

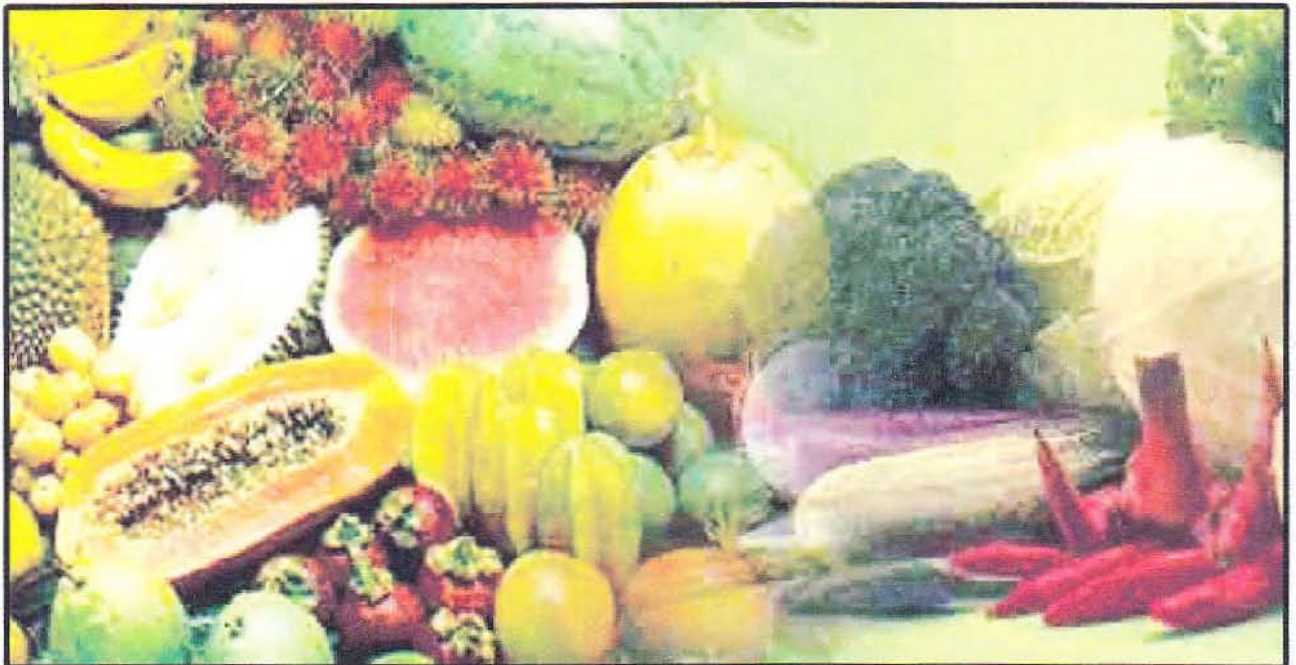


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MANUAL BOOK

International Seminar on Horticulture to
Support Food Security 2010

Bandar Lampung, 22-23 June 2010
INDONESIA



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International Seminar

on Horticulture to Support Food Security 2010

June 22-23, 2010

Bandar Lampung, INDONESIA

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TO SUPPORT FOOD SECURITY 2010**

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PREFACE

Growing populations across the world, economic growth and changes in dietary patterns have caused both the production and consumption of horticultural produce, mainly fruit and vegetables, increasingly important. Horticulture, which includes the production of fruits, vegetables, flowers, spices, medicinal and aromatic plants and plantation crops, has a vital role in farm income enhancement, poverty alleviation, food security, as well as sustainable agriculture. However, this sector severely suffers from postharvest losses. Some estimates suggest that about 30–40% of fruit and vegetables are lost or abandoned after being harvested. Huge postharvest losses result in diminished returns for producers, and reduced food availability.

It is very clear that postharvest management determines food quality and safety, competitiveness in the market, and the profits earned by producers. However, the postharvest management of fruit and vegetables in most developing countries is very poor.

The major constraints include inefficient handling and transportation; poor technologies for storage, processing, and packaging; and poor infrastructure.

In order to overcome the incidence of the huge postharvest losses in the region and new challenges faced under trade liberalization and globalization, serious efforts are needed to reduce postharvest losses of horticultural produce, and to support food security.

Therefore, the University of Lampung in collaboration with the Government of Lampung Province as well as the University of Kentucky USA has organized this seminar with the objectives: 1) to discuss recent developments in postharvest handling, processing and marketing of horticultural produce, 2) to identify issues and constraints to reduce postharvest losses, 3) to define strategies and measures to reduce such losses in order to support food security, 4) to discuss marketing and food security issues, and challenges in the postharvest management of horticultural produce, issues and obstacles to improve the marketing and safety of postharvest handling and processing of horticultural produce.

It is our hope that serious consideration will be given to the recommendations of International Seminar on Horticulture to Support Food Security in shaping the future development of the production, postharvest handling, processing and marketing of horticultural produce.

