CONTROLLED ENVIRONMENTS: PAST ACHIEVEMENTS AND FUTURE DIRECTIONS

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A brief history of controlled environments will be reviewed, from the earliest attempts to grow plants in controlled conditions. It is generally recognised that the first true controlled environment facility was the Earhart Plant Research Laboratory in Pasadena, California, which opened in 1949 under Dr F. Went. The two key technological achievements that bought about this achievement were the development of air conditioning for temperature control and the fluorescent lamp for artificial lighting.

Technological changes in lamps, control system hardware and software will undoubtedly continue to occur, especially with the drive for greater efficiency, improvements in performance and specification. However, in the new millennium, scientific opportunities will provide the demand for controlled environment capabilities, rather than technology drive, given the rapid expansion in gene technology research.

Controlled environments can be described as having five characteristic features that enable study of environmental impacts on biological systems. These include an ability to *isolate* the system for study under a *simulated* environment, an ability to *manipulate* the parameters of that environment, an ability to *replicate* a standard environment for research purposes, an ability to *quantify* responses to changes in those parameters and an ability to *integrate* results with knowledge of the natural environment.

Probably, the majority of past controlled environment research used the characteristics of isolation and simulation, replication and manipulation for the research. Such research was usually characterised by *static* conditions, that is, where environmental parameters were all held constant. Less common were controlled environment uses where the characteristics of quantification and integration of research results were emphasised. Such research is characterised more by use of *dynamic* conditions, that is, where one or more environmental parameters are changed over time. Use of controlled environments will increasingly underpin development of decision-support tools.

A new paradigm in controlled environments arises with the sequencing of plant genomes and the increasing interest in functional genomics. The five controlled environment characteristics will all be of use in gene expression and genotype - environment interaction studies. Development of contained controlled environments will thus be a necessity.