

CHILLING INJURY OF HORTICULTURAL CROPS: AN OVERVIEW

L. L. Morris

*Department of Vegetable Crops
University of California, Davis, CA 95616*

Most, if not all, horticultural fruits, vegetables, and ornamentals of tropical origin are subject to physiological injury when subjected to temperatures below about 12.5°C but above their freezing temperature. This damage does not involve freezing and is commonly termed *chilling injury*. Chilling-sensitive plants, and plant parts, are subject to injury at all stages of their development, except in the dry-seed stage.

Sensitivity to chilling can limit where, geographically, the crop is grown—especially for perennials—and it can limit when and how annual crops are produced. It can influence germination and establishment of stand, plant growth, length of growing season, the temperature required under protective structures, the storage or holding temperature, the duration of the storage period and the quality of the commodity when marketed.

Although the emphasis in this symposium will be on harvested commodities, many of the points discussed have application to the plant. In fact, one of the papers will focus on germinating seeds and seedlings. Chilling injury can occur in the field, during transportation, during storage, during wholesale distribution, in the retail store, and in the home refrigerator. Therefore, the recognition and the understanding of the phenomenon of chilling injury are of concern to all segments of the industry from grower to consumer. Hence, chilling injury is an interesting and important subject of research for horticulturists who are interested in growth or in postharvest physiology and technology. Furthermore, horticulturists concerned with crop improvement and crop adaptation are interested in the possibility of exploiting sources of resistance to chilling injury to broaden or improve the tolerance of crops to low temperatures. It is known that genetic variability in relation to chilling sensitivity exists within some species. This applies to both growing plants and to harvested commodities. The possibility of utilizing lower growing temperatures under protective structures, or of expanding production into marginal areas, takes on added significance in light of current food and energy considerations.

The above comments relate primarily to crops of tropical origin. However, certain horticultural crops of temperate zone origin also show physiological breakdown after holding at low, but non-freezing, temperatures. There may be some disagreement as to whether or not this type of injury is strictly comparable to classical chilling injury as exhibited by tropical plants. The symposium also will deal with the differences and the similarities between temperate and tropical crops in regard to their temperature sensitivity and their physiological and metabolic responses.

The term "chilling injury" is often used to refer to either the physiological phenomenon, *per se*, or to the resulting symptoms, or to both. Synonymous terms include: chilling damage, chilling disorders, low-temperature injury, low-temperature breakdown, low-temperature disorders, and others. It is useful to recognize distinct phases in regard to the responses and the symptoms that result from chilling exposure. First, there is the primary response to temperature, usually considered to be physical in nature, such as membrane alterations. Secondly, physiological changes occur that, continued over a period of time, can be harmful and can result in the development of symptoms that we then attribute to exposure to low temperatures. It is attractive to think in terms of alleviating the harmful changes or suppressing the development of the resulting symptoms. The last paper will develop ideas in this area.

Symptoms

The symptoms that develop following chilling exposures are not unique to this stress. However, there are several symptoms that commonly result from chilling and they are often indicative of the severity of the injury. Their development can be retarded by the

same low temperature that has brought about the physiological dysfunction. The symptoms often become increasingly apparent after transfer to non-chilling temperatures. The various contributors will discuss the symptoms of specific commodities, but it may be useful for us to first consider, in a general way, some of the more commonly occurring visual symptoms listed below. It is the development of these symptoms that translates into postharvest losses.

1. Surface lesions—pitting, large sunken areas, and discoloration. Development of the symptom of pitting shows the important relationships that exist among the factors of commodity characteristics, the presence of mechanical damage, severity of chilling treatment, and the relative humidity of the atmosphere.
2. Water-soaking of tissues—this disruption of cell structure and accompanying release of substrates must favor the growth of microorganisms. This is a commonly occurring symptom in leaves and is followed by wilting and desiccation.
3. Internal discoloration (browning) of pulp, vascular strands, and seeds.
4. Breakdown of tissues.
5. Failure of fruits to ripen in the expected pattern following removal to ripening conditions.
6. An accelerated rate of senescence, but with an otherwise normal appearance.
7. Increased susceptibility to decay, especially to organisms not usually found growing on healthy tissue.
8. A shortened storage life or shelf life due to one or more of the above responses.
9. Compositional changes—especially in relation to flavor and taste.
10. Loss of growth (sprouting) capacity—especially important with stored propagules.