June 22, 2010

Organizing Committee

International Seminar for Horticulture to Support Food Security 2010

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TABLE OF CONTENTS

	Page
Preface	iii
Welcoming Address from the Organizing Committee	iv
Welcoming Address from Rector of Lampung University	v
Event Schedule	vi
Table of Contents	vii
 KEYNOTE SPEAKER'S PAPER	
Increasing Food Security with Postharvest Research	KP-1
Douglas Archbold	
 PLENARY SPEAKER'S PAPER	
Problems and Developing Aspects Relating to Harvest and Postharvest Handling of Tropical Fruits	KP-6
Soesiladi Esti Widodo	
 SEMINAR PAPERS	
Group A: Horticultural Biology and Physiology	
1 Quality variation of Chilli fruit (<i>Capsicum annum</i>) due to the salt changes in the Saline Soil Solution	A-1
Wanti Mindari	
2 Adaptation Test of the Three Local Cultivars of North Maluku Tomato (<i>Lycopersicon esculentum</i>) on Saline Sand	A-7
Aisjah Rachmawaty Ryadin, Natal Basuki, Asrul Dedy Ali Hasan	
3 The Changes Content of Cytokinin and Gibberellin on Growth Stage and Age of Mangosteen Plant (<i>Garcinia Mangostana</i> L.).....	A-15
Ramdan Hidayat	
4 Accelerating the Growth of Mangosteen (<i>Garcinia mangostana</i> L.) at Agroforestry System in District of Kerinci, Jambi Province.....	A-23
Nerty Soverda	
5 Combining <i>Wedelia trilobata</i> and Inorganic-N Fertilizer for Pepper Growth and Yield.....	A-32
Nanik Setyowati, Uswatun Nurjanah, Melva M. Manurung	
6 Four Kinds Of Materials Litter Potentials As Substitution Material For Media Grows Of White Oyster Mushroom (<i>Pleurotus ostreatus</i>)	A-36
Widiwurjani	
7 Growth Analysis of Sweetcorn and Its Correlation to the Yield at Different Rate Application of Palm Oil Sludge Compost	A-41
Merakati Handajaningsih	
<hr/>	
International Seminar on Horticulture to Support Food Security Bandar Lampung - Indonesia, June 22-23, 2010	vii

8	The Role of Coconut Water in Horticultural Plant Tissue Culture	A-46
	Jeany Polii Mandang	
9	Energy Input-Output Analysis for Watermelon Production	A-53
	Agus Haryanto, Dwi Cahyani, Fadil Murda Kusuma, Arif Dwi Santoso	
10	Developing Hydroponic technology at Medium Altitude, without pesticide for medium and small agribusiness Case:tomato cuvar Recento.....	A-60
	Dedy Widayat, Aos M Akas and Nursuhud	
11	Effects Of Goat Manure On Growth, Yield, And Economic Impacts Of Vegetable Intercrops In Young Coffee Plantation.....	A-66
	Agus Karyanto, Sugiatno, and Rusdi Evizal	
12	The Response of Cocoa Seedlings due to Application of Trichoderma spp Grown on Different Media.....	A-75
	Sriwati R, Chamzurni T, Ardiansyah	
13	The Effect of Nitrogen Sources and Types of Medium Subculture on <i>Brassolaeliocat-tleya</i> (Blc.) Amy Wakasugi Shoots Growth.....	A-81
	Yayat Rochayat, Anne Nuraini and Mirna Oktavani	
14	Effects of Benzyladenine on in vitro shoot multiplication of Banana (<i>Musa paradisiaca Linn</i>) cv. Ambon Kuning and Tanduk.....	A-88
	Dwi Hapsoro, Mochamad Ivan Alisan, Titiek Ismaryati, and Yusnita	
15	In Vitro Propagation of Anthurium plowmanii cv. Wave of Love and Plantlet Acclimatization.....	A-95
	Yusnita, Sismanto, and Dwi Hapsoro	
16	Ethylene Used in The Breaking of Potato Tuber Dormancy (<i>Solanum tuberosum</i> L) Variety of Atlantic and Superjohn.....	A-101
	Johannes E. X. Rogi, Selvie Tumbelaka, and Shubzan Andi Mahmud	
17	Habitat Mapping and Raflesia Condition in Bengkulu	A-104
	Yulian Idris	
18	Insect Diversity on The Ecosystem of Citrus (<i>Citrus</i> spp.) Plantation In East Java	A-111
	Indriya Radiyahanto and Ketut Sri Marhaeni J	
19	In Vitro Seed Germination, Seedling Growth and Acclimatization of Dendrobium hybrids (<i>Orchidaceae</i>)	A-116
	Sri Ramadiana, Ronald Bunga Mayang, Dwi Hapsoro, and Yusnita	
20	Yield Tests of Some yard Long Bean Genotype on Two Environment	A-123
	Nyimas Sa'diyah, Tjipto Roso Basoeki, Eko Suprihanto, Ricky Aris Tiawan, and Setyo Dwi Utomo	
21	Responsen of Protocorm Like Bodies Hybrid Dendrobium Orchid on Various Kind Types and Concentration of Cytokinin and Auxin on Murashige and Skoog (MS) Medium.....	A-130
	Anne Nuraini, Wieny Heriliya R., Erni Suminar, and Eva Marlina	
22	Effect of Vermin Compost and Bokashi on Nutrient Content of Mustard Green and Lettuce	A-136
	Yacobus Sunaryo	

