

# Abiotic stress tolerance in perennial grasses – recommended for the management of dry and degraded areas

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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 limit or different soil type. 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 control conditions, however finally obtained 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 degraded areas.

## ❖ Materials and Methods

- 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 (content).



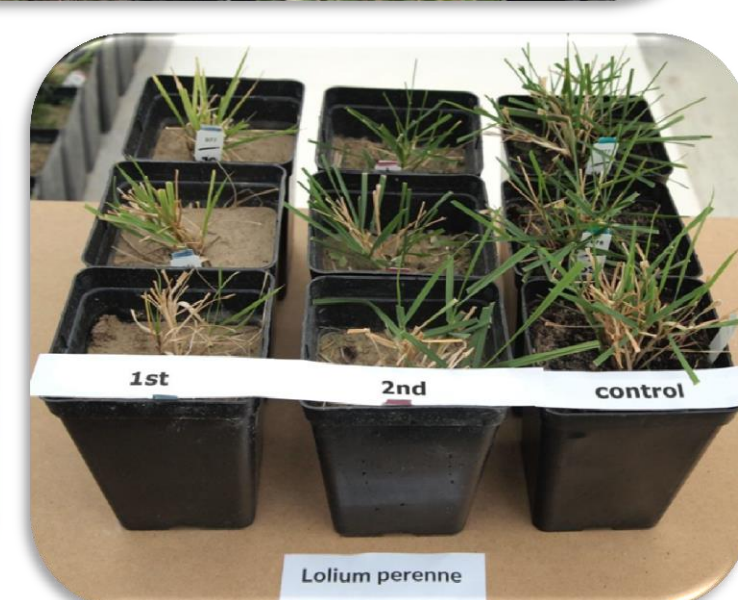
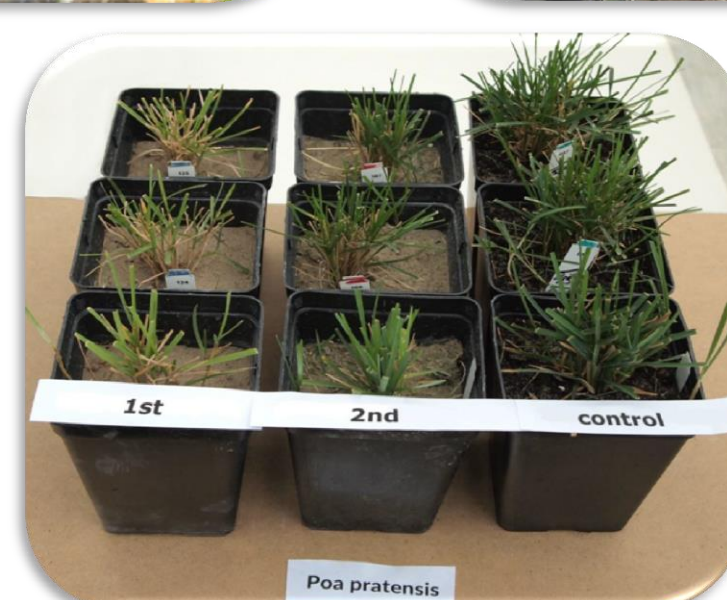
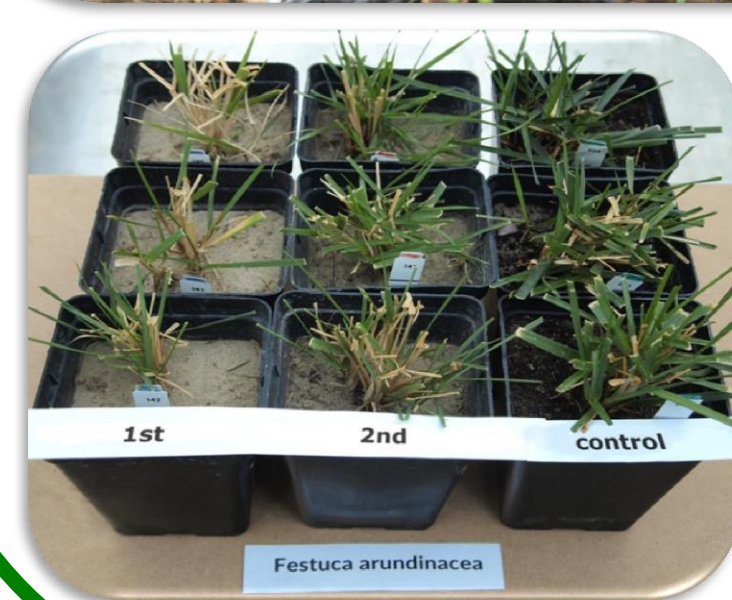
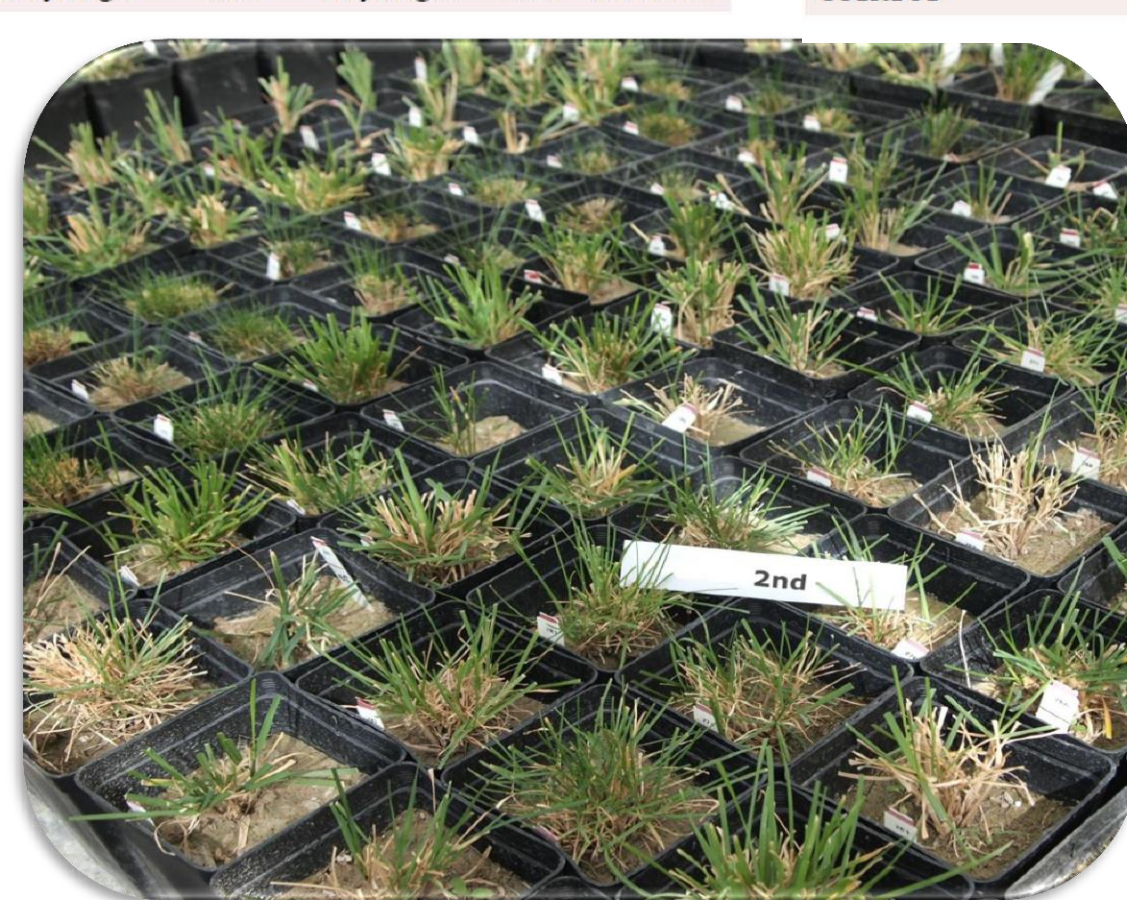
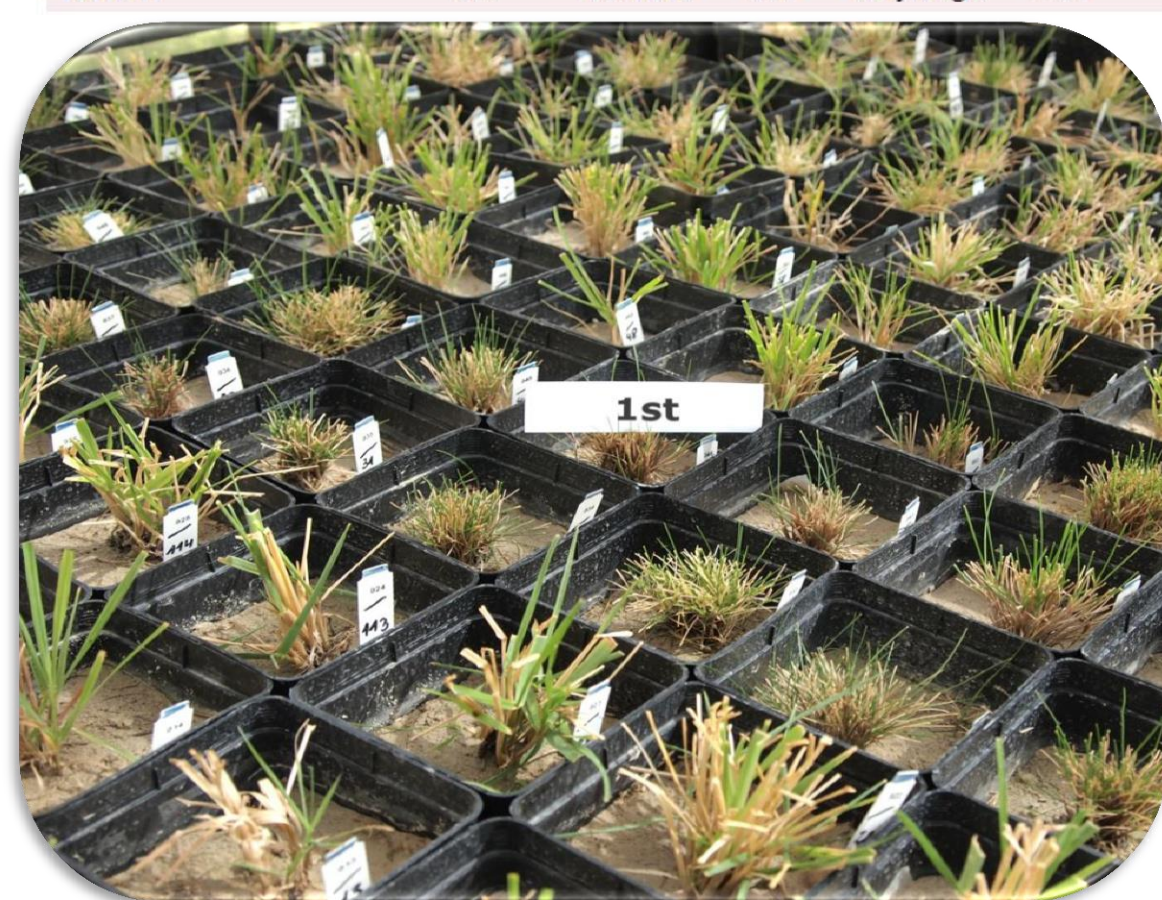
## ❖ Soil content stress

