Identification of forage grass germplasm for water-limited environments and different soil types

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Permanent grassland are a source of healthy forage for a large group of ruminant animals. They also serve to conserve biodiversity, reduce environmental pollution, including nitrogen oxide and sulfur in the air. They can contribute to the agro ecosystem sustainability by reducing soil erosion and conserving soil water. Ecotypes may provide genetic resources to improve resistance / tolerance for water stress or different soil types. Water conservation is the responsibility of every citizen, not just in areas with drought or low moisture conditions. Drought resistance is being increasingly labelled as being a 'complex trait'. We also need to take into consideration soil conditions, lighting , use and maintenance issues, and even the visual appearance. Preliminary tests could be conducted under controlled conditions, however results should be confirmed under field conditions.

OBJECTIVE

The objective of this study was to identify genotypes tolerant to water defficyt and different soil types taken from degradated areas

MATERIALS AND METHODS

In the present study, ecotypes and commercial hybrids which belong to 7 cool-season grass species were used: tall fescue (*Festuca arundinacea*), meadow fescue (*F. pratensis* Huds.), red fescue (*F. rubra* L.), perennial ryegrass (*Lolium perenne* L.), Timothy-grass (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*) and *Deschampsia cespitosa*.

Ecotypes were collected from semi-natural areas representing different parts of Poland. Based on the preliminary description, 15 – 17 genotypes from each species, were included in this study.

seedlings were taken from field conditions and after vegetative propagation they were planted into pots. They grew for six weeks at an optimum moisture content of the soil (35 – 42%; soil type - mixture: 3 peat : 1 sand), were cut every 7 days at a height of 7 cm (red fescue - 4 cm).

Under greenhouse conditions two tests were conducted: (1) tolerace to water defficyt, (2) tolerance to the different soil type

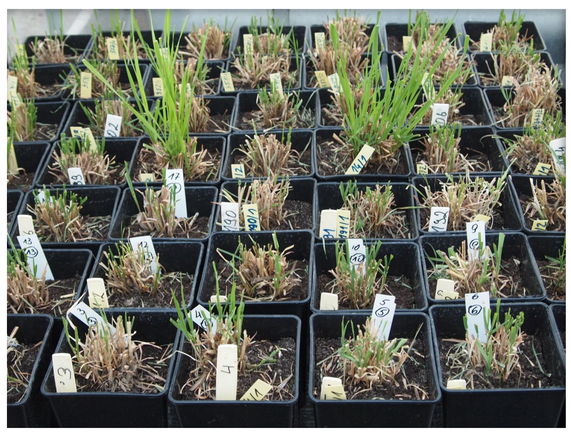


Foto 1. and 2. Tolerance to water – defficit

Tolerance to water deficyt

Experiment was conducted in the randomized block design. In the control treatments soil moisture was 35 – 40% and in the second treatment soil moisture was 8-10%. As before, every 7 days plants were measured and cut – during 3 weeks 1st, 2nd and 3rd cut was done. After this time, plants which grow in the treatment with water defficyt condition start to be watered and during the next 2 weeks they grow in the soil moisture as in the control treatment (35% - 40%), they were measured and 4th and 5th cut was done.

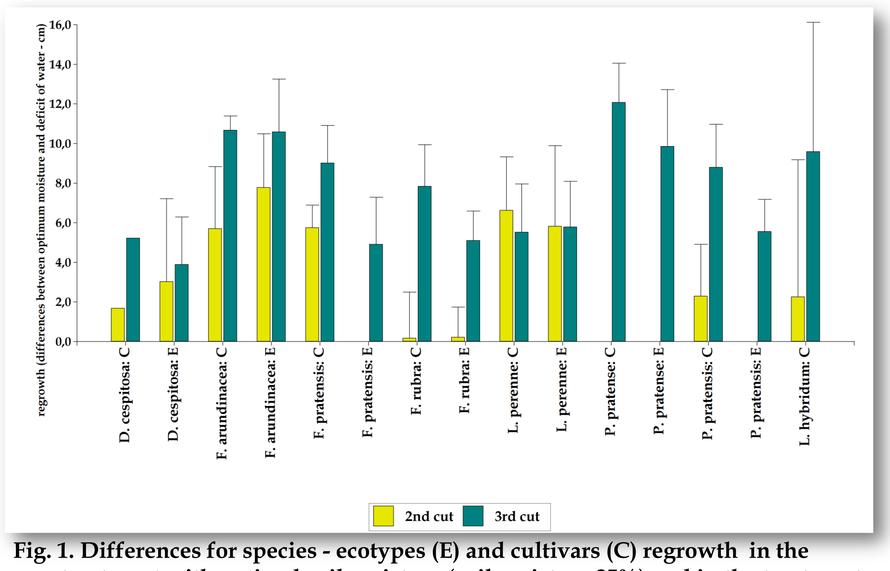


Fig. 1. Differences for species - ecotypes (E) and cultivars (C) regrowth in the treatment with optimal soil moisture (soil moisture 35%) and in the treatment with water defficyt (soil moisture 8 – 5%) after 2nd and 3rd cut.
Bars represent standard deviation.

