Diversity in the perennial grasses species recommended for conventional and low input agriculture

Elzbieta Czembor

Plant Breeding and Acclimatization Institute – NRI, Radzikow, Poland

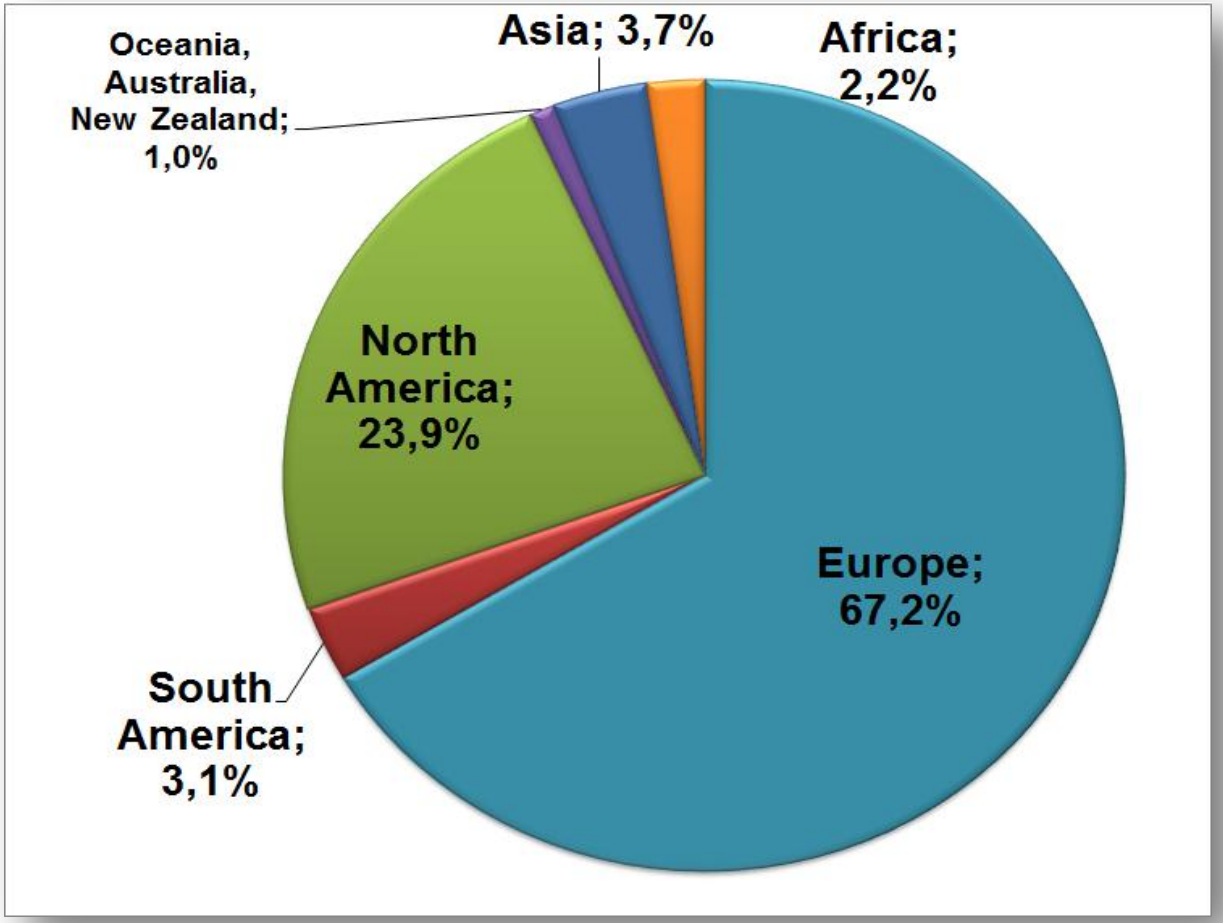
Outline

- Introduction
- Experimental design
- Results
- Conclusions

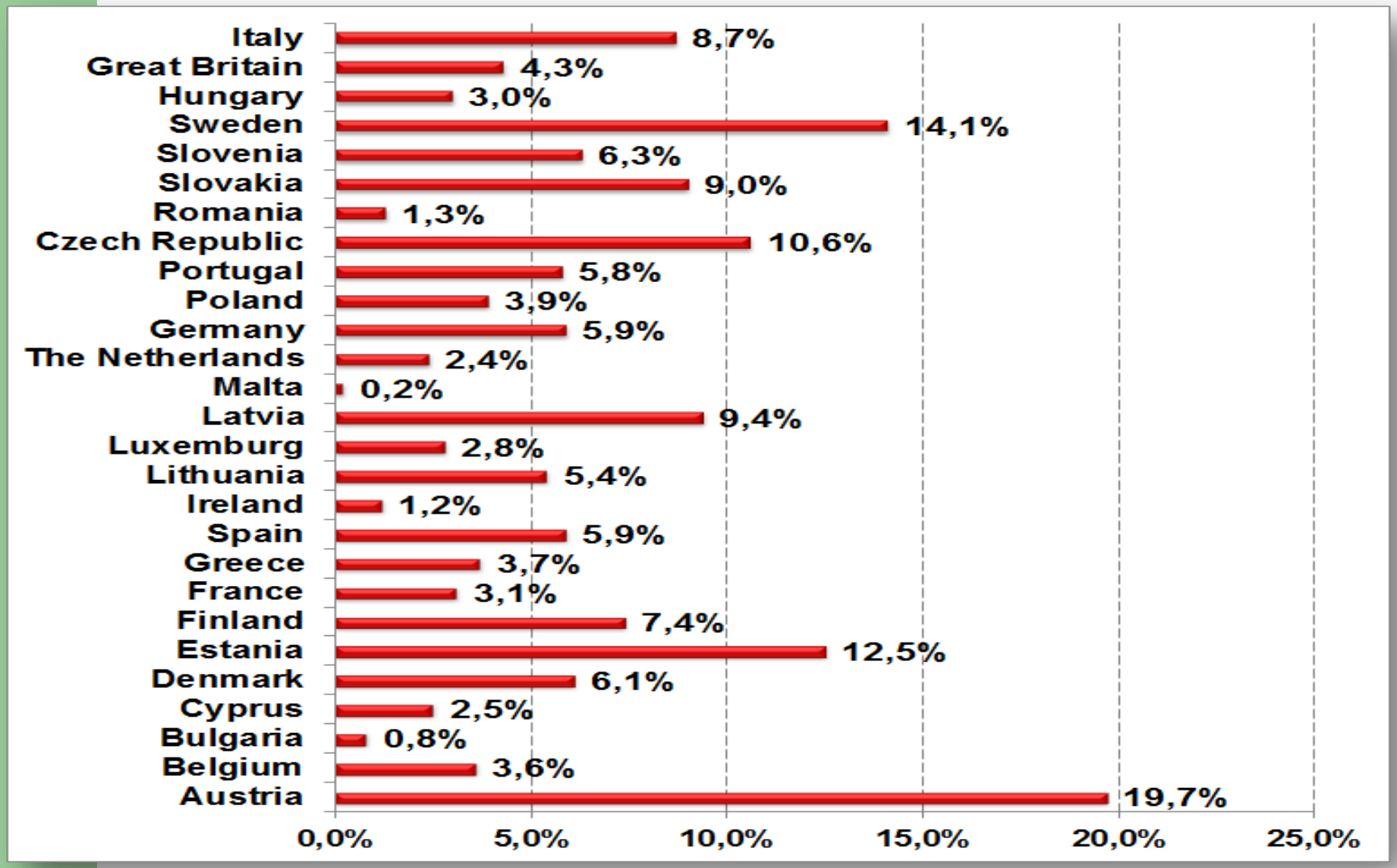
Agriculture systems

CONVENTIONAL	Agro-chemical based
LOW INPUT	Intermediate system - Nitrogen from Winter Legume Cover Cropping (WLCC) and some supplemental inorganic N; occasional herbicides
ORGANIC	Managed according to CCOF guidelines - organic N from manure and WLCC

Organic crop area –
% of the organic agricultural land in relation to the total agricultural land

