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Society of America

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April - June 2003

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PGRSA membership is open to all persons interested in the regulation of plant growth and development. Inquiries regarding membership should be directed to...

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PGRSA
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The Quarterly is open to papers of merit dealing with all aspects of plant growth regulation and plant growth regulators. Manuscripts will be reviewed by two or more reviewers. Membership in the Society is not required. Newsworthy items, viewpoints and abstracts of theses and dissertations are also published as space permits.

2003 PGRSA / JSCRP Annual Meeting – Schedule Summary

Saturday, August 2

1600 – 1900	Pre-Conference PGRSA Steering Committee Meeting (Conference Centre - Executive Boardroom)

Sunday, August 3

0900 – 1200	Pre-Conference Tour of City of Vancouver
1300 - 2000	Registration (Grand Pacific Foyer)
1400 - 1700	Pre-Conference JSCRP Steering Committee Meeting (Executive Boardroom)
1800 - 2000	Opening Reception - Gilligan's Poolside Patio Bar & Grill

Monday, August 4

0700 – 1900	Registration (Grand Pacific Foyer)
0800 - 0810	Welcoming Remarks Dr. Wayne A. Mackay, President, PGRSA (Grand Pacific Salon AB)
0810 - 0820	Welcoming Remarks Dr. Yuji Kamiya, President, JSCRP (Grand Pacific Salon AB)
0820 - 0900	Opening Address Dr. Norman E. Looney, President, International Society for Horticultural Science (Grand Pacific Salon AB)
0900 - 1045	Symposium I: Fruit Maturation Management Moderated by Dr. Ricardo Menendez, Valent Biosciences Corporation, Libertyville, Illinois (Grand Pacific Salon AB)
1045 - 1200	Contributed Paper Session I: Oral Presentations - Flowering/Fruiting Moderated by Dr. Masayuki Katsumi, Editor, Journal of JSCRP, International Christian University (Ret.) (Grand Pacific Salon AB)
1200 - 1330	Buffet Lunch (Grand Pacific Ballroom C)

1330 - 1530	Contributed Paper Session II: Oral Presentaions - Molecular Biology/Metabolism Moderated by Dr. Yuji Kamiya, Plant Science Center, RIKEN, Laboratory for Cellular Growth & Development (Grand Pacific Salon AB)
1545 - 1700	Contributed Paper Session III: Oral Presentaions - Fruiting/Fruit Quality Moderated by Dr. Gregory L. Reighard, Clemson University, Department of Horticulture, Clemson, South Carolina (Grand Pacific Salon AB)
1830 - 2030	PGRSA / JSCRP Executive Dinner (Delta Room and Patio)

Tuesday, August 5

0700 – 0830	PGRSA / JSCRP Steering Committee/Sustaining Members Breakfast (Delta Room and Patio)
0830 - 1700	Registration (Grand Pacific Foyer)
0900 - 1000	Symposium II: Biochemical and Molecular Aspects of Plant Growth Regulators Moderated by Dr. Kaio Kobayashi, Department of Biotechnology, Graduate School of Engineering, Osaka, Japan (Grand Pacific Salon AB)
1015 - 1200	Contributed Paper Session IV: Oral Presentaions - Gene Expression/ Metabolism Moderated by Dr. Ronald Smith, Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Center, Fredericton, NB (Grand Pacific Salon AB)
1200 - 1330	Lunch (on your own)
1330 - 1500	Contributed Paper Session Session V: Oral Presentaions - Regulation of Growth and Development I Moderated by Dr. Shigeo Yoshida, Plant Functions Lab, RIKEN Institute, Wako, Japan (Grand Pacific Salon AB)
1515 – 1630	Contributed Paper Session Session VI: Oral Presentaions - Regulation of Growth and Development II Moderated by Dr. Edward Stover, University of Florida, Indian River Research and Education Center, Ft. Pierce, FL (Grand Pacific Salon AB)

1830 - 2030	Poster Session and Reception Moderated by Dr. Louise Ferguson, Kearney Ag Center, University of California, Parlier, CA (Grand Pacific Foyer)

Wednesday, August 6

0800 - 1200	Registration (Grand Pacific Foyer)
0830 – 1000	Symposia III: Plant Growth Regulator in Nurseries of Trees and Woody Plants Moderated by Dr. Don Elfving, Tree Fruit Research and Extension Center, Washington State University, Wenatchee, WA (Grand Pacific Salon AB)
1015 – 1200	Industry Session Moderated by Dr. Michelle Bell, SePRO Corporation, Carmel, IN (Grand Pacific Salon AB)
1230 - 1400	PGRSA/ JSCRP Awards and Business Luncheon (International Ballroom Salon A)
1500 - 1800	PGRSA Steering Committee Meeting (Executive Boardroom)

Thursday, August 7

0830 - 1700	Ferry and Tour of Vancouver Island, Buchart Sunken Garden, Victoria

30th ANNUAL MEETING

Plant Growth Regulation Society of America
&
Japanese Society for Chemical Regulation of Plants

August 3 - 6, 2003
Vancouver Airport Conference Resort – Conference Centre
Richmond, British Columbia

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0900 - 0930 A PLURIENNIAL EXPERIENCE IN CONTROLLING PEACH FRUIT RIPENING USING DIFFERENT NATURAL SUBSTANCES. G. Costa*, A.M. Bregoli (1)

0930 - 1000 PREHARVEST PLANT GROWTH REGULATORS THAT INFLUENCE POME FRUIT MATURATION AND FRUIT QUALITY. D.W. Greene (2)

1000 - 1030 MANAGEMENT OF CLIMACTERIC FRUIT RIPENING WITH 1-METHYL-CYCLOPROPENE, AN INHIBITOR OF ETHYLENE ACTION.
J.P. Mattheis*, X. Fan, L. Argenta (3)

1030 - 1045 BREAK

Session I: Flowering/Fruiting, (Contributed Oral Papers);
Moderated by Dr. Masayuki Katsumi, Editor, Journal of JSCRP, International Christian University (Ret.), Tokyo, Japan (Grand Pacific Salon AB)

1045 - 1100 FURTHER CHARACTERIZATION OF THE MANGO FLORIGENIC PROMOTER. T.L. Davenport* and Z. Ying (4)

1100 - 1115 INCREASING FRUIT SIZE: ACHIEVEMENTS IN ISRAEL. Y. Erner*, I. Kaplan, B. Artzi, E. Tagari and M. Hamou (5)

1115 - 1130 SPRAY VOLUME AND SURFACTANT EFFECTS ON NAA THINNING OF FLORIDA CITRUS. E.W. Stover* and S.M. Ciliento (6)

1130 - 1145 PRELIMINARY RESULTS USING FOLIAR-APPLIED AMINOETHOXYVINYL-GLYCINE (AVG) TO INCREASE YIELD AND FRUIT QUALITY OF THE 'WASHINGTON' NAVAL ORANGE. C.M. Gonzalez and C.J. Lovatt* (7)