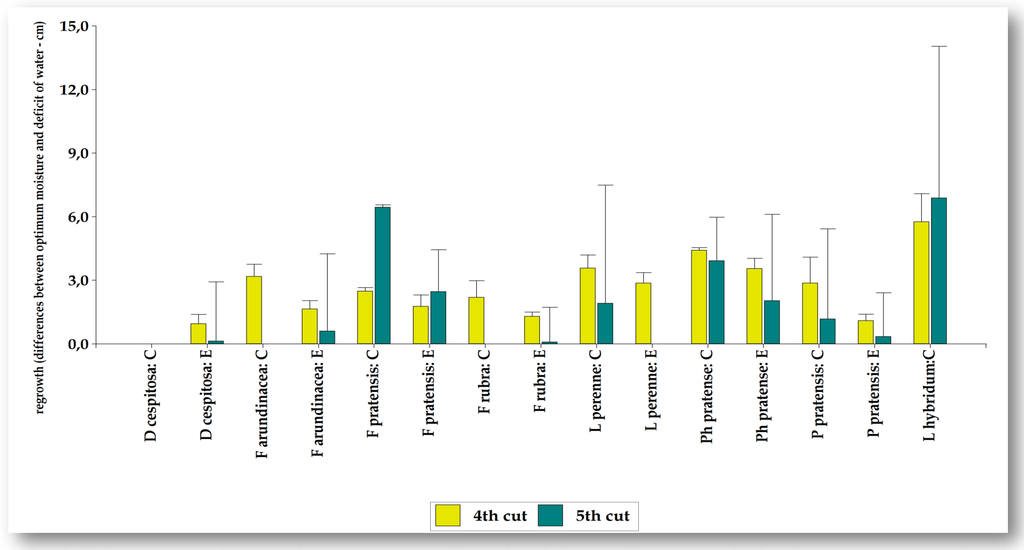


Fig. 2. Differences for species - ecotypes (E) and cultivars (C) regrowth in the treatment under optimum moisture (soil moisture 35%) and in the treatment when the moisture level of the soil was as on the optimal level 35% (regeneration after stress).
Bars represent standard deviation.

CONCLUSIONS

It was found that: (1) timothy is characterized by the larges decrease in the rate of regrowth under water defficit, differences *F. arundinacea* or *F. pratensis* regrowth in the treatment with optimal moisture and under water stress conditions are high (2), *F. arundinacea* and *Deschampsia cespitosa* and F. rubra quickly regenerate after a period of water deficit (3) meadow fescue and thimothy have a low ability to regenerate after water deficit, and (4) in all species it was possible to find genotypes tolerant to water deficit.

Tolerance to different soil types

soil type	acidity		phosphorus [mg/100g]		phosphorus [mg/100g]		magnesium [mg/100g]		boron [mg/kg]	
	pH w KCl	score	K3PO4	score	K2O	score	Mg	score	B	score
1st (degradated area)	7,2	neutral	5,1	low	2,5	very low	1,2	very low	0,36	low
2nd (degradated area)	7,1	neutral	18,6	high	4,5	very low	1,3	very low	0,82	low
control	6,9	neutral	>25	very high	>32	very high	17,8	very high	3,36	medium

soil type	N-organic [% p.s.m.]	C-organic [%]	subgroup grain size	sands	dusts		clays
				2,0-0,05	0,05-0,02	0,02-0,002	<0,002
1st (degradated area)	<0,032	0,46	loamy sand	79,4	7,1	11,7	1,8
2nd (degradated area)	0,14	1,76	sandy loam	56,5	19,6	20,8	3
control	0,21	2,15	sandy loam	74,6	12	11,8	1,8

soil type	manganese [mg/kg]		copper [mg/kg]		zinc [mg/kg]		iron [mg/kg]		heavy metals [mg/kgs.m.]	
	Mn	score	Cu	score	Zn	score	Fe	score	Pb	Cd
1st (degradated area)	275,6	average	2,3	average	3,5	average	243	high	3,3	0,23
2nd (degradated area)	210,6	average	2,3	average	10,9	average	210	high	5,3	0,33
control	173	average	4,8	average	28,5	high	308	high		