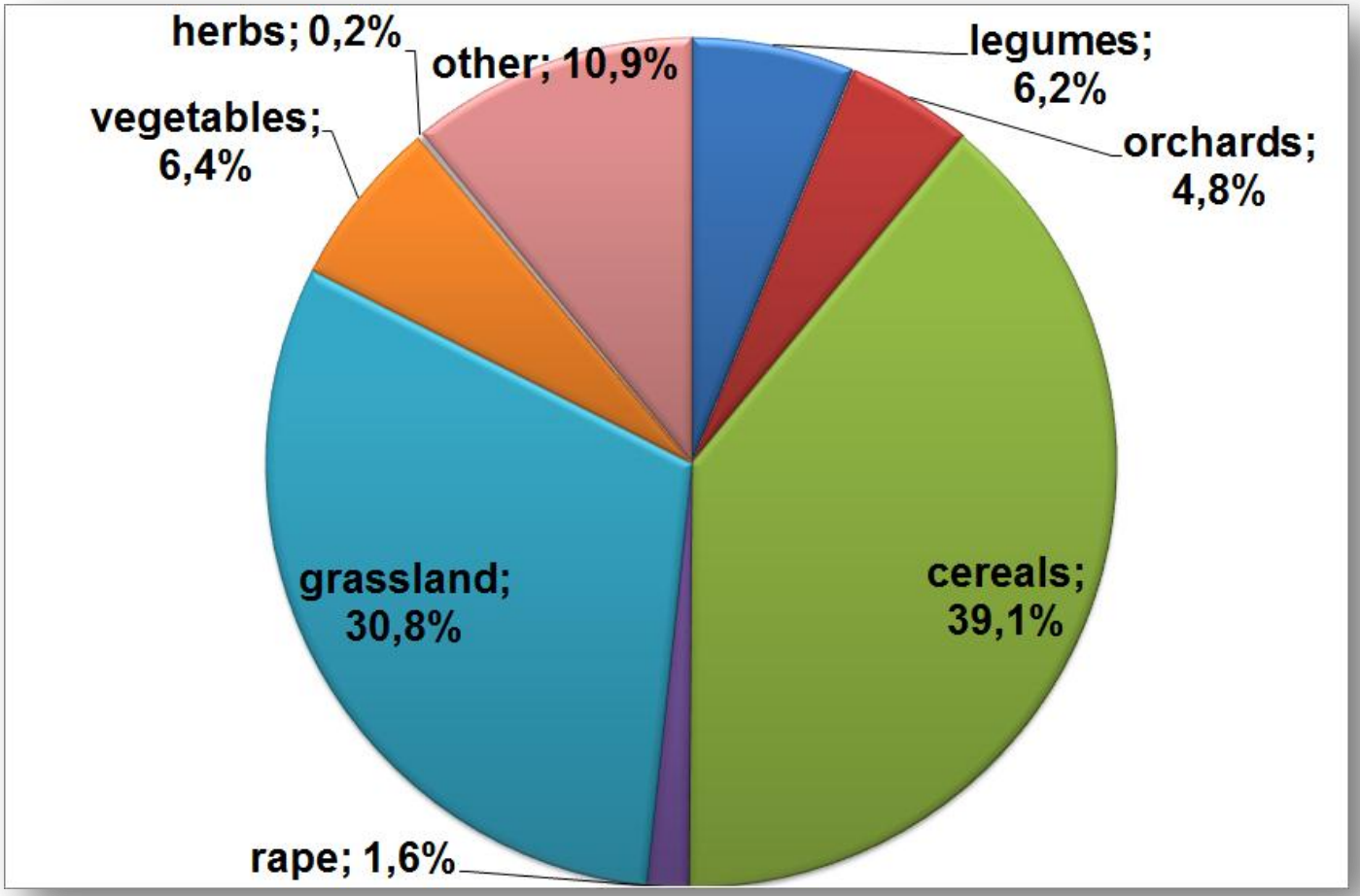


% of the organic agricultural land in relation to the total agricultural land



Organic crop area –

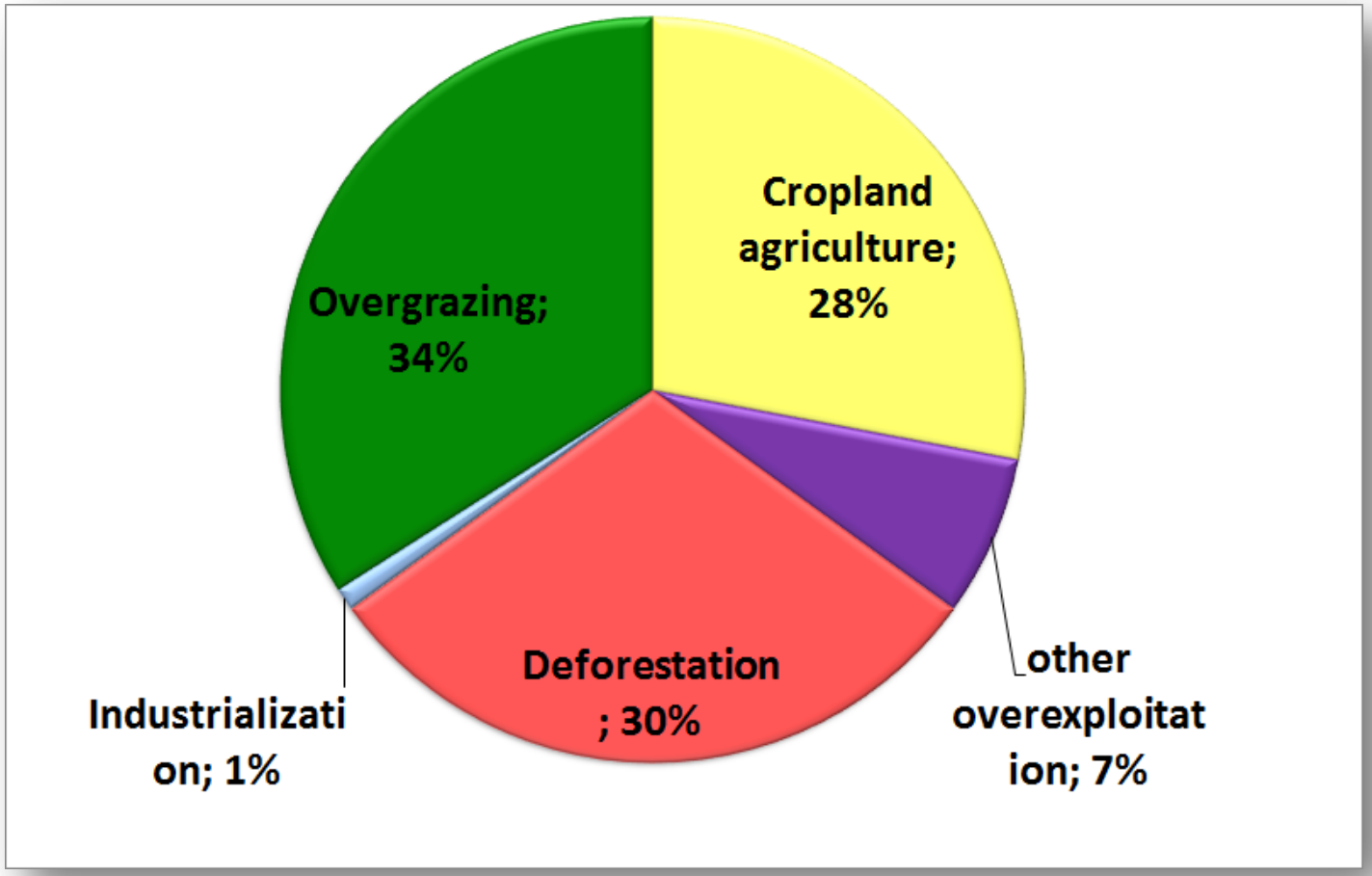
% in relation to the total ecological agricultural land



Grassland – functions

