Stem reserves and the response of barley to elevated post-anthesis temperature

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Barley is usually thought to be more drought resistant than wheat and in southern New South Wales is frequently sown later in the season than wheat for this reason. Such a delay in sowing can reduce yields and may reduce grain size, so reducing malting quality. Some of the yield reduction could be due to the effects of high temperature on the rate and duration of grain filling. This paper describes a field experiment in which the effects of elevated post-anthesis temperature on grain filling were measured. Concurrent changes in stem weight were measured to explore the apparent role of labile sugars, stored in the stem before flowering.

Methods

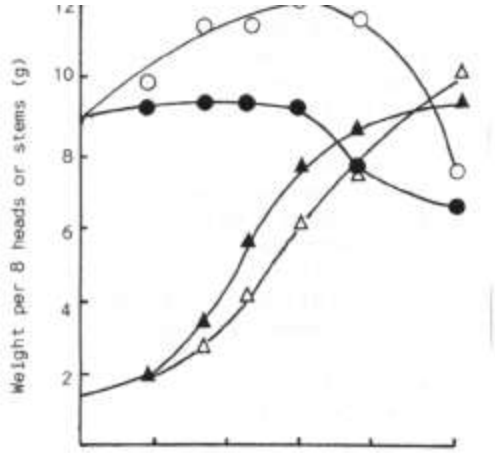
Schooner barley was grown in the field at Wagga Wagga with adequate fertilizer and unlimited water. At anthesis (23.9.86) quadrats 1.2 m^2 were enclosed in clear polythene sheeting to form a square chamber 3 m high, open at the top. Air was admitted near the bottom of the crop canopy, at ambient temperature in one treatment and 2.9?C above ambient (ambient mean = 14.4?C) in another. Sets of 8 matched stems were sampled periodically during grain filling. Green leaf weight, the lengths and weights of heads and stems, and stem sugar concentrations were measured. There were 3 replicates.

Results and Discussion

Raising air temperature by 2.9?C after flowering significantly ($P < 0.01$) increased the rate and reduced the duration of grain filling. Grain size and grain yield were reduced (by 12%) but not significantly ($P = 0.05$). The reduction in stem weight between anthesis and maturity was assumed to result mainly from translocation of pre-anthesis assimilate to the grain. It accounted for 12% and 22% of grain yield in the control and heated treatments, respectively.

Stem weight in the control treatment rose for 30 days after anthesis, due mainly to the accumulation of sugars, whilst green leaf weight declined to near zero. Grain filling continued after 30 days by apparently drawing on these sugars. They accounted for 50% of grain yield. In the heated treatment stem weight increased only slightly after flowering so presumably less assimilate was available late in grain filling. This temporary storage accounted for 33% of grain yield.

This indicates that stored pre-anthesis assimilate may be important as a buffer against later high temperatures. Of greater potential importance is the assimilate accumulated in stems early in grain filling and used later, when current assimilation is declining. Elevated temperatures reduced this storage and appeared to reduce grain size.



Effect of elevated temperature (closed symbols) on grain filling (LA) and concurrent changes in stem weight (CAD) of Schooner barley in well-watered field plots.