23	Isolation of Plant Growth Promoting Rhizobacteria (PGPR) from Various Plant Rhizospheres	A-141
	M. A. Syamsul Arif	
24	Respiration of Packaged Fresh Oyster (Tiram) Mushroom (<i>Pleurotus ostreatus</i>).....	A-149
	Gede Arda, B. Rahardjo	
25	Flower development and Induction of Haploid Population from Anther Culture	A-156
	A Husni, M Kosmiatin, and A. Purwito	
26	Dose Effect Of Compound Fertilizer Npk Ratios On Growth Red Betel (Piper Crocatum Ruiz And Pav.) With Two Types Of Planting Media	A-164
	Rugayah	
27	Introgression Of CMV Tolerance Genes To Hybrid Parent Of Hot Pepper: Employing Morphological And Rapid Marker To Identify Recurrent Parent Characteristics In BC2 Population	A-174
	Catur Herison, Sri Winarsih, Merakati Handayaningsih, and Rustikawati	
28	Improvement of Cayenne Chili-Pepper of Landrace Germplasm through selection for a Reduction of Abortive Flowers	A-181
	Saiful Hikam and Paul Timotiwu	
29	Genetic analysis of Maize Quantitative Traits On Ultisol Under Low Input	A-188
	Suprpto and M. Taufik	
30	Propagation of Gladiol (<i>Gladiolus hibrida</i>) by Using Benzil Adenin (BA).....	A-197
	Tri Dewi Andala Sari, Fitri Juwita Susanti	
31	Model Simulation of "Sawah-Kolam" System for Rainwater Harvesting to Support Rainfed Paddy Production in Metro City Lampung	A-201
	Sugeng Triyono, Oktafri, and Bustomi Rosadi	
32	Growth and Development of Protocorm Like Bodies Hybrid Dendrobium Orchids on MS Medium with Cytokinin and Auxin Combination	A-210
	Wieny H. Rizky, Anne Nuraini, Erni Suminar, and Karlina Syahrudin	
33	Evaluation of Mung Bean Genotypes for Resistance to Field and Storage Deterioration	A-217
	Marwanto	
Group B: Horticultural Postharvest Handling and Processing Technology		
34	Model of Technology Valuation System (A Case of Evaporative Cooling System for Horticulture Products).....	B-1
	Budi Dharmawan, Ropiudin	
35	Effect of Some Types of Banana Sago Flour and Substitution with Chocolate Powder to Taste Lompong Sago Produced	B-8
	Zuraida Zuki, Diana Silvi, Mutia Elfira	
36	The Storage of Gnetum Seeds by Mixing with Dry Sand and Burried in Soil	B-15
	Tamrin, Sandi Asmara, Henny Nurpa Anggraini	
37	Characterization of the Drying Process of Melinjo Seed	B-20
	Sarono, Yatim R. Widodo	

38	Influence of Source of Fat and the Difference Casia vera Extract Addition to the Quality of Ice Cream.....	B-29
	Diana Sylvi, Fauzan Azima, and Nur Aisyah Yati	
39	Technology of Passive Packaging for Chitosan-Coated 'Mutiara' Guava and 'Muli' Banana	B-36
	Zulferiyenni, Soesiladi Esti Widodo	
40	The Effect of Temperature and Time on Chilli's Physical Quality and their Kinetics Model during Hot Water Treatment	B-43
	Devi Yuni Susanti, Sri Rahayoe, Tatag Ridha Prasetya	
41	Shelf-life of Salacca Fruit in Secondary Packaging of Double Corrugated Box Stacked-up on Cross and Parallel Pattern.....	B-50
	Ridwan Thohir, Yulianingsih, Dwi Amiarsi, Ira Mulyawani	
42	Development of Cocogurt Probiotic as an Indigenous Functional Food Which Rich Medium Chain Triglyceride	B-58
	Tomí Ertanto, Riyanti Ekafitri, R. H. Fitri Faradilla, Tetuko Dito Widarso, Mujiono, Ratih Dewanti Hariyadi	
43	Physical. Chemical, and Microbiological Qualities Change in Coconut Milk Probiotic Product (Cocogurt) During Storage	B-66
	Tomí Ertanto, Riyanti Ekafitri, R. H. Fitri Faradilla, Tetuko Dito Widarso, Mujiono, Ratih Dewanti Hariyadi	
44	Study of Control System Temperature And Humidity Using Microcontroller AVR Atmega 8535 On Evaporatif Cooling Equipment Used As A Store For Guarding Of Product QualityFruit And Vegetables Postharvest	B-72
	Priswanto, Ropiudin	
45	The Effect of Kinds and Percentages of Sugar Solution to the Characteristic of Lactic Fermented Drink from Sesbania (<i>Sesbania grandiflora</i> (L.) Poir) Milk.....	B-81
	Samsul Rizal, Marniza, Sutikno	
46	Early Detection of Chilling Injury Symptoms in Horticultural Product	B-90
	Y. Aris Purwanto	
47	The Study of Content and Characterization of Resistant Starch from Some Banana Types.....	B-94
	Nanti Musita	
48	Sensory Testing of Sweet Potato Pectin Pudding	B-103
	Jane Paton and Siti Nurdjanah	
49	Effect of Type of Packaging and Storage Time to the Quality of Pumpkin Substituted Donut	B-108
	Susilawati, H. Muhammad Nur	
50	Sudy on Storage Method of Papaya	B-115
	Nofiarli, Fitriana Nasution, and Kuswandi	
51	Sensory Properties of Mangosteine Juice Affected by Xanthan Gum	B-119
	Siti Nurdjanah, Sefanadia Putri	