Physiological responses

The physiological and biochemical responses of many commodities to chilling temperatures is an active area of research. Confusion and controversy exist as to whether some of these changes represent 1) the primary response to temperature, or whether 2) they are part of the dysfunction that results from the initial event, or whether 3) they are simply secondary symptoms caused by the dysfunction. The responses receiving attention include: changes in membrane structure and function; cessation of protoplasmic streaming; alterations in respiration rates and patterns; changes in ethylene synthesis; and many biochemical and compositional changes.

Reduction of chilling injury

Studies have been directed toward treatments designed to alleviate chilling injury and the symptoms resulting from this injury. Some treatments have been applied directly to the commodity and others involve manipulation of the environment. The following paper will give us specific examples of success, and lack of success, with certain commodities. Treatments that have shown promise include conditioning at near chilling temperatures before chilling, intermittent warming treatments during chilling, increased CO₂ in the atmosphere during chilling, pre-treatments with calcium, pre-treatment with ethylene, and holding under hypobaric conditions during chilling. There is also some indication that membranes can be modified to tolerate chilling better.

At the present time, the problem of chilling injury to harvested commodities can be solved best by simply avoiding exposure to harmful temperatures. This may involve protecting the commodity against a chilling ambient temperature, or it may involve use of

Chilling Injury Of Horticultural Crops

**Shifeng Cao,Diane Maria
Beckles,Maria F. Drincovich,Isabel
Lara,Julian C. Verdonk,Qiong
Lin,Chongde Sun,Reinaldo Campos-
Vargas**

Chilling Injury Of Horticultural Crops:

Chilling Injury of Horticultural Crops Chien Yi Wang, 1990-03-20 This book provides readers with a historical background as well as current knowledge and theories on chilling injury This exciting volume covers a broad scope of topics from basic concepts to practical applications This work also brings together discussions on various aspects of chilling injury It gives basic information which describes biochemical changes molecular basis and concepts of chilling injury Additionally it describes the development of chilling injury in crops of tropical subtropical and temperate origin This interesting resource places emphasis on assessment prevention and reduction of chilling injury It also provides an extensive collection of references at the end of each chapter which offers the reader an abundance of resources for further detailed study Researchers and students in plant physiology horticulture and agronomy will find this book most valuable **Chilling**

Injury of Horticultural Crops Lisa J. Skog, 1998 *Chilling Tolerance and Regulation of Horticultural Crops: Physiological, Molecular, and Genetic Perspectives* Shifeng Cao, Diane Maria Beckles, Maria F. Drincovich, Isabel Lara, Julian C. Verdonk, Qiong Lin, Chongde Sun, Reinaldo Campos-Vargas, 2025-01-27 Chilling injury affects crops in the tropical and subtropical regions Damage can include surface pitting discolouration internal breakdown water soaking failure to ripen growth inhibition wilting loss of flavour and decay Post harvest handling of these crops within a cold chain system that maintains the desired temperature and humidity range is essential to preserving quality and shelf life To counter chilling injury crops have developed complex tolerance mechanisms These mechanisms include stress perception signal transduction transcriptional activation of stress responsive target genes and synthesis of stress related proteins and other molecules Concurrently recent integration of molecular and omics based techniques to conventional breeding has vastly improved the screening efficiency of traits associated with chilling tolerance Thus understanding these physiological biochemical and molecular responses and tolerance mechanisms is crucial to developing engineering strategies enhancing cold stress tolerance *Post Harvest Technology of Horticultural Crops* K. P. Sudheer, V. Indira, 2007 The book post harvest technology assumes great attention during recent years since preservation of agricultural produce is a basic necessity to sustain agricultural production It helps to add value of produce thus having great scope for employment generation at the production catchments In this book the authors have attempted to consolidate different methods of post harvest technology of fruits and vegetables focusing on recent advances This book will benefit both practicing food technologist post harvest technologist who are searching for answers to critical technical questions of post harvest technology Further it will be useful to agricultural engineers food processors food scientist researchers and progressive farmers and to those who are working in relevant fields it is intended to fill a gap in presently available post harvest technology literature **Postharvest Oxidative Stress in Horticultural Crops** D. Mark Hodges, 2003-02-13 Learn how oxidative stress affects fresh fruits and vegetables and how to inhibit this process This vital book brings together internationally respected authorities who share their