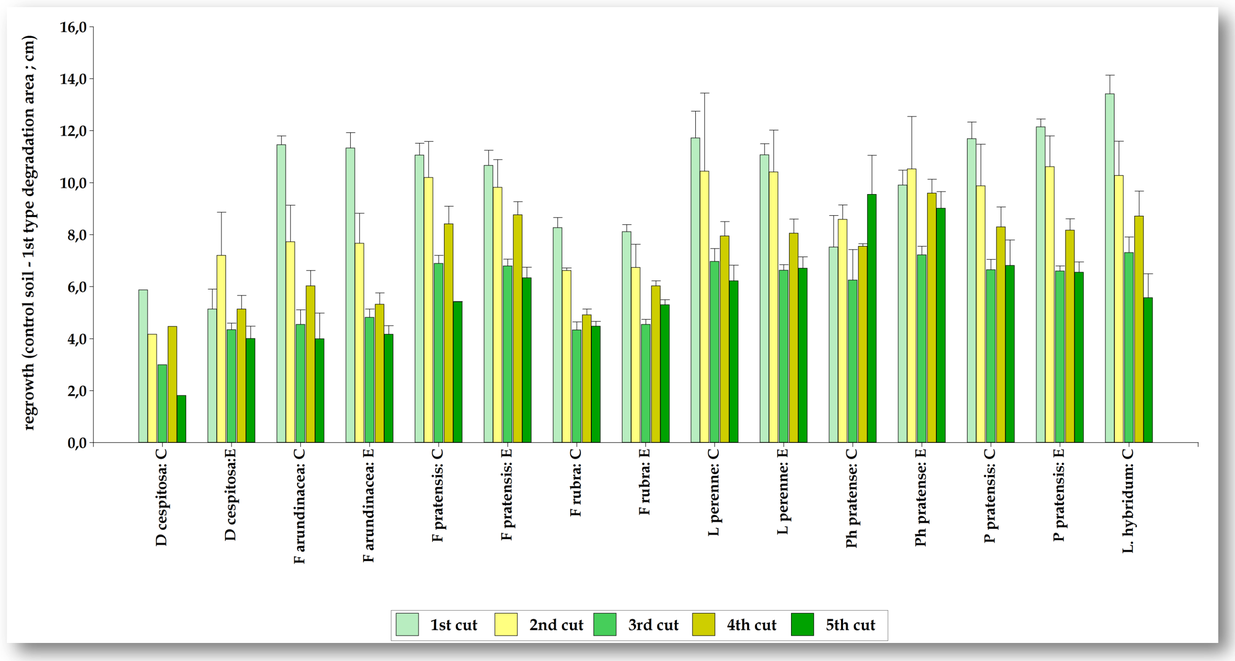


Fig 3. Differences for species – ecotypes (E) and cultivars (C) regrowth in the treatment with soil type used as a control one and in the treatment with 1st type of soil (characterized in table 1).
Bars represent standard deviation.

