E 12. The Role of Hormones in Photosynthate Partitioning and Seed Filling

Mark L. Brenner
Department of Horticultural Science and Landscape Architecture, University of Minnesota, St. Paul, Minnesota 55108, USA.

INTRODUCTION

The movement of photoassimilates from sites of synthesis in leaf tissue (source) to the sites of net accumulation in a different tissue (sink) potentially can be regulated at numerous points. Regulation of the net flow of photoassimilates is an integrated process. It is generally accepted that the concentration gradient of photoassimilates between the source and sink is the primary determinant of the current rate of transport and pattern of partitioning (14, 19, 60). However, close examination of the various components involved in the overall process of partitioning indicates that endogenous plant hormones may serve as modulators of many of the specific rate limiting components. This chapter will focus on the involvement of plant hormones as natural regulators of partitioning of photoassimilates especially to developing seeds.

THE PATHWAY OF PHOTOSYNTHATE PARTITIONING

In simplest terms, regulation of photosynthate partitioning can occur within the leaf, along the transport pathway, or within the seed. For clarity, each of these components will be discussed separately (Fig. 1).

The extent of partitioning within the leaf may be controlled by the availability of recently fixed carbon which is determined by the rate of photosynthesis itself (19). The recently fixed carbon can first be partitioned to starch for storage within the chloroplast or to triose-phosphates (triose-P) available for export through the chloroplast envelope to the cytosol. Formation of sucrose from triose-phosphates involves both cytosolic fructose-1,6-bisphosphatase (FBPase) and sucrose-phosphate-synthase (SPS). The release of inorganic phosphate (Pi) from triose-P during sucrose synthesis stimulates triose-P export by the phosphate transporter (PT in Fig. 1) in the chloroplast membrane (51).

In many plants sucrose is the prime sugar exported from source tissue to sinks. Sucrose produced within mesophyll cells can be partitioned to
Fig. 1. Schematic representation of the path and possible control points of photosynthesis and partitioning of sucrose to developing seeds. See text for details including definition of abbreviations. SC = sucrose carrier.