experiences insights and approaches to postharvest oxidative stress It examines the factors that induce oxidative stress and the processes by which oxidative stress affects the quality shelf life and nutritional value of fruits and vegetables after harvest Postharvest Oxidative Stress in Horticultural Crops also explores regulation of oxygen species production and the function of antioxidants and examines technologies that can enhance the resistance of fruits and vegetables to oxidative stress With Postharvest Oxidative Stress in Horticultural Crops you ll examine the impact of various storage temperatures and atmospheres senescence dynamics superficial scald and other symptoms of postharvest oxidative stress antioxidants and their role in inhibiting oxidative stress regulation of superoxide hydroxyl radical and hydrogen peroxide production physical treatments and chemical treatments that can reduce oxidative stress genetic engineering techniques designed to combat the tendency toward postharvest oxidative stress Essential for researchers teachers and advanced students in plant physiology biochemistry molecular biology biotechnology breeding and horticulture Postharvest Oxidative Stress in Horticultural Crops is also vital for everyone whose day to day work is impacted by plant stress

Postharvest Handling of Horticultural Crops Raju L. Bhardwaj,Yogesh Kumar Sharma,Latika Vyas,2021-12-22 This book covers the importance of post harvest technology in horticultural crops fruit growth development and post harvest physiology fruit maturity indices harvesting of fruits and vegetables initial handling of fruits and vegetable after harvesting precooling of horticulture produce transportation etc It is a rich source of modern engineering technologies for income generating concept for agro based industries The book is specially dedicated to the sub sector of the fruits and vegetables plants dealing with the fresh primary product from the product reception following the harvesting up to the storage and before launches it to the market This book will serves as a comprehensive guide for all the people who focuses on post harvest management skills Note T F does not sell or distribute the hardback in India Pakistan Nepal Bhutan Bangladesh and Sri Lanka

Abiotic and Biotic Stress in Horticultural Crops: Insight into Recent Advances in the Underlying Tolerance Mechanism Milan Kumar Lal,Rahul Kumar Tiwari,Muhammad Ahsan Altaf,Awadhesh Kumar,Ravinder Kumar,2023-06-21

Stress Tolerance in Horticultural Crops Ajay Kumar,Avinash Chandra Rai,Ashutosh Rai,Krishna Kumar Rai,Ved Prakash Rai,2021-05-14 Stress Tolerance in Horticultural Crops Challenges and Mitigation Strategies explores concepts strategies and recent advancements in the area of abiotic stress tolerance in horticultural crops highlighting the latest advances in molecular breeding genome sequencing and functional genomics approaches Further sections present specific insights on different aspects of abiotic stress tolerance from classical breeding hybrid breeding speed breeding epigenetics gene quantitative trait loci QTL mapping transgenics physiological and biochemical approaches to OMICS approaches including functional genomics proteomics and genomics assisted breeding Due to constantly changing environmental conditions abiotic stress such as high temperature salinity and drought are being understood as an imminent threat to horticultural crops including their detrimental effects on plant growth development reproduction and ultimately on yield This book offers a comprehensive resource on new developments