52	The Chemical and Physical Change and Shelf-life of Citrus Fruit (<i>Citrus reticulata</i> B.) during Storage at Modified Atmosphere	B-124
	Rofandi Hartanto, Ketut Indrayana	
53	In Vitro Study of Glucomannan Extracted Chemically and Enzymatically from Cassava, Gadung, and Walur as Prebiotic Agent	B-130
	Husniati, Medikasari	
54	The Effect of Chemical Treatment on Tomato Slices	B-137
	Darwin H. Pangaribuan	
55	The Effect of Melinjo Epidermis Extract on the Color and Quality of Red Chili Puree During Storage	B-144
	Dharia Renate	
56	Individual Seal-Packaging of Arumanis Mangoes Stored at Cold and Room Temperatures.....	B-151
	I Made Supartha Utama, Yohanes Setiyo, Ida Bagus Putu Gunadnya, and Nyoman Semadi Antara	
57	Effect of Fruit Maturity Level and Concentration of Betel Lime to Quality of Papaya Candied Fruit	B-160
	Nofiarli, Fitriana Nasution, and Kuswandi	
58	The Effect of Packaging Materials on the Qualities of Vacuum-Packed Fresh Cut Carrot During Low Temperature Storage	B-164
	Muhammad Nur and Susilawati	
59	Characterization of The Drying Process of Shelled Melinjo Seed	B-173
	Sarono, Yatim R. Widodo	
60	Soybeans for the Production of Modified Tempe with <i>Saccharomyces cerevisiae</i>	B-182
	Maria Erna Kustyawati	
61	Freezing Method of Straw Mushroom (<i>Volvarea volvacea</i>) using dry Ice	B-189
	Kurnia Novianti, Sutrisno, Emmy Darmawati	
62	The Effect of Chitosan Concentration at Two Level Maturity Against to Quality and Long Time of Keep Tomato (<i>Lycopersicum esculentum</i> Mill)	B-195
	Suskandini, Harwan Sutomo, and Tety Suciaty	
63	Study of Meniran (<i>Phyllanthus niruri</i>) as Drug for the Treatment of Malaria	B-200
	Subeki and Feriandi	
64	Some Biochemical and Total Lactic Acid Bacteria Changes During Natural Fermentation of the Purple Sweet Potatoes (<i>Ipomoea potatos</i> L) Pickle.....	B-209
	Neti Yuliana, Siti Nurdjanah and Zahroh Hayati Octarini	
65	The Influence of Pectin Concentration on Chemical and Organoleptic Properties in Combining Jam of Guava and Pineapple	B-215
	Azhari Rangga	
66	The Emulsion Stability of Coconut (<i>Cocos nucifera</i> L) Milk Added with Ethanolysis Product from Palm Kernel Oil (<i>Elaeis quineensis</i> Jacq)	B-223
	Murhadi	

67	The Possibility of Using Near Infrared Spectroscopy with Portable Spectrometer to Evaluate Some Internal Properties of Pineapple Fruit Nondestructively	B-230
	Sandi Asmara , Diding Suhandy, and Meinilwita Yulia	
68	Formulation of Weaning Food and Evaluation Protein Quality from Composite Flour of Breadfruit and Velvet Bean (<i>Macuna pruriens</i> L.)	B-234
	Sri Setyani, Medika Sari and Rabiatul Adawiyah	
69	Calcium Chloride Infiltration Methods To Extend The Storage Life Of Fresh Duku.....	B-242
	Anny Yanuriati, Musolli Arief, and Parwiyanti	
70	Designing Of Evaporative Cooling Systems To Post-Harvest Of Fruits And Vegetables Quality Using Cfd (Computational Fluid Dynamics).....	B-250
	Ropiudin and Budi Dharmawan	
71	Effects of Coating and Plastic-Wrapping on the Characteristics of Fresh Rose-Apple "Cincalo" (<i>Syzygium samarangense</i>)	B-258
	Raffi Paramawati and Safitri	
72	Improvement The Harvest and Handling Method To Reduce The Postharvest Decay Of Palembang Duku	B-265
	Anny Yanuriati and Rindit Pambayun	
73	Effects of Starter Concentration and Incubation Period On Nata depina Characteristic Produced From Liquid Waste of Pineapple Canning Factory	B-272
	Sutikno, Samsul Rizal, and Marniza	
74	Rheological Properties of SHMP-Extracted Sweet Potato Pectin	B-279
	Janet Paterson and Siti Nurdjanah	
75	Chemical Characteristic of Sweet Potato Pectin Extracted Using Different Condition	B-286
	M Wootton and Siti Nurdjanah	
Group C: Horticultural Pests and Diseases & Horticultural Postharvest Handling and Processing Technology		
76	Biological Agents (<i>Steinernema</i> spp. Local Isolate) as Support Factor for Pest Control of False Pakchoy (<i>Spodoptera</i> sp)	C-1
	Nugrohorini, Wagiyana, Wanti Mindari	
77	The Screening Attractiveness of Fruit Fly <i>Bactrocera</i> spp (Diptera: Tephritidae) on Aromatic Essential Oil plants	C-6
	Budi Untari, Dachriyanus, absol Hasyim, Siti Herlinda	
78	Non Destructive Quality Evaluation of Dragon Fruit Using Ultrasound Method	C-15
	Siti Djamila, I Wayan Budiastira, Sutrisno	
79	Plant Damage Caused by Leaf Feeder and Fruit Borer on Pomello Plantations in South Sulawesi	C-24
	Nurariaty Agus	
80	Response of Several Wild Banana Species to <i>Fusarium oxysporum</i> f.sp.cubense VCG 01213/16 in Screen House Study.....	C-29
	Riska, Jumjunidang	
81	Distribution Mapping of Aphids <i>Pentalonia nigronervosa</i> the Insect Vector of Banana Bunchy Top Disease (BBTD) and their Host in Manokwari Regency, West Papua Province	C-36
	Besse Amriati, Russel Messing	

