Exploring strategies for yield stability in maize

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Introduction

Kernel number (KN) at harvest is the main component associated with maize grain yield (GY). KN is a function of the physiological conditions of the plant during the period bracketing silking. Breeding efforts resulted in a large increase in GY associated with improvements in KN. In addition, there is great variability in GY stability for modern hybrids in multi-environment experiments.

Objective

The objective of this study was to identify moments of higher susceptibility to stresses of different intensities within the critical period for KN determination for hybrids exhibiting contrasting yield stability.

Materials and Methods

An experiment was carried out in Balcarce, Argentina during the 2011/12 growing season. Two hybrids, DK747MGRR2 (lower GY stability) and DK670MGRR2 (higher GY stability) were sown on October 6th and exposed to short shading stresses (5 days) of two intensities (65 and 85 percent of incident radiation reduction) at three moments (R1, R2, R3), including a control treatment (Table 1).Experimental area consisted of 20 rows of 40 m with an inter-row space of 0.7 m. The experimental unit consisted of 12 plants with a plant density of 8.5 plants m^{-2}. Shade treatments were performed by duplicate (blocks) using tents made by plastic mesh and pipes. GY and its components, i. e., KN and weight per kernel (KW) were estimated. Data were analyzed using R software.

Moment of shading stress	R1	R2	R3
Thermal time after emergence (°C.d^{-1})	860.9	979.3	1098.9
Length of stress (°C.d^{-1})	85.9	72.6	81
Incident radiation during stress of 85% (MJ.m^{-2})*	21.18	19.32	14.7
Incident radiation during stress of 65% (MJ.m^{-2})*	49.42	45.08	34.3

Table 1: Moment, long and intensity of treatments. *Incident radiation is presented as photosynthetic active radiation during the long of stress.

Results

Kernel number per plant for control plots averaged 569 ± 19 and 548 ± 22 for DK747MGRR2 and DK670MGRR2, respectively. KN was most reduced by the 85% shading across moments and hybrids (Figure 1 A). When the stresses occurred at R1 and R2, KN was reduced by approximately 30% and 17% respectively, for both hybrids. Conversely, with stresses at R3, reductions in KN were greater for DK747MGRR2 (30%) than for DK670MGRR2 (10%). This respond to an interaction between moment of stress and hybrid on KN (p= 0,0312). Accordingly, incident radiation during the third stress were almost ¾ comparing with previous stress moments.
Kernel weight for control treatments was 301 ± 4 and 318 ± 6 mg for DK747MGRR2 and DK670MGRR2, respectively. There was no interaction among hybrid, moment and intensity of the stress for KW, and also there was no effect of this factors (Figure 1 B).
Grain yield per m^{-2} for control plots was 1452 ± 90 and 1480 ± 39 g for DK747MGRR2 and DK670MGRR2, respectively. GY was affected by stress moment, stress intensity and hybrid with no evident interactions (Figure 1 C). However, there was a trend indicating an interaction between the stress intensity and the hybrid (p= 0,0761). Reductions in GY were associated with reductions in KN, but in some cases attenuated by variations in KW.

Conclusions

This information contributes to understand differences in hybrids stability.
The low stability hybrid (DK747MGRR2) presented greater yield reduction when it was exposed to a short shading stress in different moments after flowering.
Kernel number explained most of the variation of grain yield.
Our results indicate that part of the differences in hybrid stability could be related to the extension of the period for KN determination.

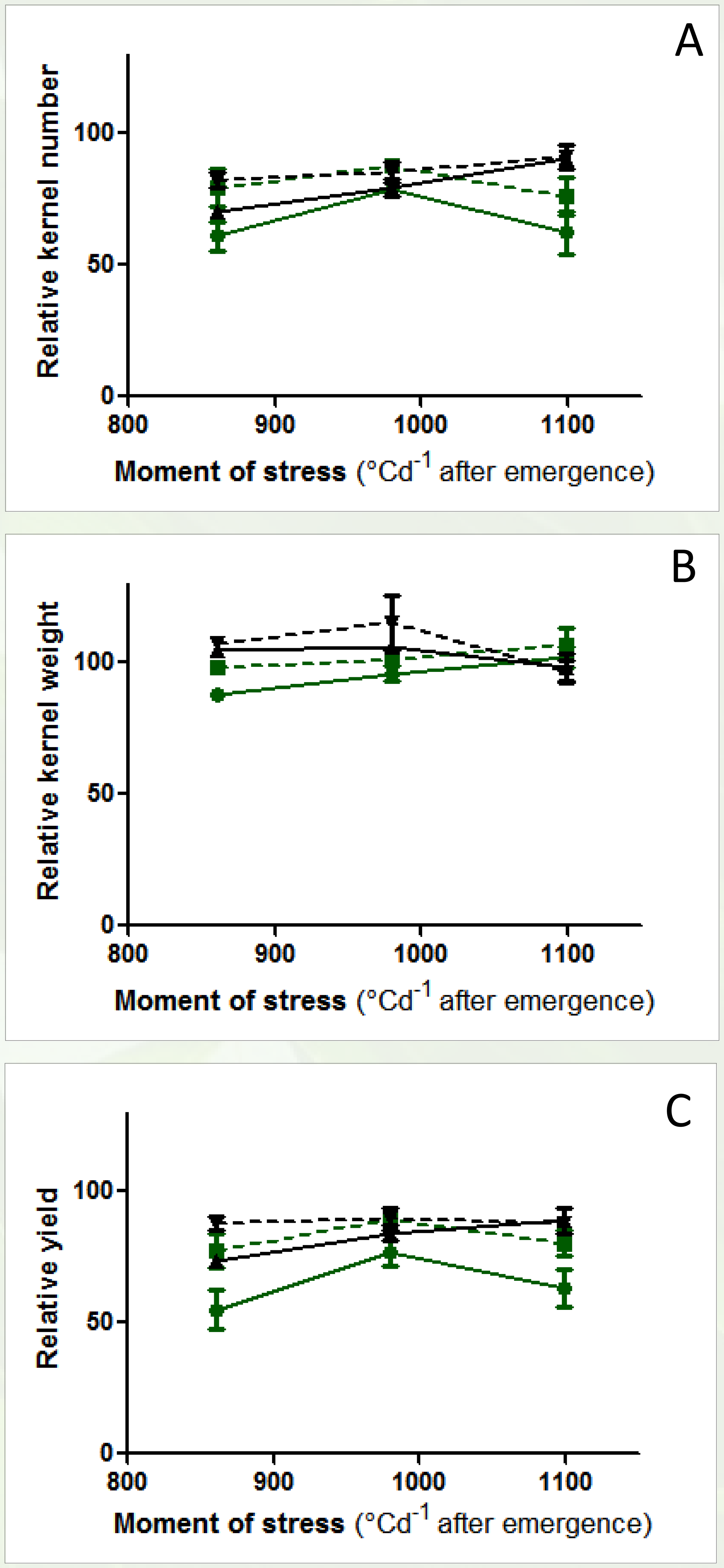

Figure 1. Kernel number (A), kernel weight (B) and grain yield (C) as a function of stress moment. Green lines correspond to DK747MGRR2 and black lines to DK670MGRR2. Dashed and solid lines represents the 65% and 85% shading stress intensity , respectively. Data are presented in relative terms to the control treatments.