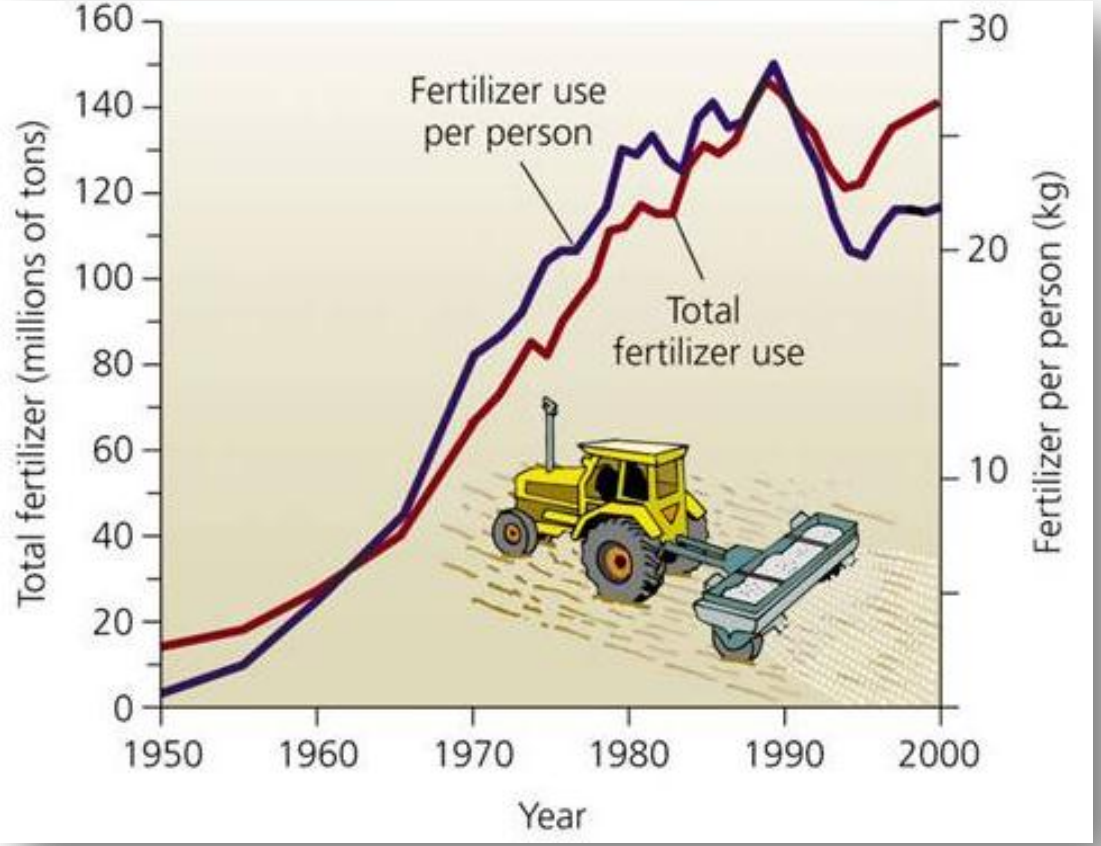
- source of healthy forage for a large group of ruminant animals.
- serve to conserve biodiversity,
- reduce environmental pollution, including nitrogen oxide and sulfur in the air
- prevent soil erosion.

