Bavarian State Research Center for Agriculture

Institute for Crop Science and Plant Breeding

LfL Pflanzenbau

Detection of Genetic Diversity for Drought Tolerance in Perennial Ryegrass (*Lolium perenne* L.)

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Potential for biomass production and persistance are the main determinants of yield strongly influenced by external factors. One of the most important factors influencing yield is the availability of water. The project presented followed two main aims: identifying easily accessable **phenotypic traits** for recording drought stress answer in grasses and screening a wide **genetic diversity** of *Lolium*-accessions for **drought tolerance**.

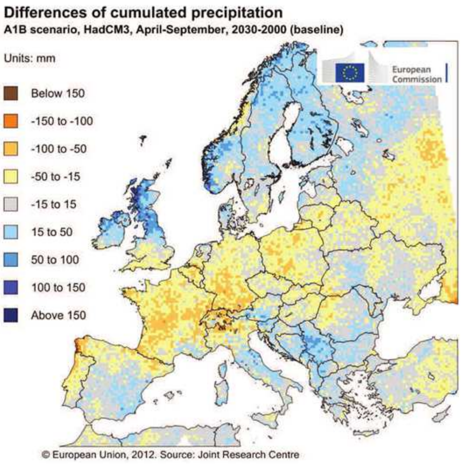

Fig. 1: Differences of cumulated precipitation (2030) for April - September. (Source: Final report of AVEMAC project 2012)

Introduction: Global climate change will have major impact on plant production in Central Europe. A general reduction of precipitation during the vegetation period is predicted (Fig. 1). Thus yield of many crop species will be affected. Perennial ryegrass as one of the most important grass species will be particularly affected by summer drought periods, as it has no distinct drought tolerance. Fig. 2 showes the impact of climate change on wheat yield in Europe, similar effects are expected for ryegrass.

As one possible solution, screening genetic variability for the use in breeding new drought tolerant varieties is presented.

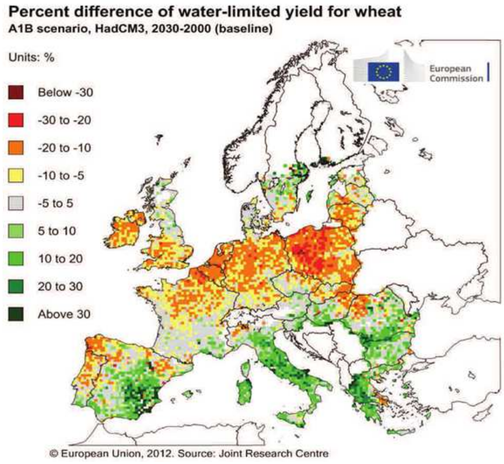

Fig. 2: Change of simulated water-limited wheat yield until 2030 based on scenario A1B. (Source: Final report of AVEMAC project 2012)

Results and Discussion: Testing 200 *Lolium*-accessions revealed a wide genetic variation for biomass growth (scale from 1 to 9 with 9 maximum biomass growth) under drought conditions at cutting date 4 after mild drought conditions (Fig. 3 left). Data for the single locations Kaltenhof and Triesdorf showed a correlation of r = 0.42.

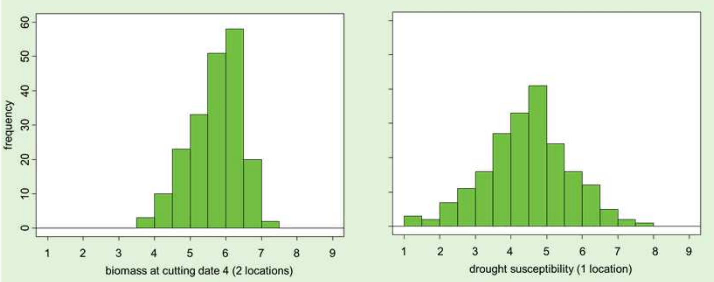

Fig. 3: Histograms of biomass growth at cutting date 4 adj. means of locations Kaltenhof and Triesdorf, and visual drought stress response at Location Les Rosiers sur Loire in the year 2013.

Visual scoring of drought stress response on a scale from 1 to 9 with 1 showing no symptoms and 9 with strong symptoms (wilting, leaf rolling, leaf colour) revealed only repeatable results when severe drought conditions occurred. Fig. 3 right showes results from location Les Rosiers sur Loire in June 2013. Correlation with biomass at cutting date 4 was r = 0.40.

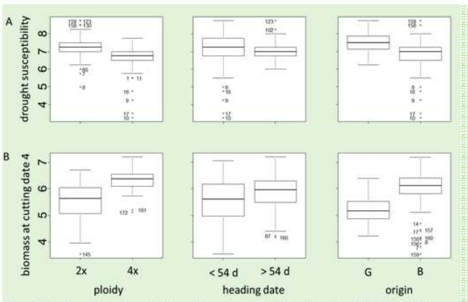

Fig. 4: A: visual scoring of drought response in Les Rosiers 2013 and B: visual biomass scoring before cutting date 4; G. genebank, B: breeders material

High heritabilities were found for most traits of biomass growth, indifferent response given by traits describing visual drought response depending on strength of drought stress (Tab. 1).

Biomass growth and drought response was influenced by ploidy and selection in breeding material, but not by heading date (Fig. 4). The most promising drought tolerance mechanism seemed to be the regrowth ability after a limited period of time.

Tab.1: Heritabilities of traits in three years multilocation analysis

trait	h^2 2012	h^2 2013	h^2 2014
STVWIN	65.92		
MBANF	68.57	86.69	86.99
MBVSC1	18.14	59.77	74.70
MBVSC2	59.53	70.52	
MBVSC3	80.05		69.86
MBVSC4		54.61	63.11
DURSD1	40.76	0.00	0.00
DURSD2	1.94		41,99
WGRUEN1		57.29	
GELBF1		49.36	

STVWIN: development before winter; MNVW: scarcity before winter; MNNWI: scarcity after winter; MBANF: biomass at begin of vegetation period; MBVSC: biomass at cutting timepoints; DURSD: drought symptoms; WGRUEN: recovery of green leafes; GELBF: yellowing

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