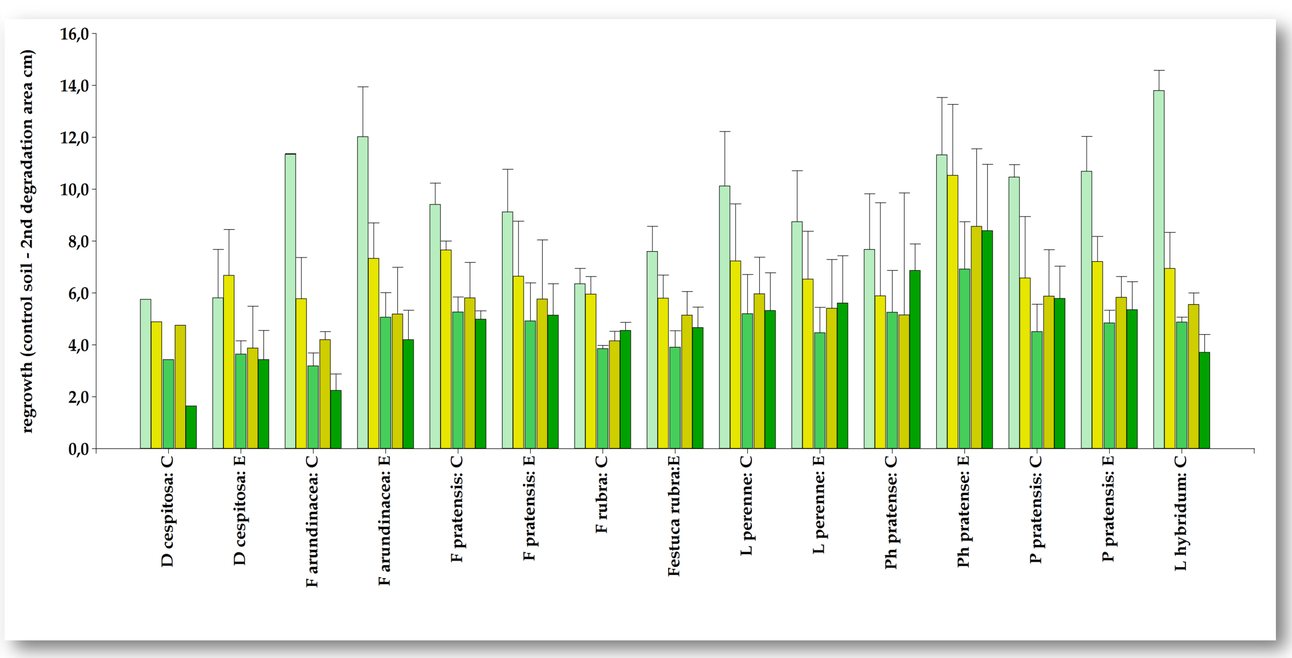
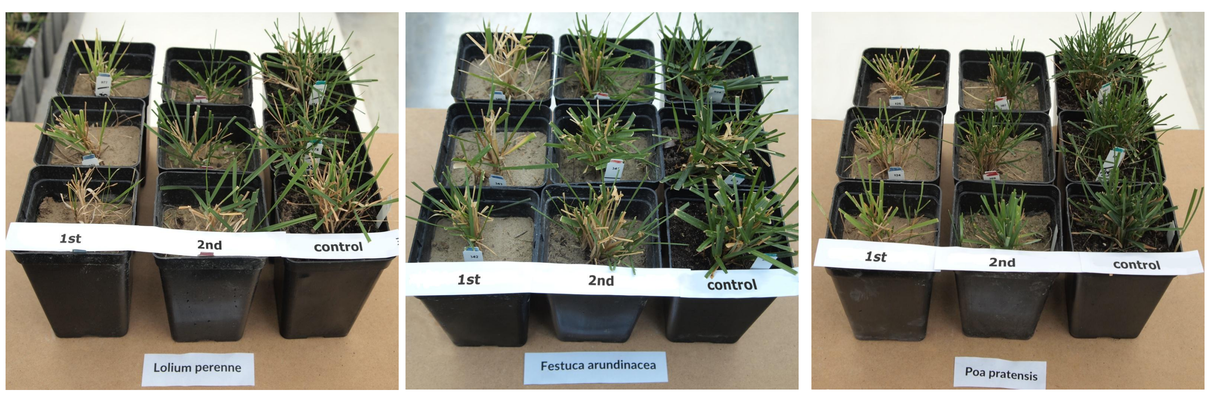
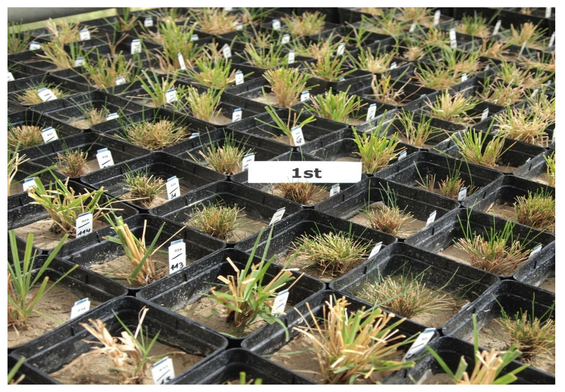


Fig 4. Differences for species – ecotypes (E) and cultivars (C) – regrowth in the treatment with soil type used as a control one and in the treatment with 1st type of soil (characterized in table 1).
Bars represent standard deviation.





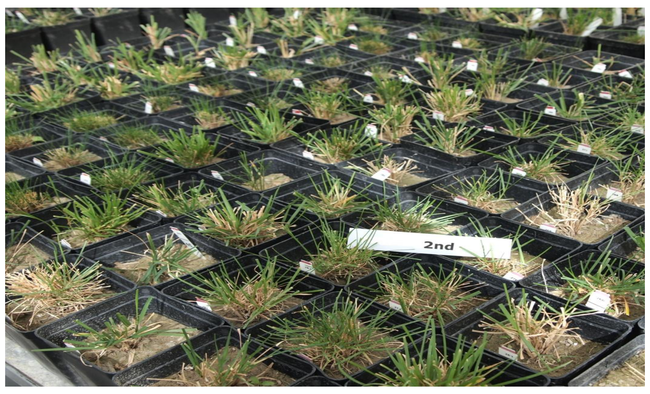


Foto. 3, 4, 5, 6 and 7. Soil stress tolerance

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