

## Effect of genotype-by-environment interaction on cool-season grass water-soluble carbohydrate concentrations

Joseph Robins, USDA

Shaun Bushman, USDA

Alan Lovatt, IBERS

Ulf Feurestein, DSV AG

We conducted two evaluations of cool-season grasses to assess WSC concentrations under western North America production conditions. The WSC concentration in cool-season grasses is quantitatively inherited. This results in wide phenotypic variation among genotypes and interaction between genotypes and environments. These studies were to determine the genotype-by-environment interaction (GEI) on WSC concentration across widely differing environments. The first study characterized the GEI of 19 perennial ryegrass (*Lolium perenne* L.) cultivars developed by IBERS that possessed differing WSC concentrations. The second study jointly characterized the GEI of two sets of orchardgrass (*Dactylis glomerata* L.) half-sib families from USDA and DSV AG for WSC concentration. The first study utilized environments in Wales, Scotland, and a line-source irrigation system in Utah. The second study utilized environments in France, Germany, Idaho, and Utah. In both studies, data collection included herbage dry matter production and WSC concentration, in addition to other nutritive value measurements. For the perennial ryegrass study, mean WSC concentrations ranged from 231 g · kg<sup>-1</sup> at the Wales environment to 101 g · kg<sup>-1</sup> at the two lowest irrigation levels in Utah. The ranking among the cultivars for WSC concentration also varied depending on environment. The cultivar 'AberMagic' possessed the highest WSC at the two UK environments. The cultivar 'AberWolf' possessed the highest WSC at the UT environment. Rank correlations for WSC were high between the two UK environments ( $\tau = 0.93$ ,  $P < 0.01$ ), but generally low to moderate among the irrigation levels of the Utah line-source environment and between UK and Utah environments. For the orchardgrass study, the 91 orchardgrass half-sib families also exhibited genotypic and GEI differences for WSC concentration. Concentrations ranged from 5.1 % in Idaho in 2014 to 9.7 % in France and Germany in 2015. There were substantial differences in ranking among the half-sib families for WSC concentration in each environment. In the European environments, the USDA half-sib families possessed higher WSC than the DSV half-sib families, but there were no differences between the two in the US environments. In both studies the European environments resulted in nearly two-fold higher WSC than the US environments. Although this difference may partially stem from different WSC measurement methods, it may also be a product of higher summer temperatures and lower photosynthetic efficiency in the US environments. The GEI effects for between European and US environments for both species highlight that breeding for this trait must be environment specific. Efforts to dissect the genetic determinants of WSC concentration are on-going to further breeding efforts.