that is ideal for anyone working in the field of abiotic stress management in horticultural crops including researchers students and educators Describes advances in whole genome and next generation sequencing approaches for breeding climate smart horticultural crops Details advanced germplasm tolerance to abiotic stresses screened in the recent past and their performance Includes advancements in OMICS approaches in horticultural crops Quality of Horticultural Crops: A Recurrent/New Challenge for Plant Scientists in a Changing World Nadia Bertin, Michel Génard, Maarten Hertog, 2018-10-11 Besides increasing crop yield to feed the growing population improving crop quality is a challenging and key issue Indeed quality determines consumer acceptability and increases the attractivity of fresh and processed products In this respect fruit and vegetables which represent a main source of vitamins and other health compounds play a major role in human diet This is the case in developing countries where populations are prone to nutritional deficiencies but this is also a pending issue worldwide where the growing middle class is increasingly aware and in search of healthy food So a future challenge for the global horticultural industry will be to answer the demand for better quality food in a changing environment where many resources will be limited This e collection collates state of the art research on the quality of horticultural crops covering the underlying physiological processes the genetic and environmental controls during plant and organ development and the postharvest evolution of quality during storage and processing *Horticultural Reviews, Volume 44* Jules Janick, 2019-02-28 Horticultural Reviews presents state of the art reviews on topics in horticultural science and technology covering both basic and applied research Topics covered include the horticulture of fruits vegetables nut crops and ornamentals These review articles written by world authorities bridge the gap between the specialized researcher and the broader community of horticultural scientists and teachers Postharvest Technology of Horticultural Crops 4th Ed: Vegetable Crops, Herbs, and Flowers Diane M. Beckles, Adel Kader, Michael S. Reid, Cai-Zhong Jiang, Marita I. Cantwell, 2025-01-24 Fresh fruit vegetables and ornamentals are composed of living tissues that experience continuous change after harvest Some of these changes are desirable e g development of sugars and improved texture during fruit ripening while others are not e g discoloration and loss of nutrients in fresh cut vegetables Senescence is the final stage in the development of plant organs culminating in a series of irreversible events leading to cellular breakdown and death These postharvest changes cannot be stopped but they can be managed to maintain optimal quality longer Maintaining recommended temperature and relative humidity while minimizing wounding and microbial contamination constitute the foundation of effective postharvest handling The first chapter of this volume describes biological factors affecting these crops including respiration rates of ethylene production water loss physical damage and damage due to pathogens environmental factors such as temperature humidity ethylene and sunlight Subsequent chapters explore the use of biotechnology to improve postharvest results and postharvest handling operations for ornamentals and cut flowers for fresh herbs for fruit vegetables e g cucurbits tomatoes for leafy and stem vegetables and for underground vegetables roots tubers bulbs Handy easy to use tables and charts along with color

photographs illustrate important points throughout A comprehensive table summarizes storage recommendations for produce a second table summarizes storage recommendations for cut flowers and greens This is Volume 7 in Postharvest Technology of Horticultural Crops 4th Edition *Postharvest Physiological Disorders in Fruits and Vegetables* Sergio Tonetto de Freitas, Sunil Pareek, 2019-01-15 This book chock full of color illustrations addresses the main postharvest physiological disorders studied in fruits and vegetables For a wide variety of fruits and vegetables Postharvest Physiological Disorders in Fruits and Vegetables describes visual symptoms triggering and inhibiting mechanisms and approaches to predict and control these disorders after harvest Color photographs illustrate the disorders important factors physiology and management The book includes a detailed description of the visual symptoms triggering and inhibiting mechanisms and possible approaches to predict and control physiological disorders The mechanisms triggering and inhibiting the disorders are discussed in detail in each chapter based on recent studies which can help readers better understand the factors regulating each disorder The description of possible approaches to predict and control each disorder can help growers shippers wholesalers and retailers to determine the best management practices to reduce disorder incidence and crop losses Features Presents visual symptoms of postharvest physiological disorders that will help readers to precisely identify the disorders in fruits and vegetables Details mechanisms triggering and inhibiting the postharvest disorders Explains possible approaches to predict and control these disorders Suggests the best postharvest management approaches for each crop Although there are many scientific publications on postharvest physiological disorders there are no recent reviews or books putting together the most recent information about the mechanisms regulating as well as about the possible approaches to predict and control these disorders *Handbook of Vegetables and Vegetable Processing* Nirmal K. Sinha, Y. H. Hui, E. Özgül Evranuz, Muhammad Siddiq, Jasim Ahmed, 2010-11-19 Vegetables are an important article of commerce both in developed and developing economies Many studies point to importance of vegetables in our diet Handbook of Vegetables and Vegetable Processing serves as a reference handbook on vegetables and vegetable processing containing the latest developments and advances in this fast growing field The book can be considered as a companion to Y H Hui's popular Handbook of Fruits and Fruit Processing 2006 Handbook of Vegetables and Vegetable Processing is contemporary in scope with in depth coverage of new interdisciplinary developments and practices in the field of vegetables emphasizing processing preservation packaging and nutrition and food safety Coverage includes chapters on the biology horticultural biochemistry microbiology nutrient and bioactive properties of vegetables and their significant commercialization by the food industry worldwide Full chapters are devoted to major vegetables describing aspects ranging from chemistry to processing and preservation World renowned editors and authors have contributed to this essential handbook on vegetables and their production technology storage processing packaging safety and commercial product development Special Features Coverage includes biology and classification physiology biochemistry flavor and sensory properties microbial safety and HACCP principles nutrient and