82	Vegetative Compatibility Group Test of <i>Fusarium oxysporum</i> f.sp.cubense Isolates and Identification of Infected Banana Varieties in Banana Development Area in Lampung Province.....	C-41
	Jumjunidang, Riska	
83	Schedulling Application of Fungicide on Purple Blotch Disease (<i>Alternaria porri</i>) Based on Weather Data: An Effort to Optimize Economic Return of Shallot Production	C-48
	Herry Nirwanto	
84	Investigation of Pesticide Residues in Horticultural Products in South Sulawesi	C-51
	Itji Diana Daud	
85	Detected and Characterize the Endophytic fungal Associated on Leaf Area Cacao (<i>Theobroma cacao</i> L.) Tree in East Aceh	C-55
	Sriwati R, Susanna, Schardl C. L	
86	Prey Consumption Rate of <i>Menochillus sexmaculata</i> Fabr (Coleoptera coccinellidae) on Different Prey Densities <i>Aphis gossypii</i> Glover (Homptera: Aphididae)	C-62
	Syafrina Lamin, Siti Herlinda, Yulia Pudjiastuti, and Arinafril	
87	Insecticidal Activity of Brucein-C from Buah Makasar (<i>Brucea javanica</i>) Against Cashew Insect Pest <i>Helopeltis antonii</i>	C-67
	Subeki, Sri Hidayati, Elna karmawati, and Chandra Indrawanto	
88	Population and spesies of Fruit fly (<i>Batrocera</i> spp.) with Attractant Sticky Yellow Trap (ASYTA) Formulation from Natural Plant Product.....	C-79
	Sylvia Sjam, Sulaeha and Zulfitriani	
89	Effectivity of Insect Pathogen, <i>Fusarium</i> sp. in Controlling Cabbage Worm, <i>Plutella xylostella</i> L.	C-84
	Melina and Yumarto	
90	Ultrasonic Attenuation application For Detection Arumanis Mangoes Damage Caused by Fruit Fly	C-88
	Warji	
91	Distribution Of <i>Fusarium Oxysporum</i> F.Sp. Cepae Which Caused Moler Disease Through Shallot Seed Bulbs	C-96
	Sri Wiyatiningsih, Bambang Hadisutrisno, Nursamsi Pusposendjojo, and Suhardi	
92	Influence Of The Interval When Granting The <i>Streptomyces</i> To <i>Fusarium</i> Wilt Disease Development In Melon Crops	C-101
	Endang Triwahyu P. and Kurniawati	
93	Orange red mite <i>Panonychus citri</i> (McGregor) (ACARI: TETRANYCHIDAE): exotic mites, abundance on citrus, APPLE, AND COFFEE.....	C-107
	Retno Dyah Puspitarini	
94	Bacterial wilt incidence on banana (<i>Musa</i> spp.) plantation at Bengkulu City.....	C-114
	Mucharromah, Misnawaty, Rahmadi Fitriyanto	
95	Variation in the Production and Attacks of Fruit Flies on Nine Varieties of Mango at Natar Garden Experiment Lampung.....	C-123
	Nila Wardani	