- Tolerance to different soil type: tree treatments – (1) soil with low phosphorus, magnesium n-organic, C-organic content, (2) soil with high clay content and low phosphorus and magnesium content, (3) control (mixture: 3 peat : 1 sand). Plants were cut every 7 days at a height 7 cm (red fescue - 4 cm), and regrowth measured.

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 (degraded area)	7,2	neutral	5,1	low	2,5	very low	1,2	very low	0,36	low
2nd (degraded 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 (degraded area)	<0,032	0,46	loamy sand	79,4	7,1	11,7	1,8				
2nd (degraded 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/kg.s.m.]	
	Mn	score	Cu	score	Zn	score	Fe	score	Pb	Cd
1st (degraded area)	275,6	average	2,3	average	3,5	average	243	high	3,3	0,23
2nd (degraded 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		



leaf area elongation (cm)

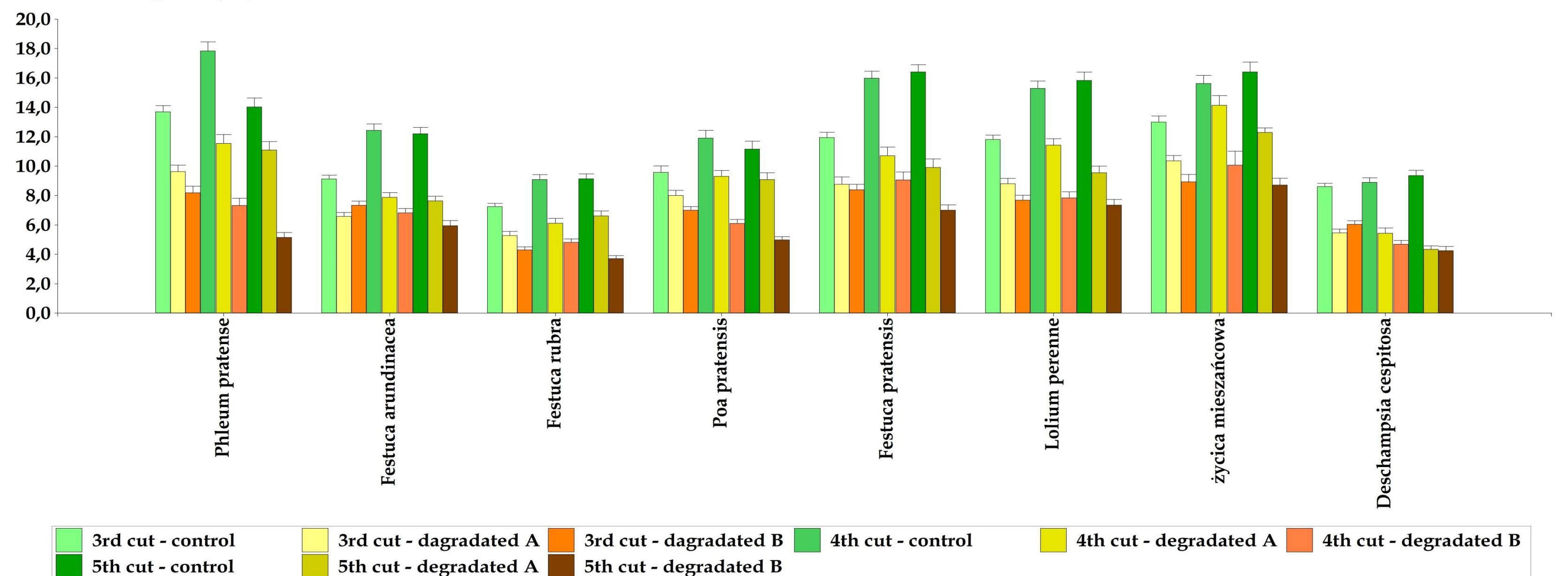


Fig 1. Differences between species – ecotypes (E) and cultivars (C) – regrowth in the treatment with soil type used as a control one and in the treatment with 1st type of soil (characterized in table 1). Bars represent standard error.