bioactive properties In depth descriptions of key processes including minimal processing freezing pasteurization and aseptic processing fermentation drying packaging and application of new technologies Entire chapters devoted to important aspects of over 20 major commercial vegetables including avocado table olives and textured vegetable proteins Unparalleled expertise on important topics from more than 50 respected authors **Abiotic Stress Tolerance in Crop Plants** Bidhan Roy,Asit Kumar Basu,2009 Abiotic stresses have become an integral part of crop production One or other persist either in soil water or in atmosphere The information in the areas of injury and tolerant mechanisms variability for tolerance breeding and biotechnology for improvement of crop plants against abiotic stresses are lying unorganized in different articles of journals and edited books This information is presented in this book in organized way with up to date citations which will provide comprehensive literatures of recent advances More emphasis has been given to elaborate the injury and tolerance mechanisms and development of improved genotypes against stress environments This book also deals with the plants symptoms of particular abiotic stress reclamation of soil and crop cropping pattern to over come the effect of adverse condition s Each has been laid out with systematic approaches to develop abiotic stress tolerant genotypes using biotechnological tools Use of molecular markers in stress tolerance and development of transgenic also have been detailed Air pollution and climate change are the hot topic of the days Thus the effect of air pollution and climate change on crop plants have been detailed in the final three s of this book Under abiotic stress plant produces a large quantity of free radicals oxidants which have been elaborated in a separate Oxidative Stress This book has been divided into seven major parts physical stress salt water stresses drought and waterlogging temperature stresses heat and cold metal toxicities aluminium iron cadmium lead nickel chromium copper zinc etc and non metal toxicities boron and arsenic oxidative stress and finally atmospheric stresses air pollution radiation and climate change Hope this book will be of greater use for the students and researchers particularly Plant Breeders and Biotechnologists as well as the Botanists to understand the injury and tolerance mechanisms and subsequently improvement of crop genotypes for abiotic stresses Postharvest Physiology and Pathology of Vegetables Jerry A. Bartz,Jeffrey K. Brecht,2002-12-04 Focusing exclusively on postharvest vegetable studies this book covers advances in biochemistry plant physiology and molecular physiology to maximize vegetable quality The book reviews the principles of harvest and storage factors affecting postharvest physiology calcium nutrition and irrigation control product quality changes during handling and storage technologies to improve quality spoilage factors and biocontrol methods and storage characteristics of produce by category It covers changes in sensory quality such as color texture and flavor after harvest and how biotechnology is being used to improve postharvest quality Bibliography of Agriculture ,1990