96	Integrated Pest Management on Banana at South Lampung	C-131
	Nina Mulyanti	
97	Integrated Pest Management (IPM) Component Adoption Effect Using Natural Enemy and Botanical Pesticides in Hot Chili Cultivation	C-136
	Danarsi Diptaningsari and Nila Wardani	
98	Actinomycetes as Potential Biocontrol of Fusarium wilt Disease (<i>Fusarium oxysporum</i>) at Hot Pepper Plants	C-141
	Tri Mujoko, Endang Triwahyu P	
99	Postharvest Pathogens of some banana varieties caused by wounds and bruises	C-151
	Moralita Tauhid, Siti Nurdjanah, Sefanadia Putri, Verawati, Sri Mulyani, Nurhayati, Maya Sari, Refi Arieon, and Rozi A Jamain	
100	Callus Formation and Regeneration of Chrysanthemum Leaf Discs Explants Through in Vitro	C-156
	Murgayanti, Suminar E, Rizky, W.H and Rustiani, S	
101	Effect of Gamma Rays Mutagen on Callus In Vitro of Pineapple (<i>Ananas comosus</i> (L.) Merr.).....	C-159
	Erni Suminar, Sobir, and Agus Purwito	
Group D: Economy of Horticulture and Horticulture for Food Security		
102	The Performance of Conventional Marketing Channel of Vegetables in Jogjakarta.....	D-1
	Antik Suprihanti	
103	Spatial Marketing System: An Alternative to More Effective Distribution System of Fresh Horticultural Product from Highland Area in West Papua Origin.....	D-8
	Fitryanti Pakiding, F.H. Listyorini, Arif Faisol	
104	Institutional Analysis of Marketing, Profit Margin of Banana Chips in West Tulang Bawang, Lampung.....	D-19
	Robet Asnawi	
105	Correlation of Economic Social Farmer with Application of Shallot Integrated Pest Management	D-25
	Achmad Faqih	
106	Fresh-Cut Vegetables, Times Efficiency and Vegetables Business Prospect	D-36
	Rr. Leslie Retno Angeningsih	
107	Behavior Of Consumer Fruit In Traditional Market And Modern Market In Jember District ...	D-44
	Evita Soliha Hani and Nyra Dewi Sartika	
108	The Study of Consumer's Preference and Behavior of Banana Chips in Bandar Lampung	D-54
	Fibra Nurainy, Zulferiyenni, Wiriawan Sada Melindra	
109	Marketing Analysis Of Red Dragon Fruit (<i>Hylocereus costaricensis</i>) In Pekanbaru, Riau Province	D-62
	Yeni Kusumawaty, Ermy Tety, Tengku Harunur Rasyid, and Zainal Abidin	
110	The Demand for Carrot in SMEP Market in Bandar Lampung: A Non Linear Homogeneous Degree Zero in Prices and Income Approach.....	D-69
	Johannis Damiri	

111	Basic Causes Of Horticultural Farmer Poverty (Cabbage And Chilli) In Gisting District Of Tanggamus Regency	D-72
	Dame Trully Gultom, Tubagus Hasanuddin, Rio Prayitno and Teguh Endaryanto	
112	Food Security Status of Horticulture Farmers in Highland Region of the Manokwari District	D-75
	Nouke L. Mawikere, Fitryanti Pakiding, Mudjirahayu	
113	Risk Analysis of Farm Chillies and Tomatoes Applying Monoculture and Polyculture Cropping Pattern in West Lampung District.....	D-83
	R. Hanung Ismono	
114	Coffee Commodities Market integration in Lampung province Tanggamus	D-90
	I Wayan Suparta, Husaini	
115	Mobile APPLICATION: Land ResourceS Information System for Horticulture Practices....	D-101
	Purnomo Edi Sasongko	
116	Development Factors of Homegardens and Plantations in Buffer Zone of Way Kambas National Park.....	D-106
	M.D. Wicaksono	
117	Water Balance Analysis Based on Effective Rainfall at Ponoragan Sub River Basin Area Kutai Kartanegara Regency	D-112
	Benny Mochtar Effendi Ariefin	
118	Water Balance Analysis Based on Normally Rainfall at Tenggara Seberang District Kutai Kartanegara Regency	D-117
	Setyo Budiharto	
119	Water Balanced Analysis to Growing Season at Karangmumus River Basin Area-East Kalimantan.....	D-122
	Akas Pinarangan Sujalu	
120	Design of The Hydram Pump Model to Support Irrigation of Farming Land in Province of Lampung.....	D-128
	Jorfri B. Sinaga	
121	Strategy for Strengthening Post-Harvest Handling to Improve the Competitiveness of Indonesian Horticultural Products	D-136
	Sutrisno, E. Darmawati, Sugiyono, Ismi M. Edris	
122	Potential of Floating Horticulture System on Swampland in South Sumatra	D-142
	Siti Masreah Bernas	
123	Community Aspirations In Fruit Crop Development Featured In Bojonegoro.....	D-147
	Indra Tjahaja Amir	
124	Factors That Influence The Farmer Opportunity in Selling Its Product to Modern Market	D-156
	Johannis Damiri and Irham Lihan	
125	The Development of Instant Ginger Business Strategies (Case Study in Sari Jahe Inyong, A Small Industry in Bandar Lampung)	D-160
	Wisnu Satyajaya, Adrina Yustitia and Fanni Desiyanto	

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Governor of Province of Lampung, Indonesia
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EARLY DETECTION OF CHILLING INJURY SYMPTOMS IN HORTICULTURAL PRODUCTS**Y. Aris Purwanto**