prevent soil erosion
Causes of soil degradation



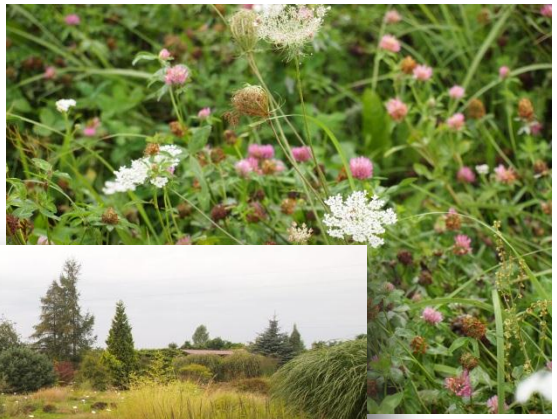
Global fertilizer usages

- *Fertilizer use has risen in the past 50 years.*



Serve to conserve biodiversity

- biotic variation at intraspecific genetic variation level,
- species diversity
- ecosystem diversity



Biotic variation at intraspecific genetic variation level

- **Opinion of the impact of agricultural intensification on biodiversity**
- **caused the extinction of many ecotypes and replacing them with new forms of crops.**
- **the negative impact on the biodiversity is not observed, because the genetic resources *in situ* and *ex situ* form are included into the breeding programs and the wide variation within the newly created varieties could be maintained.**

Example - Perennial ryegrass

- **Plant material: 169 perennial ryegrass population belonging to six groups were included - diploid commercial cultivars (30) and tetraploid commercial cultivars (21); clones and 41 ecotypes.**
- **It was found that perennial ryegrass ecotypes, clones and diploid and tetraploid commercial cultivars formed a distinct group in terms of their traits (resistance to biotic and abiotic stress, seed yield components and phenological or agronomic characters).**

However

- **Because within the European diploid and tetraploid cultivars the important differences were found in respect to many biological characteristics including resistance to biotic and abiotic stresses, it can be concluded that breeding did not result in reducing the variability occurring within species *Lolium perenne*.**

- **The range variability has been moving towards forms with the traits more important from the agricultural point of view.**

