- + high transport cost
- + supplementary mulching necessary
- + conservation difficult
- + good for every site

#### Turfing

- + seed amount harv. effic.: high
- + species number harv. effic.: high
- + necessary equipment usually not available
- + high harvesting cost
- + high transport cost
- + supplementary mulching not necessary
- + conservation difficult
- + good for stone poor soils
- + good for receptor sites concident or close to donor site



#### **Conclusions**

There are several "best methods".

This corresponds to the site and biological diversity of semi-natural grasslands.