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ABSTRACT

Chilling injury symptoms in horticultural products were examined through the dynamic state of water by proton NMR analysis. Cucumber fruits, a chilling sensitive horticultural product, were used as a sample. After harvesting, samples were stored in polyethylene bags at temperature of 5°C and 25°C for 9 days. T_1 relaxation time, weight loss, pH, ion leakage and the occurrence of pitting were measured during the period of storage. For samples stored at 25°C, T_1 changed slightly for the first 3 days from 1.25 to 1.29s and increased from 4 days at the range of 1.35 to 1.38s. In contrast to this, at storage temperature of 5°C, T_1 increased extremely from 1.24 to 1.59s from storage time of 2 to 4 days and after that decreased to 1.38s at 9 days. The change in T_1 indicates the change in water movement in cell due to the physical change in membrane permeability. This phenomenon was supported by the change in weight loss, pH and ion leakage. The weight loss of samples for 25 and 5°C was almost the same; therefore, it is considered that the pitting for samples stored at 5°C was due to the impact of low temperature. The increasing tendency of pH was observed for samples stored at 5°C with the value at 9 days was higher than that at 25°C. The increase in pH could be thought as the change in acid content which indicates the occurrence of chilling injury. The rate of ion leakage for samples stored at 5 °C was higher than that at 25°C. This shows that impact of chilling has changed the membrane permeability. It is concluded that longer T_1 relaxation time in chilling temperature indicates the change in the dynamic state of water which is related to the increase in membrane permeability. The dynamic state of water which is showed through the change in T_1 could be applied to detect the early symptom of chilling injury before the external symptoms such as pitting can be detected.

Keywords: T_1 relaxation time, proton NMR, ion leakage, membrane permeability

INTRODUCTION

Low temperature is commonly storage method to extend the post harvest life of fresh horticultural products. However, for some products, stored under low temperature (above °C) are liable to reduce their marketability considerably because of chilling injury (Fukushima *et al.*, 1977). Chilling injury is primarily a disorder of crops of tropical and subtropical origin. The critical temperature for chilling injury varies with the commodity, but it generally occurs when produce is stored at temperatures below 10 – 13 °C. The injury symptoms may develop as characterized by abnormal ripening, surface pitting, discoloration, water-soaking, etc., if the period of exposure to chilling temperature becomes longer (Saltveit, 2002).

If the horticultural products are stored below the critical temperature for short periods, the product may repair the damage. If exposure is prolonged, irreversible damage occurs and visible symptoms often result. Injury occurs sooner and is more severe, the lower the temperature is below the threshold temperature. Detection of chilling injury is often difficult, as products often look sound when removed from the chilling temperature, but symptoms may occur when the products is placed at higher temperatures. Symptoms which appear at higher temperatures may appear almost immediately, or may take several days to develop; symptoms also may not be visible externally. The change in membrane permeability as a response to chilling temperature has been pointed out as a possible causes of chilling injury (Lyons, 1973). The membrane permeability regulates the water

movement in cell and the dynamic state of water can be used to detect a chilling-induced permeability change of membrane (Naruke *et al.*, 2003). The dynamic state of water in cell structure during chilling treatment can be examined through the change in water proton NMR T_1 relaxation time (Iwaya-Inoue *et al.*, 1996). T_1 relaxation time reflects structurally related differences in the relaxation properties of the proton ^1H nuclei of water and indicates mobility of water molecules (Watanabe and Iwaya-Inoue, 1996).

From those points of view, early detection of symptoms of chilling injury will be important in order to understand when chilling-induced change occurs. In this study, chilling injury index of horticultural product was investigated through the dynamic state of water by proton NMR analysis. T_1 relaxation time and diffusion coefficient were set as an index of the dynamic state of water. Cucumber fruits were used as a sample of horticultural products.

MATERIALS AND METHODS

Material and storage condition

Cucumber fruits (*Cucumis sativus*, L) cv. Alfa Fushinari and Flesco 100 were used as a sample. One day after harvesting, cucumber fruits were transported to the laboratory at ambient temperature. Sample of fruits were then placed at storage chamber at set temperature condition in polyethylene bags. The temperature was set at 5°C (chilled) and 25°C as a control (room temperature). The fruits were then put into polyethylene bags (340 x 240 x 0.08 mm) which each bag contains 4 fruits. Ten bags were stored at temperature of 5°C (chilled) and another 10 bags at 25°C (ambient temperature) for 9 d. The polyethylene bags were ventilated once a day to prevent anaerobic condition.

Sample preparation and measurement

For measurement of T_1 relaxation time, samples of sarcocarp with dimensions of 5x5x20mm were dissected from the middle of the longitudinal axis of cucumber fruits. After the dissection, the sample was put in a NMR tube and placed in the NMR spectrometer (25MHz, 0.58T, JNM-MU25, JEOL). From the same middle part of cucumber fruits, sample of sarcocarp with 4mm of diameter and 10mm of length was dissected using cork borer for ion leakage measurement. The samples were soaked in deionized water (40ml) which the initial value of its electric conductivity was known. The change in electric conductivity in the solution with time was then measured by EC meter (D-24, HORIBA) at 20°C. After 8 h, the sample was homogenized for 2 min. to leak all ions out from the sample and the total electric conductivity was measured. Data of ion leakage was expressed as a percent of the total conductivity of the solution. The remaining part of cucumber fruits was then squashed to extract the solution. pH of solution was measured by pH meter (D-24 HORIBA) at 20°C. T_1 relaxation time, weight loss, pH, ion leakage and the occurrence of pitting were examined during period of storage. For each measurement, 4 fruits were used.