1145 - 1200 REDUCING PEACH FLOWER BUD NUMBER WITH A MID-WINTER APPLICATION OF SOYBEAN OIL. G.L. Reighard*, S.M. Njoroge, S. Lennon, D. Ouellette and K. Brock (8)

1200 - 1330 **LUNCH** (Grand Pacific Salon C)

Session II: Molecular Biology/Metabolism, (Contributed Oral Papers); Moderated by Dr. Yuji Kamiya, Plant Science Center, RIKEN, Laboratory for Cellular Growth & Development, Yokohama, Japan (Grand Pacific Salon AB)

1330 - 1345 REGULATION OF GIBBERELLIN BIOSYNTHESIS DURING SEED GERMINATION IN *ARABIDOPSIS*. Y. Yamauchi, M. Ogawa, Y. Kamiya* and S. Yamaguchi (9)

1345 - 1400 THE ENDOGENOUS GIBBERELLINS IN A GERMINATED BARLEY DWARF MUTANT. K. Dewi** and P.M. Chandler (10)

1400 - 1415 PHYTOHORMONE PROFILES YIELD POSITIONAL INFORMATION TO BUDS IN THE CONIFER TREE *ABIES NORDMANNIANA*. H.N. Rasmussen*, B. Veierskov, R. Noerbaek and J. Hansen-Moeller (11)

1415 - 1430 METABOLISM OF DEUTERIUM-LABELED JASMONIC ACID AND OPC 8:0 IN POTATO PLANT (*SOLANUM TUBEROSUM* L.). H. Matsuura* and T. Yoshihara (12)

1430 - 1445 DEVELOPMENT OF NOVEL PLANT TRANSFORMATION METHOD USING arF EXCIMER LASER MICRO ABLATION. A. Kobayashi* and S. Kajiyama (13)

1445 - 1500 PLANT METABOLITE ANALYSIS USING LASER-ASSISTED SINGLE CELL SAMPLING. S. Kajiyama* and A. Kobayashi (14)

1500 - 1515 DEVELOPMENT OF TRANSIENT RNAi ASSAY SYSTEM USING *ARABIDOPSIS* MESOPHYLL PROTOPLASTS. C.-I. An*, E. Fukusaki, A. Sawada and A. Kobayashi (15)

1515 – 1530 HOW WELL ARE THE PHOTORECEPTOR SYSTEMS CONSERVED IN NON- PHOTOSYNTHETIC PLANTS? A. Okazawa*, C. Trakulnaleamsai, H. Hiramatsu, T. Sando, E. Fukusaki, K. Yoneyama, Y. Takeuchi and A. Kobayashi (16)

1530 - 1545 BREAK

Session III: Fruiting/Fruit Quality; (Contributed Oral Papers); Moderated by Gregory L. Reighard, Clemson University, Department of Horticulture, Clemson, South Carolina (Grand Pacific Salon AB)

1545 - 1600 DOES PREHARVEST APPLICATION OF NAA INDUCE RIPENING IN APPLE AND PEAR? E.A. Curry (17)

1600 - 1615 APPLICATION OF 2,4-D AND 3,5,6-TPA TO INCREASE YIELD AND FRUIT SIZE OF CLEMENTINE MANDARIN IN CALIFORNIA. C.T. Chao*, L. Ferguson and C.J. Lovatt (18)

1615 - 1630 FOLIAR-APPLIED TRYPTOPHAN INCREASES YIELD AND FRUIT QUALITY OF *LYCOPERSICON ESCULENTUM* AND *CITRUS SINENSIS*. L.J. Pillitteri, I. Bertling, L. Xiao, C.M. Gonzalez and C.J. Lovatt* (19)

1630 - 1645 RESPONSE OF 'CRIOLLA DOMINICANA' TABLE GRAPE TO NITROGUAIACOL, BRASSINOLIDE AND ACETYLTHIOPROLINE. J.P. Morales-Payan (20)

1645 - 1700 PLANT GROWTH REGULATORS MAKING A DIFFERENCE IN INDIAN AGRICULTURE. A.K. Raina (21)

1830 - 2030 **PGRSA / JSCRP Executive Dinner** (Delta Room and Patio)

Tuesday, August 5

0700 - 0830 **PGRSA Sustaining Members Breakfast** (Delta Room and Patio)

0830 - 1700 **Registration** (Grand Pacific Foyer)

Symposium II: Biochemical and Molecular Aspects of PGRs; Moderated by Dr. Akio Kobayashi, Department of Biotechnology, Graduate School of Engineering, Osaka, Japan (Grand Pacific Salon AB)

0900 - 0930 USING PROTEOMIC TOOLS TO STUDY ACTIONS OF PLANT POLYPHENOLS ON DISEASE-RELEVANT PROTEINS. H. Kim (22)

0930 - 1000 HORMONAL INTERACTIONS IN FRUIT DEVELOPMENT. J. Ozga* and D. Reinecke (23)

1000 - 1015 BREAK

Session IV: Gene Expression/Metabolism (Contributed Oral Papers); Moderated by Dr. Ronald Smith, Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Center, Fredericton, NB (Grand Pacific Salon AB)

1015 - 1030 A KINASE HIGHLY HOMOLOGOUS TO PKA FROM PARASITIC PLANT. K. Uematsu*, K. Yomeyama, Y. Sugimoto and Y. Fukui (24)

1030 - 1045 *ETHYLENE INSENSITIVE 2* EXPRESSION LEVEL AND ETHYLENE SENSITIVITY IN PETUNIA FLOWERS. K. Shibuya*, K. Barry, J. Ciardi, S. Nourizadeh, H. Loucas, H. Klee and D. Clark (25)

1045 - 1100 3'UNTRANSLATED REGION SPECIFIC RNAi AND ITS APPLICATION TO FACILE HUNTING OF LOW EXPRESSING GENE HOMOLOG. E. Fukusaki*, K. Kawasaki, C.-I. An, A. Sawada, S. Kajiyama, A. Kobayashi (26)

1115 - 1130 ROLES OF BRASSINOSTEROIDS AND THEIR BIOSYNTHESIS GENES IN SEED GROWTH AND GERMINATION OF PEA. T. Nomura*, M. Ueno, S. Takatsuto, Y. Takeuchi and T. Yokota (27)

1130 - 1145 PRELIMINARY COMPARISON OF DIFFERENCES IN GENE EXPRESSION BETWEEN VEGETATIVE AND FEMALE BUDS OF BLACK SPRUCE (*Picea mariana*) USING SERIAL ANALYSIS OF GENE EXPRESSION (SAGE). R.F. Smith*, J. Letourneau and B. Flynn (28)