## ❖ Water deficit

- 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 6 weeks 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>, 4<sup>th</sup>, 5<sup>th</sup>, cut was done. After this time, plants which grow in the treatment with water deficit 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 6<sup>th</sup>, 7<sup>th</sup> cut was done.

leaf area elongation (cm)

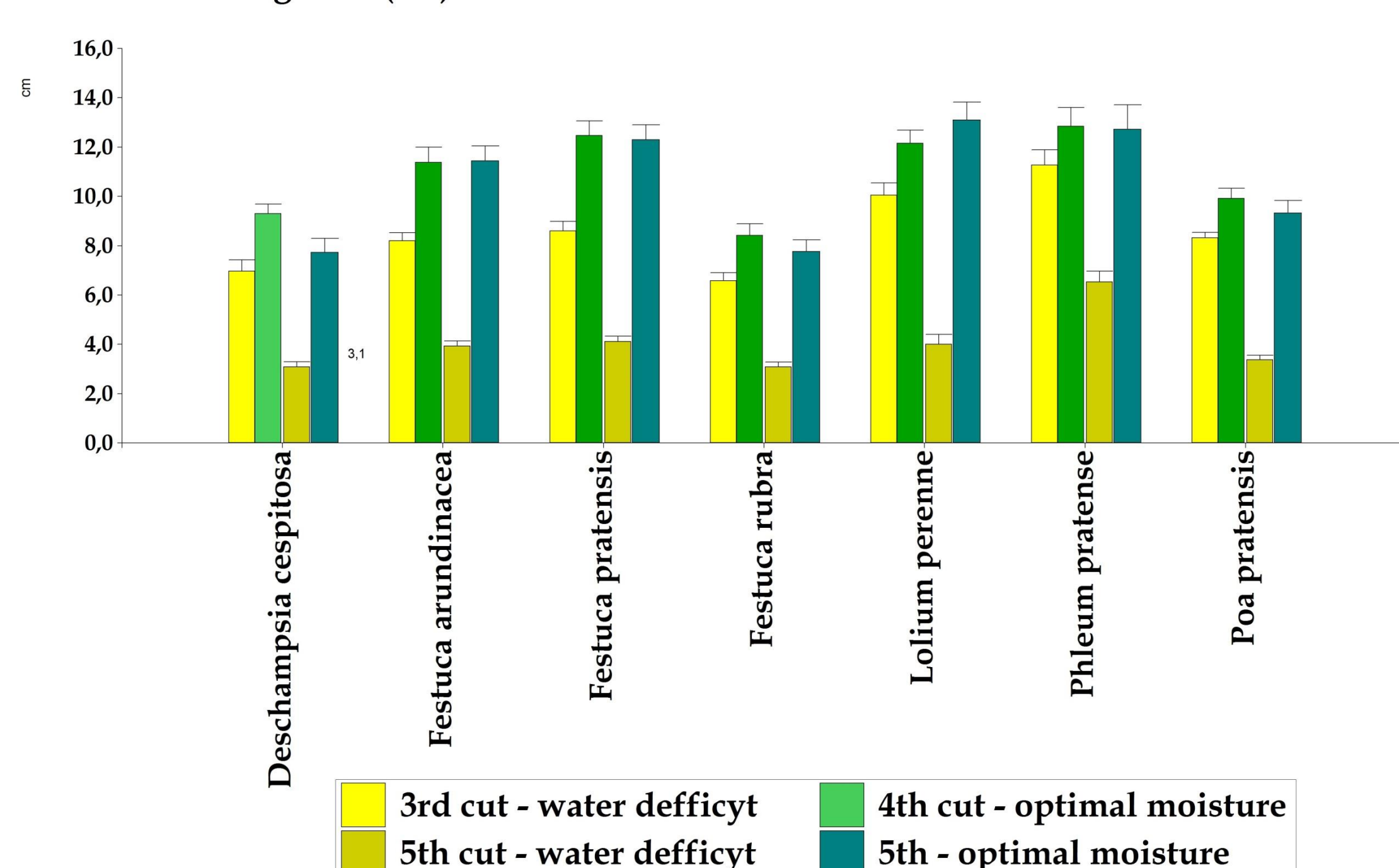


Fig. 2. Differences between species - ecotypes and cultivars regrowth in the treatment with optimal soil moisture (soil moisture 35%) and in the treatment with water deficit (soil moisture 8 – 5%). Bars represent standard error.

leaf area elongation (cm)