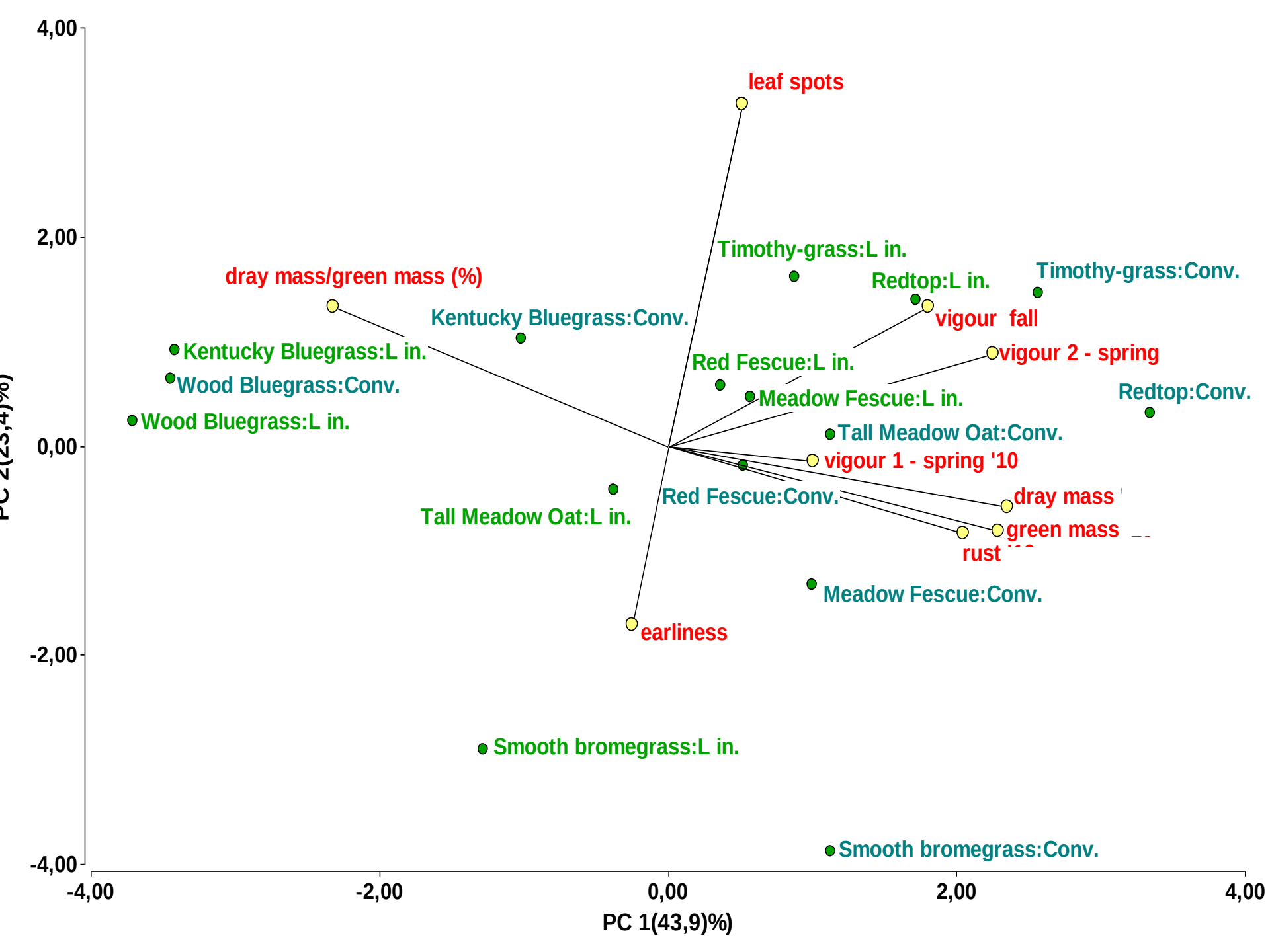
Objectives

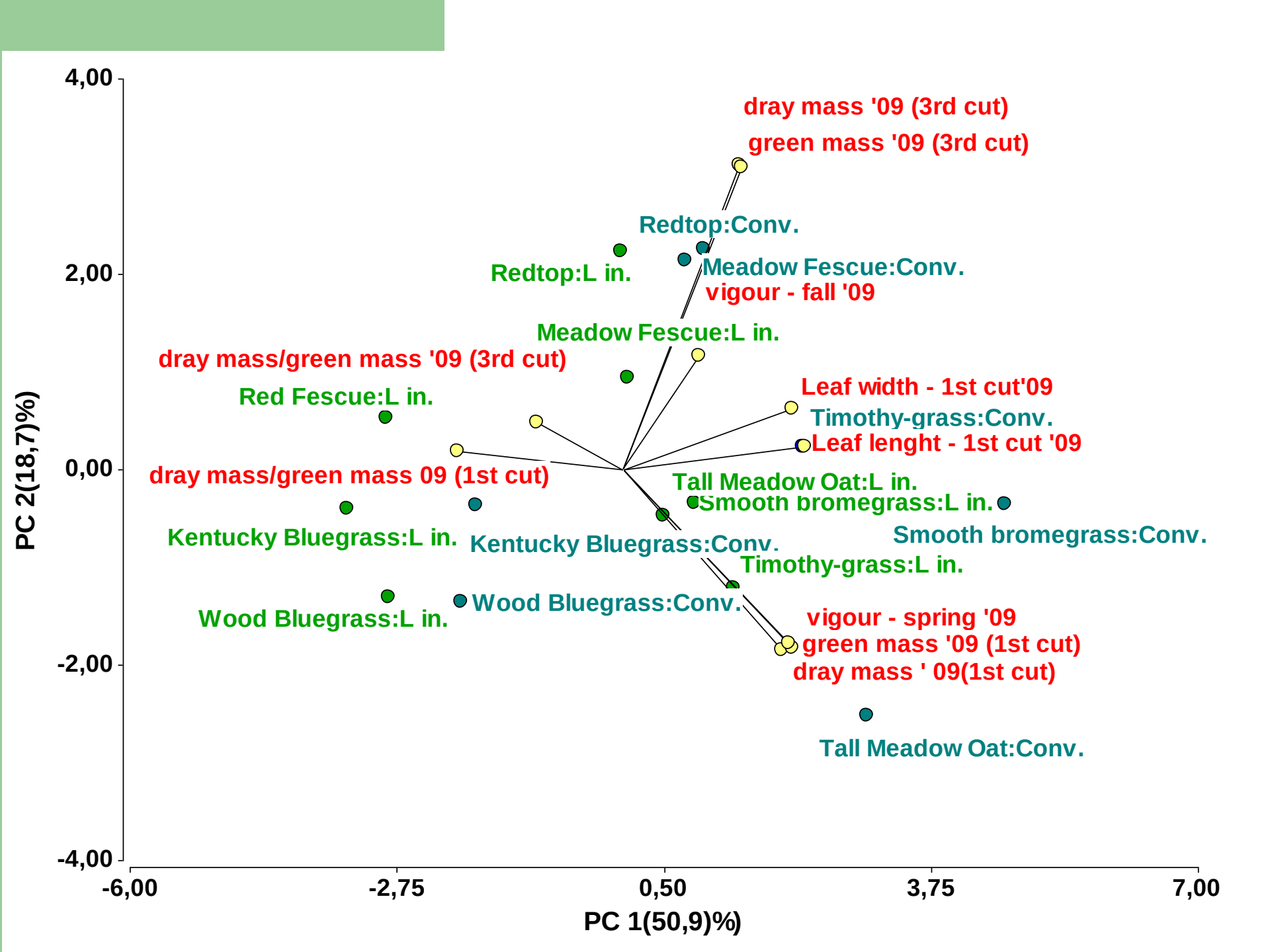
- **Evaluate diversity in the perennial grasses species recommended for conventional and low input agriculture**