1145 - 1200 THEOBROXIDE STIMULATES LIPOXYGENASE ACTIVITY AND LEVEL OF JASMONIC ACID IN SHORT-DAY PLANTS. X. Gao**, C. Minami, Q. Yang, A. Kimura, H. Matsuura and T. Yoshihara (29)

(**Graduate student competitor for "Best Student Paper")

1200 - 1330 **LUNCH (on your own)**

Session V: Regulation of Growth and Development I (Contributed Oral Papers);
Moderated by Dr. Shigeo Yoshida, Plant Functions Lab, RIKEN Institute, Wako Japan (Grand Pacific Salon AB)

1330 - 1345 CONTROLLING WHEAT GROWTH ONBOARD THE INTERNATIONAL SPACE STATION (ISS): GERMINATION AND EARLY DEVELOPMENT. G.W. Stutte*, O. Monje and S. Anderson (30)

1345 - 1400 EFFECT OF BENZYLAMINOPURINE ON TISSUE DEVELOPMENT AND VASCULARIZATION IN REPRODUCTIVE STRUCTURES OF PIGEONPEA (*Cajanus cajan*). D.S. Narine** and G.F. Barclay (31)

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1415 - 1430 EFFECTS OF PLANT GROWTH REGULATORS ON AGRONOMIC CROP YIELDS IN THE DESERT SOUTHWEST. M.D. Rethwisch (33)

1430 - 1445 INTEGRATING PLANT GROWTH REGULATORS AND A MYCOHERBICIDE TO ENHANCE THE COMPETITIVE ABILITY OF BELL PEPPER WITH THE WEED LIVID AMARANTH. J.P. Morales-Payan*, W.M. Stall, R. Charudattan and J.T. DeValerio (34)

1445 - 1500 INFLUENCE OF GROWTH SUPPRESSION ON STATURE REDUCTION, PANICLE DEVELOPMENT AND CROP PROTECTION IN RICE. R.T. Dunand (35)

(**Graduate student competitor for "Best Student Paper")

1500 - 1515 BREAK

Session VI: Regulation of Growth and Development II (Contributed Oral Papers); Moderated by Dr. Edward Stover, University of Florida, Indian River Research and Education Center, Ft. Pierce, FL (Grand Pacific Salon AB)

1515 - 1530 ENHANCEMENT OF PROPAGULE FORMATION OF *HEMEROCALLIS* AND *HOSTA*. M. Leclerc**, C.D. Caldwell, L. Mapplebeck, R. Lada and J. Norrie (36)

1530 - 1545 PRODUCTION APPLICATIONS OF PACLOBUTRAZOL AND ANCYMIDOL AFFECTS LANDSCAPE PERFORMANCE OF PANSIES. M.A. Arnold* and G.V. McDonald (37)

1545 - 1600 OPTIMUM PGR RATES FOR PRODUCTION OF SPIDERWORT. S. White, J.G. Latimer* and H.L. Scoggins (38)

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1615 - 1630 EFFECT OF A SEAWEED-DERIVED BIOSTIMULANT ON THE YIELD OF PURPLE NUTSEDGE-INFESTED BELL AND CUBANELLE PEPPERS. J.P. Morales-Payan* and W.M. Stall (40)

(**Graduate student competitor for "Best Student Paper")

1830 - 2030 **Poster Session and Reception;** Moderated by Dr. Louise Ferguson, Kearney Ag Center, University of California, Parlier, CA (Grand Pacific Foyer)

POSTERS

(**Graduate student competitor for "Best Student Paper")

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EXPANSIN5 AND ROOT GROWTH IN *ARABIDOPSIS THALIANA*. T.-W. Kim**, S.C. Chang, S.C. Park and S.-K. Kim (46)

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GIBBERELLINS INDUCE á-AMYLASE AND CONCERN THE DEVELOPMENT OF COTYLEDON IN IMMATURE SEEDS OF P. NIL. M. Nakajima, A. Nakayama, Z.-J. Xu and I. Yamaguchi* (88)

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PRODUCTIONS OF SEEDLESS FRUITS IN SOME PALM DATE CULTIVARS. M.A. Shaheen (94)

Wednesday, August 6

0800 - 1200 **Registration** (Grand Pacific Foyer)

Symposia III: PGRs in Nurseries of Trees and Woody Plants
Moderated by Dr. Don Elfving, Tree Fruit Research and Extension Center, Washington State University, Wenatchee, WA (Grand Pacific Salon AB)

0830 - 0900 PLANT GROWTH REGULATION IN ORNAMENTAL NURSERIES: UNREALIZED OPPORTUNITIES. G.J. Keever (95)

0900 - 0930 BIOREGULATOR APPLICATIONS IN FRUIT-TREE NURSERY PRODUCTION. D.C. Elfving* and E.A. Curry (96)

0930 - 1000 GROWING 200,000,000 FOREST SEEDLINGS – PELTON NURSERY. S. Pelton

1000 - 1015	BREAK
	Industry Session, Moderated by Dr. Michelle Bell, SePRO Corporation, Carmel, IN (Grand Pacific Salon AB)
1015 - 1030	Dr. Ricardo Menendez, Valent Biosciences Corporation, Libertyville, IL
1030 - 1045	Jerry Stoller, The Stoller Group, Houston, TX
1045 - 1100	Dr. Dennis Shepard, Syngenta International Ag, Franklin, TN
1100 - 1115	Dr. Henry Rodriquez, Precision Biochemicals, Inc., Vancouver, BC
1115 - 1130	Dr. Michelle Bell, SePRO Corporation, Carmel, IN
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ABSTRACTS

(1)

A PLURIENNIAL EXPERIENCE IN CONTROLLING PEACH FRUIT RIPENING USING DIFFERENT NATURAL SUBSTANCES

G. Costa*, A.M. Bregoli.
Dipartmento di Colture Arboree, University of Bologna, #46 Fanin Street, Italy

The natural fermentation product aminoethoxyvinylglycine (AVG) and the growth substances polyamines (PAs) were applied for different years on peach and nectarine cultivars to investigate their effect during "on-tree" fruit ripening. Different concentrations and application times of AVG and of the main PAs were tested and fruit ethylene emission and quality parameters were measured. Moreover, biochemical and molecular analyses were performed to investigate the physiological effects of these naturally occurring substances. A clear reduction and a delay of ethylene emission was observed on peach and nectarine with both substances and, as a consequence of this control, several fruit quality parameters were affected. Treated fruit were in fact at a ripening stage earlier than that of controls and in some cases also their natural abscission was delayed. Results will be discussed on the basis of the effect on PA metabolism and on ethylene and PA biosynthetic gene expression.