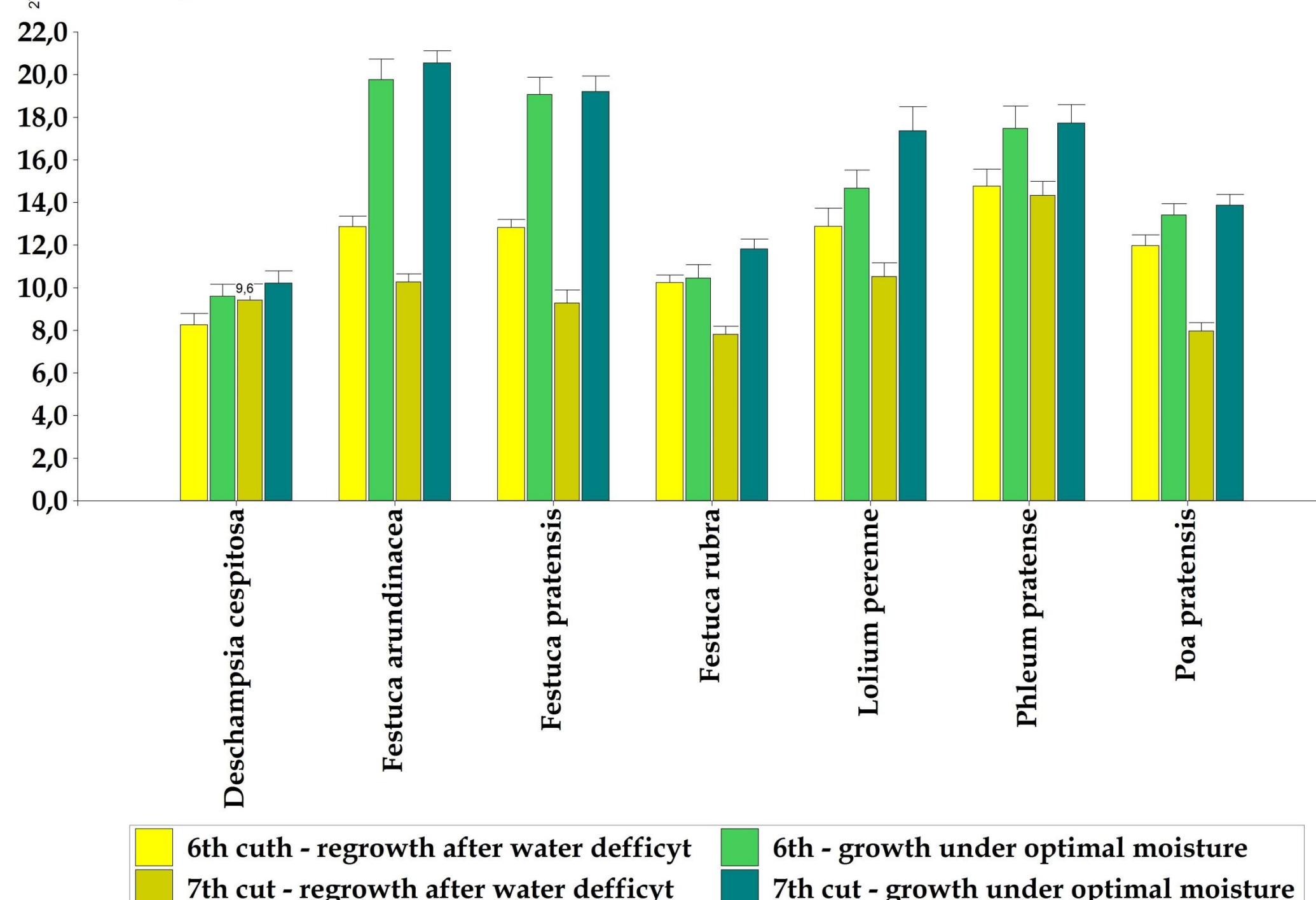


Fig. 3. Differences between species - ecotypes and cultivars regrowth in the treatment with optimal soil moisture (soil moisture 35%) and in the treatment with water deficit (soil moisture 8 – 5%) – 6<sup>th</sup> and 7<sup>th</sup> cut. Bars represent standard error.

