

Plant physiological understanding for increased crop productivity

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There have been many routes to increased productivity that were led by crop physiology over the past decades. Early crop physiologists were trained in biochemistry and brought a science base to plant production. Issues such as winter hardiness, drought stress, growth regulation, flowering regulation, seed germination, ripening, and storage factors were researched to support both horticultural and agronomic applications. Parallel studies in cooperation with soil scientists investigated roles of mineral elements and the efficiencies of fertilizer applications. Later, as research methods and instruments were developed and new technologies emerged for mechanization of production, crop physiologists with backgrounds in physics were needed. They evaluated climatic factors and took leadership to develop simulation models of crop growth to allow the many interactions to be better understood. As plant breeding matured from an art to a science they found crop physiologists were effective partners for understanding basic principles of growth, development and adaptation as well as the quality of the product. Responses to increased plant populations and narrow row spacing were understood and improved. Nutrient-use-efficiency was increased. And the physiological and biochemical mechanisms of disease and insect resistance were first understood and then applied to decrease crop loss. Now crop physiologists study metabolic processes at the more basic level, especially those associated with biotic and abiotic stresses, light harvest (photosynthesis), mineral nutrition, and nitrogen metabolism, both NO_3 and N_2 fixation. Today, there is great interest in molecular biology and genetic modification by use of transgenic means for crop improvement. These efforts will continue to need crop physiologists to obtain the basic background information and to understand the utility of the changes that arise. They will also provide science-based guidance to help determine what gene changes have occurred and to evaluate the new products to verify the gene expression and to understand its application.