(2)

PREHARVEST PLANT GROWTH REGULATORS THAT INFLUENCE POME FRUIT MATURATION AND FRUIT QUALITY

Duane W. Greene*.
Department of Plant and Soil Sciences, University of Massachusetts, Amherst, MA 01003 USA

Several plant growth regulators (PGRs) are used or have been used to influence ripening and enhance fruit quality. These include naphthaleneacetic acid (NAA), 2-chloroethylphosphonic acid (ethephon), succinic acid-2, 2-dimethylhydrazide (daminozide), and aminoethoxyvinylglycine (AVG). NAA was one of the first drop control compounds. It can advance fruit ripening and reduce storage life under certain circumstances. Ethephon is an ethylene generating compound that retards growth. It is applies as a preharvest spray to advance ripening and improve red color. AVG is the newest PGR that retards preharvest drop and affects all aspects of fruit maturation by delaying ethylene biosynthesis. The history, development and current uses of NAA, ethephon, and AVG will be discussed. Included will be an update to show how these products are currently being used to improve fruit quality.

(3)

MANAGEMENT OF CLIMACTERIC FRUIT RIPENING WITH 1-METHYLCYCLOPROPENE, AN INHIBITOR OF ETHYLENE ACTION

J.P. Mattheis[1]*, X. Fan[2], L. Argenta[3].
[1]USDA, ARS, TFRL, 1104 N. Western Avenue, Wenatchee, WA 98801 USA; [2]USDA, ARS, ERRC, 600 E. Mermaid Lane, Wyndmoor, PA 19038 USA; [3]Epagri, Estacao Experimental de Cacador, Caixa-Postal 591, Cacador, SC Brazil

Ripening of climacteric fruit is regulated by ethylene. As normal ripening requires the presence of ethylene as well as the capacity in fruit to perceive ethylene, management of ripening can be accomplished by inhibiting fruit ethylene production, ethylene removal from the storage environment, or by inhibiting the capacity in fruit to perceive the presence of ethylene. The discovery by Drs. Ed Sisler and Sylvia Blankenship at North Carolina State University that 1-methylcyclopropene (1-MCP) interferes with the ability of plant tissue to bind ethylene provides a potential new tool for postharvest management of climacteric fruits. Research to date indicates the rate of many processes of ripening are significantly reduced following fruit exposure to 1-MCP, and that development of various postharvest disorders is reduced in the absence of ethylene action. Responses to 1-MCP in many climacteric fruit vary with cultivar, maturity at the time of treatment and other postharvest factors.

(4)

FURTHER CHARACTERIZATION OF THE MANGO FLORIGENIC PROMOTER

T.L. Davenport* and Z. Ying.
University of Florida, IFAS, Tropical Research and Education Center, 18905 SW 280 St, Homestead, FL 33031 USA

Floral induction of mango is determined by interaction of a short-lived, florigenic promoter that is up-regulated in leaves during exposure to cool temperatures and an age-dependent vegetative promoter at the time that initiation of shoot growth occurs. Research conducted this flowering season demonstrated that ¼ of a leaf per stem was sufficient to stimulate flowering in 100% of the tested stems. Three or more leaves on a donor stem of an isolated branch bearing five defoliated stems induced flowering on all six stems. One leaf on the donor stem was sufficient to induce flowering in all of the donor stems and most of the five defoliated stems, and ½ leaf on the donor stem stimulated flowering in that stem and in less than ½ of the defoliated stems. Stems that did not flower initiated vegetative shoots instead. Flowering occurred on those stems that were inserted into main branches in the same phylotaxic position as the leaf. Evidence suggests that leaves are capable of producing far greater amounts of florigenic promoter during strong floral inductive conditions than needed for induction of buds and that the promoter can move great distances in phloem aligned in the same phylotaxic position of the source leaf.

(5)

INCREASING CITRUS FRUIT SIZE: ACHIEVEMENTS IN ISRAEL

Y. Erner*, I. Kaplan, B. Artzi, E. Tagari and M. Hamou.
ARO. The Volcani Center, Fruit Tree Sciences, POB 6, Bet-Dagan 50250 Israel

Consumers' preference for fresh and large fruit sizes, over the natural distribution of fruits on the tree, has become essential requisite for growers in order to be economical. The difference in prices is very large and small fruit does not cover the expenses. Maximum income can be achieved by adequate yield and big sizes. Increasing size by thinning should apply only to varieties that set over 1000 fruits per tree (e.g. mandarins), while enhancing the size of normal set of oranges and grapefruit is required. Potassium (5%) and Auxins (20-60ppm) were found to increase size on a precise timing. Best time of application found to be 40-60 days after full bloom. Thinning with NAA is not enough to increase size and further application of 2,4-DP is necessary to obtain maximum size. Potassium increases acidity and therefore is not recommended for use with early harvest varieties or varieties with high level of acid. 2,4-DP as dimethyl amine, of one isomer, at 60ppm was found to be the best over a wide range of tested auxins.

(6)

SPRAY VOLUME AND SURFACTANT EFFECTS ON NAA THINNING OF FLORIDA CITRUS

E.W. Stover* and S.M. Ciliento.
University of Florida, Indian River Research and Education Center, Fort Pierce, Florida, USA

There are many reports of reduced cropload and increased fruit size following NAA application during early fruit development to various citrus cultivars in diverse growing regions. NAA has been labeled for thinning of many Florida citrus varieties for more than twenty years, but has received little commercial use. Almost all published reports have used high spray volumes requiring > \$500·ha^{-1} NAA at current prices and rates of 250-500 ppm required to thin Florida citrus. We conducted four trials to determine whether lower spray volumes and/or different surfactants would permit adequate thinning with much less cost per hectare. In two consecutive years, NAA trials in 'Murcott' demonstrated significant cropload reduction and fruit size enhancement from all NAA applications, with no or small differences between spray volumes of 560, 1120, or 2340 L·ha^{-1} at the same ppm. The effect of surfactant (non-ionic, Silwet L-77, and LI-700) on NAA thinning was tested in both 'Murcott' and 'Sunburst'. The most notable difference was greater cropload reduction from L-77 with less increase in production of largest fruit sizes compared to non-ionic surfactant in 'Murcott'. The trend was similar but not significant in 'Sunburst'.

(7)

PRELIMINARY RESULTS USING FOLIAR-APPLIED AMINOETHOXYVINYLGLYCINE (AVG) TO INCREASE YIELD AND FRUIT QUALITY OF THE 'WASHINGTON' NAVEL ORANGE

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Aminoethoxyvinylglycine (AVG) (38 mg/L) sprayed on 'Washington' navel orange trees at 75% petal fall significantly increased fruit retention through January (mid-harvest), but not through late harvest in March. AVG applied at June drop or preharvest drop (Nov.) had no effect on fruit retention. AVG applied at petal fall or June drop significantly reduced crease, a rind disorder causing low pack-out and grower return. AVG applied at June drop was more effective than petal fall but preharvest treatment had no effect on crease. AVG applied at petal fall significantly reduced fruit size for all harvests, but when applied at June drop, only early-harvested fruit were smaller. Preharvest AVG treatment had no effect on fruit size. Petal fall, June drop or preharvest foliar applications of AVG at 300 mg/L were without beneficial effect and significantly reduced fruit size. Based on these preliminary results, use of AVG to reduce fruit abscission and crease of citrus cultivars warrants further testing.