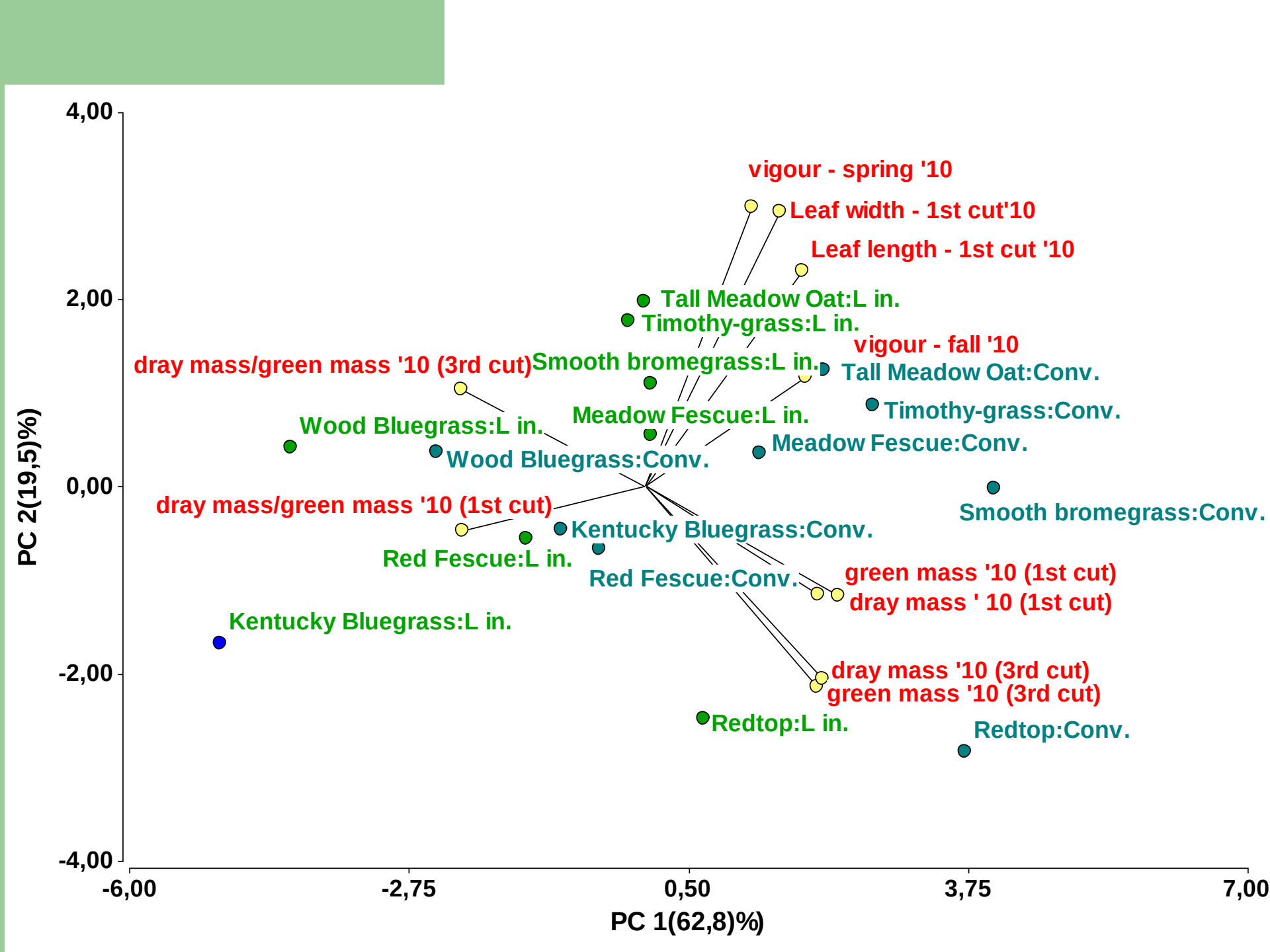
Experimental Design 2008 - 2010

- 9 species: Meadow Fescue; Red Fescue; Timothy-grass; Kentucky Bluegrass; Tall Meadow Oat; Redtop; Wood Bluegrass; Tall Meadow Oat; Smooth bromegrass
- 3 genotypes per species
- 2 management systems: low input (organic fertilizers) and conventional (chemical fertilizers)

Year	Traits	
2008 (1st)	rusts (stem / crown)	summer
		fall
	leaf spots	summer
		fall
	fall performance (vigour)	fall
2009 and 2010	spring performance (vigour)	spring
	rusts (stem / crown)	summer
		fall
	leaf spots	summer
		fall
	leaf length	spring
	leaf width	spring
	green and dray mass production	spring (1st cut)
		summer (2nd and 3rd cuts)
		fall (4th cut)
	fall performance (vigour)	fall


4,00
2,00
0,00
-2,00
-4,00
PC 2(23,4)%)
-4,00
-2,00
0,00
2,00
4,00
PC 1(43,9)%)
leaf spots
Timothy-grass:L in.
Timothy-grass:Conv.
dray mass/green mass (%)
Redtop:L in.
vigour fall
Kentucky Bluegrass:Conv.
Kentucky Bluegrass:L in.
vigour 2 - spring
Red Fescue:L in.
Wood Bluegrass:Conv.
Meadow Fescue:L in.
Redtop:Conv.
Wood Bluegrass:L in.
Tall Meadow Oat:Conv.
vigour 1 - spring '10
Red Fescue:Conv.
dray mass
Tall Meadow Oat:L in.
green mass
rust
Meadow Fescue:Conv.
earliness
Smooth bromegrass:L in.
Smooth bromegrass:Conv.

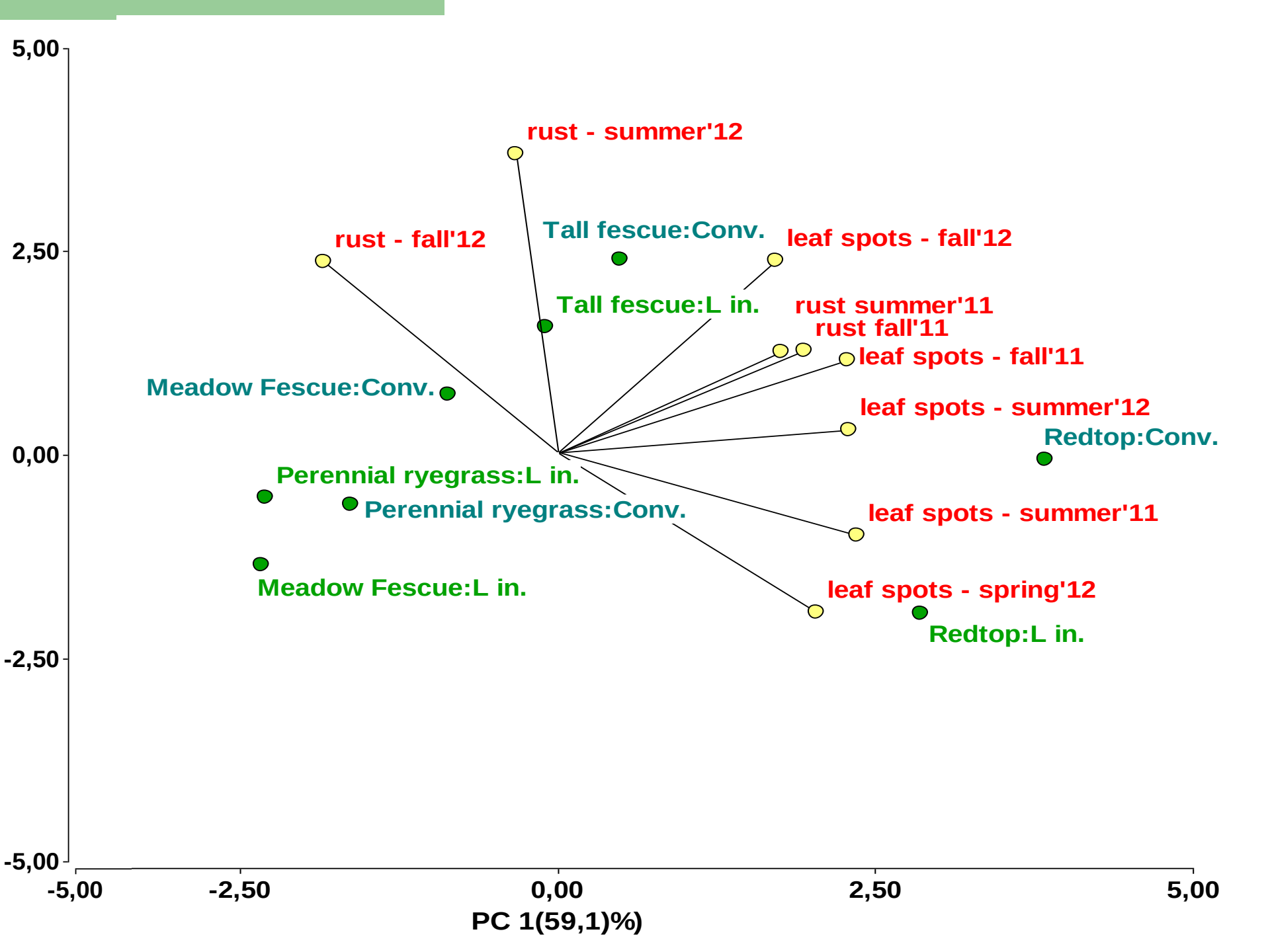

4,00
2,00
0,00
-2,00
-4,00
-6,00
-2,75
0,50
3,75
7,00
PC 2(18,7)%)
PC 1(50,9)%)
dray mass '09 (3rd cut)
green mass '09 (3rd cut)
Redtop:Conv.
Redtop:L in.
Meadow Fescue:Conv.
vigour - fall '09
Meadow Fescue:L in.
dray mass/green mass '09 (3rd cut)
Red Fescue:L in.
Leaf width - 1st cut'09
Timothy-grass:Conv.
Leaf lenght - 1st cut '09
dray mass/green mass 09 (1st cut)
Tall Meadow Oat:L in.
Smooth bromegrass:L in.
Kentucky Bluegrass:L in.
Kentucky Bluegrass:Conv.
Smooth bromegrass:Conv.
Timothy-grass:L in.
Wood Bluegrass:Conv.
Wood Bluegrass:L in.
vigour - spring '09
green mass '09 (1st cut)
dray mass ' 09(1st cut)
Tall Meadow Oat:Conv.