Tropical and Subtropical Fruits Muhammad Siddiq,Jasim Ahmed,Maria Gloria Lobo,Ferhan Ozadali,2012-08-07 Tropical and sub tropical fruits have gained significant importance in global commerce This book examines recent developments in the area of fruit technology including postharvest physiology and storage novel processing technologies applied to fruits and

in depth coverage on processing packaging and nutritional quality of tropical and sub tropical fruits This contemporary handbook uniquely presents current knowledge and practices in the value chain of tropical and subtropical fruits world wide covering production and post harvest practices innovative processing technologies packaging and quality management Chapters are devoted to each major and minor tropical fruit mango pineapple banana papaya date guava passion fruit lychee coconut logan carombola and each citrus and non citrus sub tropical fruit orange grapefruit lemon lime mandarin tangerine melons avocado kiwifruit pomegranate olive fig cherimoya jackfruit mangosteen Topical coverage for each fruit is extensive including current storage and shipping practices shelf life extension and quality microbial issues and food safety aspects of fresh cut products processing operations such as grading cleaning size reduction blanching filling canning freezing and drying and effects of processing on nutrients and bioavailability With chapters compiled from experts worldwide this book is an essential reference for all professionals in the fruit industry

Postharvest Management Approaches for

Maintaining Quality of Fresh Produce Mohammed Wasim Siddiqui, Jesus Fernando Ayala Zavala, Cheng-An (Andy)

Hwang, 2016-02-24 The volume presents existing and novel management approaches that are in use or have a great potential to be used to maintain the postharvest quality of fresh produce in terms of microbiological safety nutrition and sensory quality In comparison to traditional synthetic chemicals these eco friendly molecules are equally effective with respect to slowing the physiological and biochemical changes in harvested produce Application of terpenic compounds phenolic compounds salicylic acid methyl jasmonates hydrogen peroxide ethanol sulphur compounds polyamines plant growth regulators active carbohydrates ozone hexanal and nitric oxide have been proven effective in minimizing storage disorders like chilling injury scald fungal diseases like stem end rot blue mould rot green mould rot anthracnose regulation of ripening and senescence etc This book will be a standard reference work for the management of shelf life in the fresh produce industry

Post Harvest Technology of Horticultural Crops Marley Gibbs & Pablo Steele, 2018-11-16 The book post harvest technology accepts incredible consideration amid late years since preservation of agricultural create is an essential need to maintain agricultural generation It includes estimation of deliver in this manner having incredible breadth for work age at the creation catchments In this book the writers have endeavored to solidify distinctive techniques for post harvest technology of products of the soil concentrating on late advances This book will profit both honing sustenance technologist post harvest technologist who are scanning for answers to basic specialized inquiries of post harvest technology Further it will be valuable to agricultural specialists nourishment processors sustenance researcher analysts and dynamic ranchers and tom the individuals who are working in applicable fields it is planned to fill a hole in directly accessible post harvest technology writinge A definitive objective of yield creation is to give quality deliver to shoppers at sensible rates Most new create is profoundly perishable and postharvest misfortunes are critical under the present techniques for administration in numerous nations Be that as it may noteworthy accomplishments have been made amid the most recent couple of years to

reduce postharvest misfortunes in crisp deliver and to guarantee sustenance security and wellbeing also These incorporate progressions in rearing green products for quality change postharvest physiology postharvest pathology and entomology postharvest administration of natural products vegetables and blossoms nondestructive advances to survey deliver quality insignificant preparing of leafy foods and additionally developments in bundling and capacity technology of new create

Units, Symbols, and Terminology for Plant Physiology Frank B. Salisbury, 1996-10-10 This book represents a beginning toward a consensus on units symbols and terminology in the plant sciences Written by 27 specialists and reviewed by several others each discussion is condensed for easy reference but still thorough enough to answer virtually any question concerning plant terminology Principles are outlined and covered in readable text Some chapters include formulas and definitions of specialized terms while others include recommendations for suitable units The appendices offer guidelines on presenting scientific data such as principles of grammar oral and poster presentations and reporting on data from experiments that utilized growth chambers Anyone involved in the plant sciences particularly plant physiology will find this an invaluable reference

Chilling Injury Of Horticultural Crops Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has are more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is truly remarkable. This extraordinary book, aptly titled "**Chilling Injury Of Horticultural Crops**," written by a highly acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound affect our existence. Throughout this critique, we shall delve to the book is central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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