(8)

REDUCING PEACH FLOWER BUD NUMBERS WITH A MID-WINTER APPLICATION OF SOYBEAN OIL

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Removal of peach flower buds, flowers or young developing fruit in early spring is important to increase fruit size. Methods such as summer GA sprays, burning flowers with chemicals, or hand-thinning to remove buds and flowers are costly or inconsistent, thus growers wait until ~ 30 days after full bloom to start hand-thinning fruit, which often reduces the potential fruit size. Experiments were conducted in 2001, 2002, and 2003 in commercial peach orchards in South Carolina to determine the efficacy of soybean oil (SO) for pre-bloom thinning of difficult-to-thin peach varieties. Previous work reported by Sams, Deyton, and others showed that SO rates of 6 and 8% effectively thinned peach flower buds without over-thinning. Varieties were selected and sprayed once in December, January or February during these 3 years using rates of 6, 7 or 8% degummed SO. Dormant oil at 2% was the control treatment. Bloom was either delayed or advanced by SO depending on variety and year. SO significantly reduced the number of live flower buds. SO also significantly decreased hand thinning costs and for some varieties improved fruit size and commercial packout.

(9)

REGULATION OF GIBBERELLIN BIOSYNTHESIS DURING SEED GERMINATION IN *ARABIDOPSIS*

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During *Arabidopsis* seed germination, two genes encoding GA 3-oxidase, *AtGA3ox1* and *AtGA3ox2*, are mainly expressed in the same cell-types. We found that the *AtGA3ox1* gene, but not the *AtGA3ox2* gene, is up-regulated in response to cold treatment for stratification (4°C in the dark). Consistent with *AtGA3ox1* expression, endogenous GA_4 levels were elevated following cold treatment. Using a loss-of-function mutant of *AtGA3ox1*, we showed that *AtGA3ox1* is essential for the promotion of seed germination by cold treatment. Affymetrix GeneChip (8.3K genes) analysis identified a new set of GA-responsive genes that appear to be unique to the cold temperature environment. *In situ* hybridization illustrated that the *AtGA3ox1* transcript was detectable in additional cell-types after cold treatment. These results suggest that GA distribution and response are modulated under different environmental conditions during seed germination. Combined with our previous findings, these data illustrate part of the complex mechanisms by which active GA levels are determined through the regulation of *AtGA3ox1* and *AtGA3ox2* genes.

(10)

THE ENDOGENOUS GIBBERELLINS IN A GERMINATED BARLEY DWARF MUTANT

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The endogenous gibberellins (Gas) and the expression of mRNAs for both GA 20-oxidase and GA 3-oxidase were evaluated in germinated barley grains. We used grains from parent plants that were heterozygous for a GA-deficiency allele, *grd2-430*, which give rise to tall and dwarf seedlings in a 3:1 ratio. The content of endogenous GA_1 measured at 4 days after germination was 8 pg/dwarf seedling and 405 pg/tall seedling. The contents of GA_{53}, GA_{44}, GA_{19} and GA_8 were lower in dwarf compared to tall, whereas GA_{20} and GA_{29} were slightly higher in dwarf compared to tall. These results suggest that *grd2-430* homozygotes are low in GA 3-oxidase activity. Northern blots indicated that both GA 20-oxidase and GA 3-oxidase mRNAs were expressed at higher levels in the scutellum of dwarf compared to tall seedlings. This suggests that feed-back regulation of gibberellin biosynthesis occurs in barley.

(11)

PHYTOHORMONE PROFILES YIELD POSITIONAL INFORMATION TO BUDS IN THE CONIFER TREE *ABIES NORDMANNIANA*

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Abies nordmanniana Spach. Is a tree with regular architecture, all growth points of the crown having predictable fates depending on their position. By electrospray LC-MS techniques we identified the cytokinins in buds at specified positions and quantified them with picomol sensitivity and ±5% precision. All buds held about the same Zeatin/Z riboside and Dehydrozeatin/DHZ riboside ratios but at very differing levels, and varied with respect to relative levels of Z+ZR, DHZ+DHZR and IPA+IPAR. The resulting profiles thus closely reflected the original position of buds and they changed in a consistent manner from autumn to spring. A subapical stem sample showed lower levels than the apical bud, with relatively more in ribosidic form. The content in root samples was close to detection limit, suggesting that roots are not the primary production site.

(12)

METABOLISM OF DEUTERIUM-LABELED JASMONIC ACID AND OPC 8:0 IN POTATO PLANT (*SOLANUM TUBEROSUM* L.)

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The metabolism of deuterium-labeled jasmonic acid and 3-oxo-2-[(Z)-2' - pentenyl]cyclopentaneoctanoic acid in potato plant are examined using cultures of single-node segments of potato stem *(Solanum tuberosum* L.*).* Deuterium-labeled jasmonates, which had been prepared from commercially available methyl jasmonate, were applied to the potato single node stems, and the metabolites were extracted from the plants and analyzed using a liquid chromatography-selected ion monitoring system. Exogenously applied deuterium-labeled jasmonic acid and 3-oxo-2-[(Z)-2' - pentenyl]cyclopentaneoctanoic acid are metabolized to 5' and 4'-O-glucopyranosyloxyjasmoic acid in the plant.

(13)

DEVELOPMENT OF NOVEL PLANT TRANSFORMATION METHOD USING ArF EXCIMER LASER MICRO ABLATION

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Plants have hard and thick cell walls around the plasma membrane and it is difficult to access inside the cells without pernicious cell damage. Due to the presence of the hard barrier, protoplast cells are generally used for introduction of foreign materials such as DNA. However, the proliferation and regeneration efficiencies are usually not so high in protoplasts which are physically labile. Here, we report a novel laser micro ablation method to remove the restricted area of cell wall surface using 193 nm pulsed ArF excimer laser. Through unsheltered plasma membrane, we injected foreign gene into the cell. In the case of epidermal cells of torenia (*Torenia fournieri* Lind.), transient expression of foreign gene (GFP) was observed in *ca*. 10% of treated cells. This method can minimize the damage of the targeted cells and provides a 'window' for introduction of not only small plasmid vectors but also huge genetic materials such as chromosome or organelle into the targeted cell.