4,00
2,00
0,00
-2,00
-4,00
-6,00
-2,75
0,50
3,75
7,00
PC 2(19,5)%)
PC 1(62,8)%)
vigour - spring '10
Leaf width - 1st cut'10
Leaf length - 1st cut '10
Tall Meadow Oat:L in.
Timothy-grass:L in.
vigour - fall '10
dray mass/green mass '10 (3rd cut)
Smooth bromegrass:L in.
Tall Meadow Oat:Conv.
Timothy-grass:Conv.
Meadow Fescue:L in.
Wood Bluegrass:L in.
Meadow Fescue:Conv.
Wood Bluegrass:Conv.
dray mass/green mass '10 (1st cut)
Smooth bromegrass:Conv.
Kentucky Bluegrass:Conv.
Red Fescue:L in.
Red Fescue:Conv.
green mass '10 (1st cut)
dray mass ' 10 (1st cut)
Kentucky Bluegrass:L in.
dray mass '10 (3rd cut)
green mass '10 (3rd cut)
Redtop:L in.
Redtop:Conv.

Experimental Design
2010 - present

- 4 species: Meadow Fescue; Tall Fescue; Redtop; Perennial ryegrass
- 3 genotypes per species
- 2 management systems: low input and conventional

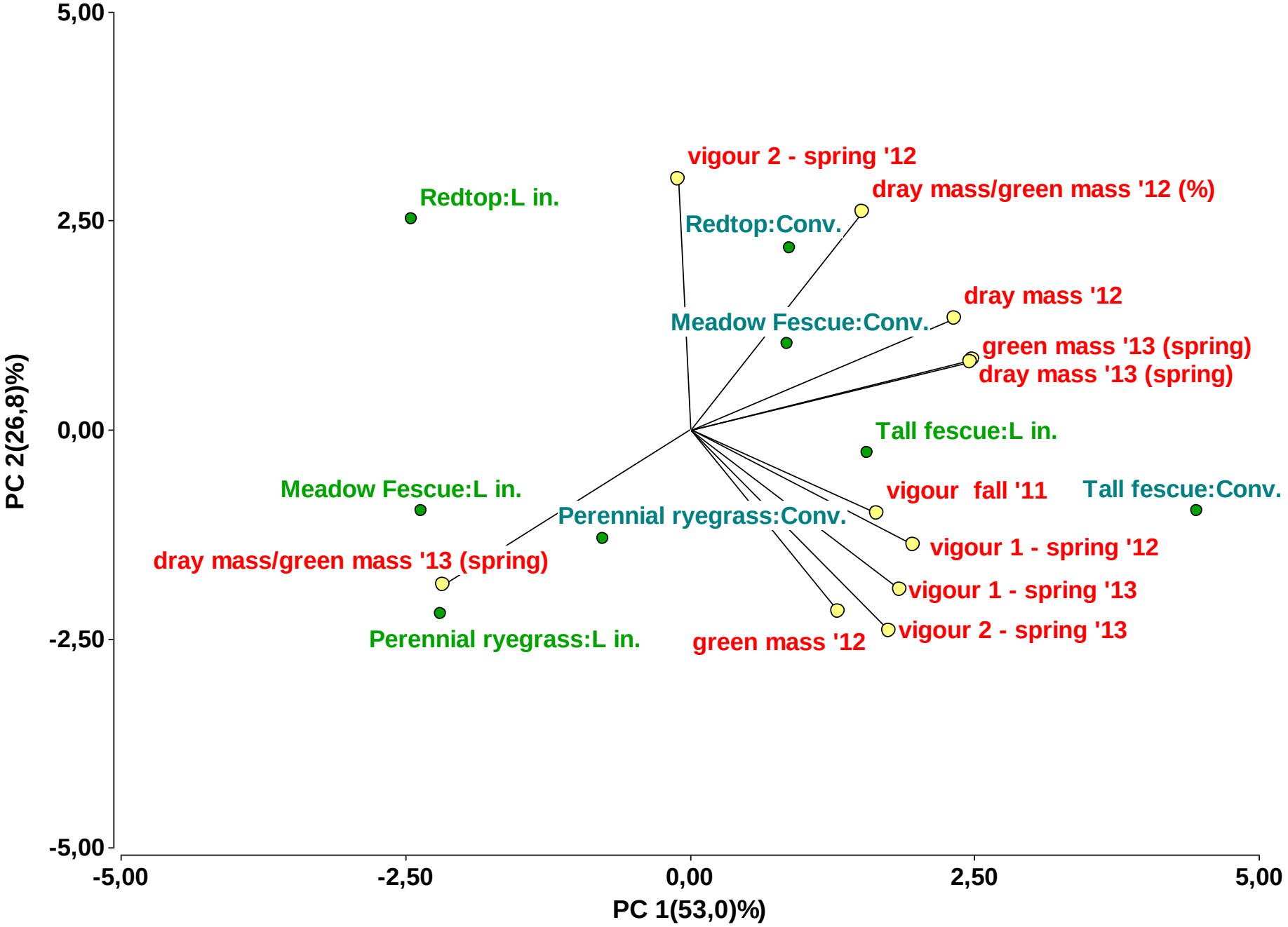
Year	Traits	
2008 (1st)	rusts (stem / crown)	summer
		fall
	leaf spots	summer
		fall
	fall performance (vigour)	fall
2009 and 2010	spring performance (vigour)	spring
	rusts (stem / crown)	summer
		fall
	leaf spots	summer
		fall
	leaf length	spring
	leaf width	spring
	green and dray mass production	spring (1st cut)
		summer (2nd and 3rd cuts)
		fall (4th cut)
	fall performance (vigour)	fall

