C3. Gibberellin and Abscisic Acid in Germinating Cereals

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INTRODUCTION

Study of the response of cereal aleurone to gibberellic and abscisic acids (GA and ABA, respectively), particularly with reference to α-amylase synthesis, has made a significant contribution to our understanding of GA action in plant cells especially as it relates to the control of protein synthesis. While much of the work has been carried out using isolated aleurone from a single cultivar of barley ("Himalaya"), it seems so far that the principles which have emerged from this system can be applied to in vivo behaviour of other cereal grains.

This article is a synopsis of our understanding of hormone action in aleurone. It briefly discusses the role of GA and ABA in grain development, and the influence of environment and genotype of the developing grain on hormone responsiveness of mature aleurone. For background information and for more comprehensive documentation and referencing of earlier studies, the reader is referred to recent reviews (4,5,8,28,30,56).

The incubation of isolated aleurone layers in media containing specified concentrations of GA and/or ABA, has been extensively studied as a model for hormone action in plants. The main observation is that GA (coming from the developing embryo in the case of a germinating seed, or added to the media in the case of isolated aleurone layers) can stimulate aleurone cells to secrete a range of hydrolytic enzymes, in particular α-amylase (Fig. 1). These enzymes are responsible for the mobilization of stored endosperm reserves which provide the growing seedling with a supply of fixed carbon and reduced nitrogen. The interest in ABA lies in the observation that it can prevent the action of GA if present in excess, and induces its own set of proteins in isolated aleurone.
HORMONES IN DEVELOPING GRAIN

While the responses of mature isolated aleurone to applied GA or ABA are fairly well understood, quantitative aspects of the response can vary between different harvests of the same cultivar. This observation suggests that environmental conditions during grain development can influence the eventual hormone responsiveness of aleurone. For example, it has been shown that aleurone from barley grown in relatively high temperatures produces high levels of α-amylase in the absence of added GA (47). In normal development, cereal seeds accumulate significant levels of both GA and ABA (see below); since the activity of these hormones during grain development, or their residual levels in the dry seed may influence subsequent aleurone behaviour during and following germination, we will begin by considering the role of GA and ABA in the developing grain before going on to discuss the response of aleurone from mature seeds.

Gibberellins in Developing Grain

The accumulation of GA activity in developing grains of wheat and barley (Fig. 2) occurs as fresh weight increases and peak levels (100-700 pg GA₃ equiv. per grain) are attained prior to maximum dry weight (43,50). Most of the GA present during development is in the endosperm (which includes the aleurone), testa and inner pericarp. As maturation