(14)

PLANT METABOLITE ANALYSIS USING LASER-ASSISTED SINGLE CELL SAMPLING

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Along with the progress of plant physiology, the reliable method for single cell sampling is sought-after to investigate the precise metabolic profiling of different cell types. Single cell sampling of plant cells is usually performed by a fine oil-filled glass microcapillary, mounted on a micromanipulator. However, this method is time consuming and needs rather high skill due to the hard and thick cell wall barrier. We developed a unique method of laser-assisted single cell sampling and applied this to metabolite analysis at the resolution of the individual cell. Some pico-litter cell content of GFP expressed transgenic torenia (*Torenia fournieri* Lind.) were picked up from a single cell (epidermal and petal cell) using this method. The trans gene (GFP) mRNA was detected by RT-PCR, and the petal pigments *i. e.* peonidin-3,5–*O*-diglucoside and malvidin -3-glucoside-5-(*p*-coumaroyl)-glucoside were also identified by using nano flow LC-ESI MS/MS and MALDI TOF MS. This method would be one of the most powerful tools for studying metabolic profiling of individual plant cells.

(15)

DEVELOPMENT OF TRANSIENT RNAi ASSAY SYSTEM USING *ARABIDOPSIS* MESOPHYLL PROTOPLASTS

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Double-stranded RNA (dsRNA) induces sequence-specific gene silencing in eukaryotes through a process known as RNA interference (RNAi) or RNA silencing. RNAi is now used as a powerful tool for reverse genetics in many eukaryotes including plants. Here we report a transient RNAi assay system using *Arabidopsis* mesophyll protoplasts. Introduction of dsRNA into protoplasts led to marked silencing of a target gene. We observed that DNA fragments also induced gene silencing. In this report, some applications of this system will be also demonstrated.

(16)

HOW WELL ARE THE PHOTORECEPTOR SYSTEMS CONSERVED IN NON-PHOTOSYNTHETIC PLANTS?

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Light is the most important environmental signal for plants. So it is necessary to understand the photoreceptor systems to control the growth of plants by light. But limited information on the systems is available to date because of their complexity. To get new information on the systems, we focused attention on non-photosynthetic (NP) plants. Our hypothesis is that the photoreceptor systems to control the photosynthetic ability such as shade-avoidance response are lacking but the systems to control the basic photomorphological responses such as flowering are conserved in NP plants. In this study, from several NP plants, *PHYA* and *CRY1* homologous cDNAs were cloned. Sequence analysis revealed that many amino acids conserved in the photoreceptors of photosynthetic plants were substituted in the NP plants.

(17)

DOES PREHARVEST APPLICATION OF NAA INDUCE RIPENING ON CLIMACTERIC TREE FRUIT?

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1-Naphthaleneacetic acid (NAA) has been an effective bioregulator for the control of preharvest fruit abscission on apples and pears for more than 60 years. Although it has been reported NAA at super-optimal rates for control of preharvest drop may advance ripening, data reported herein suggest this may not be the case. Like ethylene, NAA promotes fruit abscission in the early spring, presumably by an ethylene-induction mechanism. Because ethylene also stimulates fruit ripening in the fall, is it tempting to assume NAA acts similarly on mature fruit tissue, even though ethylene promotes whereas NAA inhibits fruit abscission. Opposing fruit abscission responses to preharvest ethylene or NAA, therefore, may be due to the following: 1) differential tissue sensitivity or response to NAA; 2) differential auxin status across the abscission zone created by the changing absorptive surface areas of leaves and fruit; or 3) because NAA inhibits ethylene in the stem abscission zone and, may do so in fruit tissue as well. Indeed, that NAA advances ripening may just be a perception based on the artificial retention of fruit of advanced maturity.

(18)

APPLICATION OF 2,4-D AND 3,5,6-TPA TO INCREASE YIELD AND FRUIT SIZE OF CLEMENTINE MANDARIN IN CALIFORNIA

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Clementine mandarin (*Citrus reticulata* Blanco) is a seedless citrus with excellent taste and an easy-to-peel rind of bright orange color. A significant acreage of Clementine mandarin has been planted in the past years. The problem of small fruit size has also increased. The auxins 3,5,6-trichloro-2-pyridyl-oxyacetic acid (3,5,6-TPA) and 2,4-dichlorophenoxyacetic acid (2,4-D) were applied to 'Fina Sodea' Clementine mandarin in California in 2001 and 2002 as a foliar spray. The 3,5,6-TPA significantly increased yield and fruit size, but reduced juice weight and total soluble solids to acid ratio compared to the untreated control. The 2,4-D also significantly increase the yield and fruit size in early June application, but it did not increase the yield or fruit size in July application. We will discuss the benefit and potential use of plant growth regulators in Clementine mandarin production in California.

(19)

FOLIAR-APPLIED TRYPTOPHAN INCREASES YIELD AND FRUIT QUALITY OF *LYCOPERSICON ESCULENTUM* AND *CITRUS SINENSIS*

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Leaves, flowers and fruit of 'Supersweet' cherry tomato and 'Washington' navel orange take up, translocate and convert L-tryptophan (TRP) to IAA. Metabolism of TRP to IAA is independent of microorganisms. For 'Supersweet' tomato, foliar applications of TRP (10^{-8} M) during bloom significantly increased total weight (*P*£0.05) and total number (*P*£0.10) of fruit per plant compared to untreated control plants. For 'Washington' navel orange, foliar application of TRP (10^{-7} M) at maximum peel thickness (July) to increase fruit size, but not yield, significantly increased the 3-year cumulative yield of commercially valuable large-size fruit (6.9-8.0 cm transverse diameter) (*P*≤0.001) compared to untreated control trees. In addition, the July application consistently increased brix to acid ratio Nov. through Jan. Foliar application of TRP in October (10^{-10} M) for early navel harvest consistently reduced acidity and increased brix to acid ratio just two months after application.

(20)

RESPONSE OF 'CRIOLLA DOMINICANA' TABLE GRAPE TO NITROGUAIACOL, BRASSINOLIDE, AND ACETYLTHIOPROLINE

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Acetylthioproline (AP 0, 75, 150, 225, 300 $mg \cdot L^{-1}$), sodium salts of 5-nitroguaicol + ortho-para-nitrophenol (NG, 125, 250, 375, 500 $mg \cdot L^{-1}$), and brassinolide (BR, 0.01, 0.02, 0.03, 0.04 $mg \cdot L^{-1}$), were sprayed on plants of 'Criolla Dominicana' table grapes (*Vitis vinifera*) to determine their effects on crop yield and grade. The biostimulants were sprayed once, twice or thrice on starting at flowering (and at 15 day-intervals for multiple applications). Yield was not affected by one application of AP or NG. Multiple applications of AP and NG resulted in increased berry yield and marketable appearance. BR increased the number of berries and fruit weight, but reduced marketable appearance because fruit clusters were too tight.