RESULTS AND DISCUSSIONS

Pitting and other quality evaluation

Pitting was observed for fruits stored at 5°C at days 6. For fruits stored at 25°C, a white color at the middle of the longitudinal axis cut of cucumber fruits was observed for all samples (5 days), this might be caused by the dehydration of fruits due to the deterioration process during storage. The weight loss after 9 days for the fruits stored at 25 and 5°C was 2.5% and 1.5%, respectively (Figure 1). The weight loss for both conditions was almost the same; therefore, it thought that the pitting for fruits at 5°C was because of the impact of low temperature. Water loss, i.e. weight loss, has a close relationship to membrane water permeability.

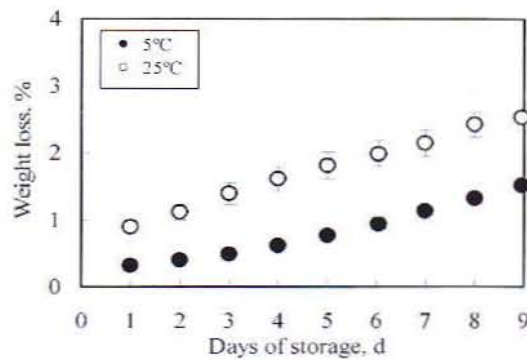


Figure. 1. Weight loss of cucumber fruits stored at 5°C and 25 °C

Change in pH

The change in pH during storage at both condition of 5 and 25°C was slightly (Figure 2). The increasing tendency of pH was observed for fruits stored at 5°C with the value at storage time of 9 days were higher than that at 25°C. The increase in pH could be thought as the change in acid content which indicate the occurrence of chilling injury.

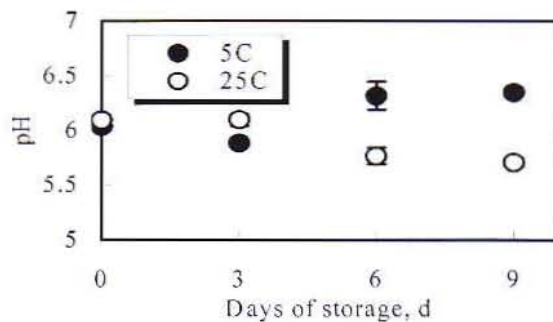


Figure 2. Change in pH

Change in ion leakage

After 20 min, the slope of the change in percentage of ion leakage was not extremely as occur in the first 20 min. However, the rate of ion leakage for fruits stored at 5 °C was higher than that at 25°C. This indicates that impact of chilling changed the membrane permeability. The extremely difference in percentage of ion leakage was observed at storage time of 9 days which show that the percentage of ion leakage reached to 87% at 60 min for 5°C and 39% for 25°C (Figure 3).

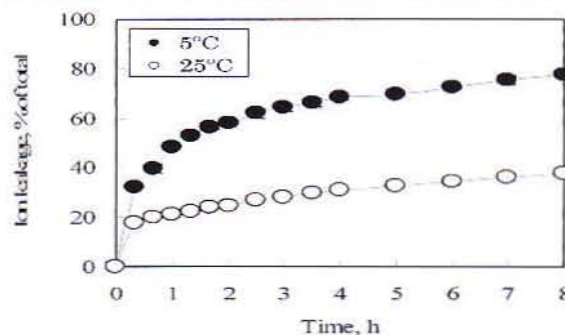


Figure 3. Change in ion leakage

Change in T₁ relaxation time

The change in T₁ relaxation time at condition of 5C indicates the change in water movement in the cell due to the physical change in membrane permeability. Impact of chilling is thought to be a

cause of the increase in membrane permeability (Lyons, 1973), in this study was indicated by the extremely increase in the value of T_1 relaxation time. It was shown that the dynamic state of water in cucumber fruits changed into a different state at the chilling temperature. In other word, T_1 relaxation times became longer at the incipient stage of chilling injury during physiological change such as pitting of fruits could not be detected by visual inspection. The variation in T_1 relaxation time was thought to be due to the increase in membrane permeability in relation to chilling temperature (Figure 4).

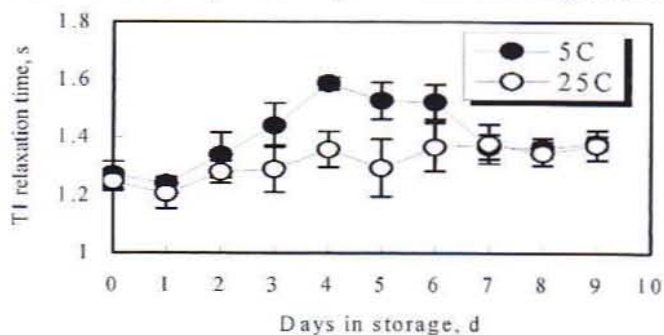


Figure 4. Change in T_1 relaxation time

CONCLUSIONS

Longer T_1 relaxation time in chilling temperature indicates the change in the dynamic state of water which is related to the increase in membrane permeability. This is thought to be the occurrence of chilling injury. Impact of chilling injury can also be detected from the change in pH, ion leakage and weight loss. Finally, the dynamic state of water which showed through the change in T_1 relaxation time could be applied to detect the early symptom of chilling injury.

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