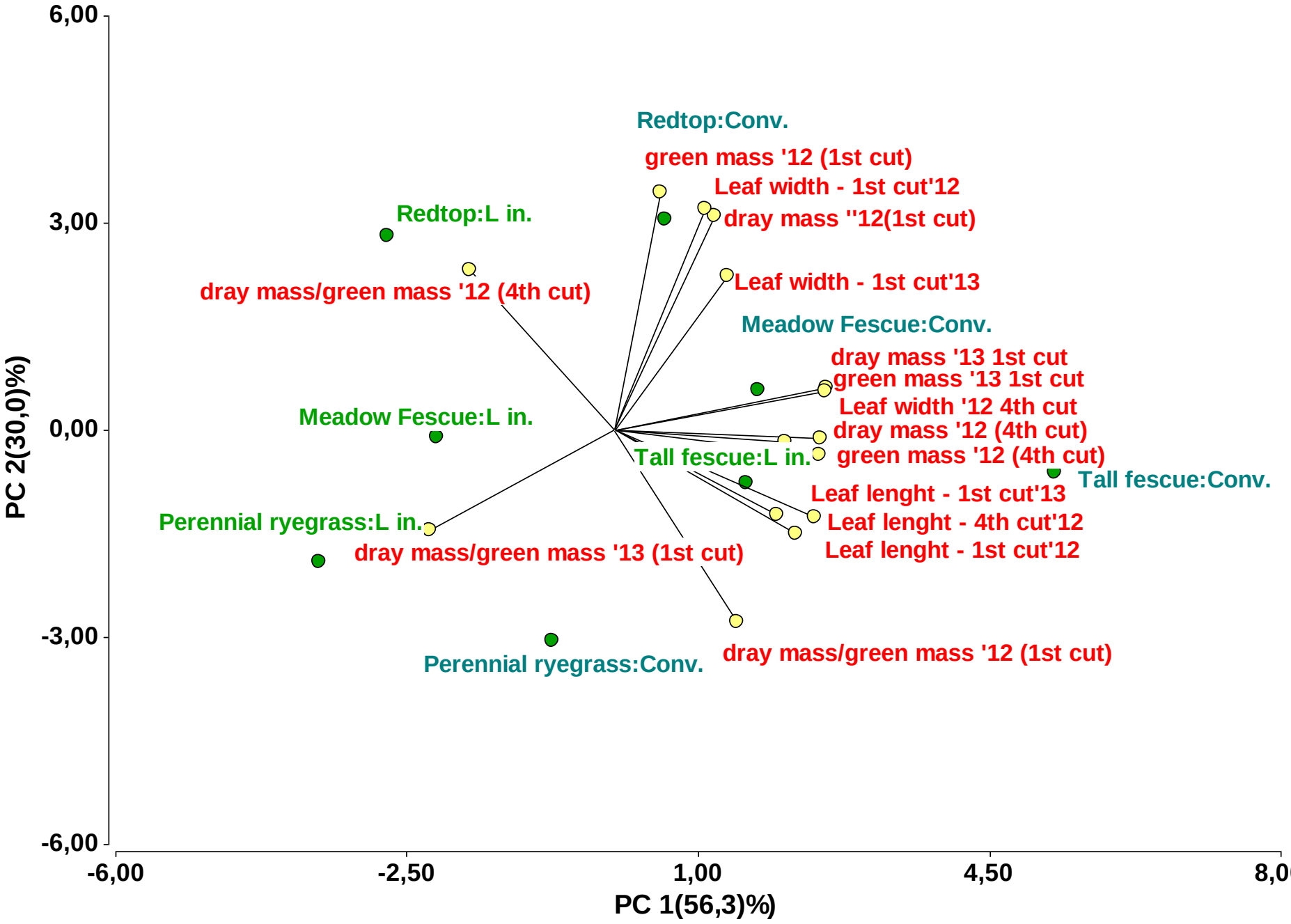

5,00
2,50
0,00
-2,50
-5,00
-5,00
-2,50
0,00
2,50
5,00
PC 1(59,1)%)
rust - summer'12
rust - fall'12
Tall fescue:Conv.
leaf spots - fall'12
Tall fescue:L in.
rust summer'11
rust fall'11
leaf spots - fall'11
Meadow Fescue:Conv.
leaf spots - summer'12
Redtop:Conv.
Perennial ryegrass:L in.
Perennial ryegrass:Conv.
leaf spots - summer'11
Meadow Fescue:L in.
leaf spots - spring'12
Redtop:L in.

RESISTANCE

Redtop

Meadow Fescue


5,00
2,50
0,00
-2,50
-5,00
PC 2(26,8)%)
-5,00
-2,50
0,00
2,50
5,00
PC 1(53,0)%)
vigour 2 - spring '12
dray mass/green mass '12 (%)
Redtop:L in.
Redtop:Conv.
dray mass '12
Meadow Fescue:Conv.
green mass '13 (spring)
dray mass '13 (spring)
Tall fescue:L in.
Meadow Fescue:L in.
vigour fall '11
Tall fescue:Conv.
Perennial ryegrass:Conv.
vigour 1 - spring '12
dray mass/green mass '13 (spring)
vigour 1 - spring '13
vigour 2 - spring '13
green mass '12
Perennial ryegrass:L in.


6,00
3,00
0,00
-3,00
-6,00
PC 2(30,0)%)
-6,00
-2,50
1,00
4,50
8,00
PC 1(56,3)%)
Redtop:Conv.
green mass '12 (1st cut)
Leaf width - 1st cut'12
dray mass ''12(1st cut)
Redtop:L in.
dray mass/green mass '12 (4th cut)
Leaf width - 1st cut'13
Meadow Fescue:Conv.
dray mass '13 1st cut
green mass '13 1st cut
Leaf width '12 4th cut
Meadow Fescue:L in.
dray mass '12 (4th cut)
Tall fescue:L in.
green mass '12 (4th cut)
Tall fescue:Conv.
Leaf lenght - 1st cut'13
Perennial ryegrass:L in.
Leaf lenght - 4th cut'12
dray mass/green mass '13 (1st cut)
Leaf lenght - 1st cut'12
dray mass/green mass '12 (1st cut)
Perennial ryegrass:Conv.

Conclusions

- **Differences between speciec are significant – we have a broad collections of marginal grasses and their descripton is needed**
- **programs for the collection and storage of natural forms, together with their detailed description of both should be conducted *in situ* and *ex situ*.**

THANK YOU FOR YOUR ATTENTION !!!