(21)

PLANT GROWTH REGULATORS MAKING A DIFFERENCE IN INDIAN AGRICULTURE

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Over the last few years PGRs like Gibberellins, Cytokinins, Auxins, and many new growth regulatory compounds, natural as well as synthetic have found some place in Indian Agriculture, especially the horti-crops. Fruit crops like grapes and mangoes continue to use a major proportion of these compounds. Use of GA and its combinations, 6-BA, IBA and CCC are of common use in grapes at different stages of flowering or fruit set. Secondary metabolites used in various agricultural crops include Tricontanol in its various fatty alcohol mixture formulations, Brassinosteroids, low C-chain isoacid salts like AIB or the proprietary mixtures thereof like the branded Dinitrosoceferol for Sugarcane and Besmonac ethoxylate for fruit ripening are in use. Again GA combinations with Forchlorfenuron-CPPU and GA additive Vinitrol, proprietary, have shown great promise for grapes. Use of NAA and Paclobutrazol, for elevating the problem of fruit drop and alternate bearing in Mangoes is picking up. The commercialization attempts in these recent years have been need based, but in many cases with bumpy start. Lack of technical support from the institutions like agricultural universities and sketchy information from Indian or oversea use data supplied by the manufacturers have been the limitations, and in many situations the ultimate user has to take his decisions, depending more on ingenuity rather than scientific rational. All India Research effort must be initiated by ICAR in collaboration drawn from the state agricultural universities and the concerned PGR industry.

(22)

PROTEOMICS OF ACTIONS OF PLANT POLYPHENOLS ON DISEASE-RELEVANT PROTEINS IN RODENT BRAIN

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In 2002, Americans spent $3 billion on over-the-counter dietary supplements, many of which are botanically-derived such as grape seed extract which contain high levels of proanthocyanidins which are considered beneficial anti-oxidants. Because oxidative stress is a risk factor for age-related neurodegenerative conditions, including Alzheimer's disease, we hypothesized dietary supplementation with proanthocyanidin-rich grape seed extract preparation would have neuroprotective actions in normal adult rodent brain. Using proteomics technology, we found several proteins in rat brain changed in response to grape seed extract. These were previously implicated in Alzheimer's disease brain tissue or brains from mouse models of neurodegeneration; most of the changes were in the opposite direction to those detected for these proteins in the disease tissues suggesting ingestion of components in grape seed extract was neuroprotective, and efforts toward engineering plants with enhanced proanthocyanidin content be given high priority.

(23)

HORMONAL INTERACTIONS IN FRUIT DEVELOPMENT

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Fruit development involves a complex interplay of cell division, differentiation and expansion of sporophytic and gametophytic tissues that is carefully coordinated over time. Plant hormones are signals that regulate many processes of plant development including fruit development leading to mature fruit and viable mature seed. Auxins, gibberellins (GAs), cytokinins, abscisic acid, and ethylene have been implicated at various stages of fruit development. In the past hormone application studies and hormone analysis studies have supported that fruit development is in part regulated by hormonal interaction. More recently, biochemical and molecular studies are showing how hormones effect fruit development. This talk will focus on understanding the interaction between auxin and gibberellin in pea fruit development using physiological, biochemical, and molecular approaches.

(24)

A KINASE HIGHLY HOMOLOGOUS TO PKA FROM PARASITIC PLANT

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To understand the germination mechanism of root parasitic plant (Orobanche minor), we searched for genes coding protein kinases, expressed in the conditioned seed. One of them showed significant homology to catalytic subunits of PKAs (CAMP-dependent protein kinase) from other organisms, which was named as pkal. Expression of pkal was detected only in seeds. The gene product expressed in E.coli as a recombinant protein exhibited the kinase activity on the synthetic PKA substrate (kemptide). In addition to this, a gene homologous to the regulatory subunit of PKA was also cloned. These results suggest that CAMP- PKA system is present in the root parasitic plants.

(25)

ETHYLENE INSENSITIVE 2 EXPRESSION LEVEL AND ETHYLENE SENSITIVITY IN PETUNIA FLOWERS

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Senescence of Petunia flowers is accelerated by ethylene. EIN2 is a component that mediates ethylene signal transduction. We cloned the *EIN2* gene (*PhEIN2*) in petunia. Both *EIN2* co-suppression and RNAi knockout lines showed lower expression levels of *PhEIN2* expression and delayed flower senescence compared to wild type, with RNAi lines showing the lowest *EIN2* expression and the longest flower life. Flower longevity of *EIN2* RNAi plants was equivalent to *etr1-1* petunia, which harbors a mutated Arabidopsis ethylene receptor gene. *EIN3-like 1* expression was induced by ethylene in *EIN2* co-suppression plants but less than wild type, and was not induced in *EIN2* RNAi and *etr1-1* plants. These data suggest that lower *EIN2* expression causes stronger ethylene insensitivity. Furthermore, the relationship between ethylene sensitivity and other physiological responses will be discussed.

(26)

3' UNTRANSLATED REGION SPECIFIC RNAi AND ITS APPLICATION TO FACILE HUNTING OF LOW EXPRESSING GENE HOMOLOG

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RNAi induction for chalcone synthase gene (*CHS*) of torenia, *Torenia hybrida* Blue was performed in order to elucidate the effect of target region that was introduced and expressed as double strand RNA in plant. Each inverted repeat DNA construct for a coding region and 3'UTR region of *CHS* was introduced into torenia plant. The transformant targeting a coding region represented a complete disappearance of follower color. In contrast, petals of the transformant for 3'UTR showed pale blue color. These results suggest that all the homologous genes were silenced in case of RNAi with coding region and the target gene was specifically down regulated with 3'UTR. Furthermore, we succeeded in the cloning of a minor CHS homologue gene with low expression level from the cDNA of the CHS 3'UTR RNAi transgenic plant in which a major CHS was thought to be specifically silenced. This result opened up the possibility that RNAi would be used for the efficient cloning of the low expression homologous genes.

(27)

ROLES OF BRASSINOSTEROIDS AND THEIR BIOSYNTHESIS GENES IN SEED GROWTH AND GERMINATION OF PEA

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As pea seeds rapidly grow, the levels of brassinolide (BL) and castasterone (CS) were increased but, in fully-expanded seeds, were decreased drastically, indicating BL and CS are important for seed growth. In support of this, the expression of *D* homolog was increased in conjugation with the increase of CS and BL. 6-Deoxocathasterone was the major brassinosteroid (BR) in mature seeds and is likely to be an important storage form. Furthermore, mature seeds retained considerably high levels of BR biosynthesis gene transcripts. Especially the *CPD* homolog gene was elevated to the highest level in mature seeds. In imbibed seeds, neither CS nor BL were detected but the transcripts of BR biosynthesis genes were already increased. One day after the imbibition, CS and *D* transcript was detected in germinating seeds and the CS synthesis seems to occur from 6-deoxocathasterone stored. Three days after imbibition, *de novo* synthesis of BRs seems to start because the level of CS and of BR biosynthesis gene transcripts, especially *D* mRNA, was highly elevated in shoots and roots.

(28)

PRELIMINARY COMPARISON OF DIFFERENCES IN GENE EXPRESSION BETWEEN VEGETATIVE AND FEMALE BUDS OF BLACK SPRUCE (*PICEA MARIANA*) USING SERIAL ANALYSIS OF GENE EXPRESSION (SAGE)

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Significant progress has been made over the past 20 years in elucidating the physiologic factors controlling reproductive development in conifers and in developing tools for increasing cone production. Although significant progress has been made in identifying the genes associated with flowering in many herbaceous plants, few studies have attempted to do the same for any conifers. Similarly, identifying quantitative changes in gene expression e.g., genes that are up- and (or) down- regulated following cone-induction treatments, has not been done for any conifer. Serial Analysis of Gene Expression (SAGE) is a relatively new technique through which both a qualitative and a quantitative assessment of gene expression can be obtained. Using SAGE, it is possible effectively compare gene expression between two cell or tissue types, detect and identify 'novel' genes that are being expressed, and to provide a quantitative assay on the abundance of known transcripts. This paper will describe the SAGE technique and present some preliminary results comparing our first two SAGE-tag libraries using vegetative and female buds in black spruce (*Picea mariana*).

(29)

THEOBROXIDE STIMULATES LIPOXYGENASE ACTIVITY AND LEVEL OF JASMONIC ACID IN SHORT-DAY PLANTS

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Theobroxide spraying completely reversed the inhibitory effect of night break (NB) on the potato (*Solanum tuberosum* L.) tuberization and flower bud formation in *Pharbitis nil*. Theobroxide also stimulated lipoxygenase (LOX) activity in the plants grown under both long days (LD) and short days (SD). Theobroxide-treated plants had an increased level of endogenous jasmonic acid (JA) under LD, and it suggested that JA was metabolized to tuberonic acid (TA) during 2 weeks after spraying in potato plants. However, spraying with salicylhydroxamic acid (SHAM), repressed the effect of theobroxide on the potato tuberization and flower bud formation in *Pharbitis nil*. The LOX activities and endogenous contact of JA and TA were also reduced in the theobroxide+SHAM-treated plants. These data indicate a potent role of theobroxide in the developmental regulation of short-day plants.

(30)

CONTROLLING WHEAT GROWTH ONBOARD THE INTERNATIONAL SPACE STATION (ISS): GERMINATION AND EARLY DEVELOPMENT

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A series of experiments to determine the effects of microgravity on growth and development of wheat were conducted during a 73-day period onboard the International Space Station. The experiment relied upon telescience for the remote operation, monitoring, and management of the experiment. Growth and development of wheat was measured directly by the ISS crew, estimated from analysis of telemetry data, and quantified with digital image analysis. Results indicated that germination, early seedling growth, and final canopy biomass was high in microgravity as in the Earth controls. Final height of ISS grown plants was slightly higher than comparable aged Earth grown plants.

(31)

EFFECT OF BENZYLAMINOPURINE ON TISSUE DEVELOPMENT AND VASCULARIZATION IN REPRODUCTIVE STRUCTURES OF PIGEONPEA (*CAJANUS CAJAN*)

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To test the hypothesis that increased seed yield, in legumes treated with benzylaminopurine (BAP), is caused by increased vascularization of the tissues associated with the pods, solutions of BAP were selectively painted or sprayed onto pericarps, pedicels, and racemes of plants of the tropical grain legume pigeonpea *(Cajanus cajan*) during flowering and podset. Images of sections of fixed and embedded plant material were analyzed with Scion Image and ImageJ software in conjunction with a Cohu greyscale camera, Scion frame grabber, Wacom digiter, associated computer and microscope equipment, and Minitab Release 13.1. Effects on tissues are discussed in relation to transport considerations.

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HORMONAL REGULATION OF SOMATIC EMBRYO DEVELOPMENT IN CONIFERS

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The role of endogenous auxins for the establishment of bilateral symmetry during embryo development was investigated using *Larix decidua* somatic embryos and the auxin transport inhibitors TIBA and NPA. The development of embryos was investigated starting from stage-1-embryos proliferating on medium containing 2,4D and BAP. Proliferation was reduced and maturation was initiated by the removal of auxin and cytokinin. Application of auxin transport inhibitors influenced the formation of lateral symmetry. 10 to 20 mM NPA caused fusion of cotyledons and the formation of trumpet-like embryos; 50 mM NPA inhibited the formation of cotyledons completely and disturbed histogenesis. The number of mature embryos was not affected. The effect of TIBA was less dramatic. Differentiation of cotyledons was normal and morphological divergence, compared to inhibitor free cultivated material, was low. The results underline that the whole process of somatic embryogenesis is highly autonomous, provided that an appropriate heterotrophic nutrition is guaranteed. The strong impact of auxin inhibitors show that hormonal regulation is crucial, and that endogenous auxins and their distribution play an important role in regulation of cell division, polarity formation and development of lateral symmetry.

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EFFECTS OF PLANT GROWTH REGULATORS ON AGRONOMIC CROP YIELDS IN THE DESERT SOUTHWEST

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Messenger and AuxiGro were evaluated on cotton and alfalfa, and Apogee was also evaluated on alfalfa. Results from cotton field trials utilizing commercial harvest equipment indicated that Messenger and AuxiGro usage without fertilizers did not increase yields. AuxiGro usage in combination with fertilizers increased yields slightly, but greatest economic effects were as a result of improved cotton quality. Treatments on alfalfa did not increase yields when applied early in cutting cycle (~5 inches of regrowth). Application of Apogee resulted in increased hay quality classification when applied in May, but not later harvests.

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INTEGRATING PLANT GROWTH REGULATORS AND A MYCOHERBICIDE TO ENHANCE THE COMPETITIVE ABILITY OF BELL PEPPER WITH THE WEED LIVID AMARANTH

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A study was conducted to assess the efficacy of integrating the mycoherbicide *Phomopsis amaranthicola* (PA) and gibberellic acid (GA_3, 20 $mg \cdot L^{-1}$), kinetin (KIN, 30 $mg \cdot L^{-1}$), acethylproline (AP, 200 $mg \cdot L^{-1}$), and triterpenic acid (TTA, 40 $mg \cdot L^{-1}$) to improve the competitiveness of pepper with livid amaranth (*Amaranthus lividus*) (LA), by simultaneously suppressing weed growth and stimulating crop growth. Pepper was sprayed with GA_3, AP, and KIN, and TTA one day before transplanting. PA (1.0×10^6 conidia $\cdot ml^{-1}$) was applied 10 and 20 days after weed emergence. When LA competed with pepper without PA, GA_3, AP, KIN, or TTA application, crop yield was <50% as compared to weed-free pepper. GA_3, AP, and KIN increased the competitiveness and yield of pepper. Application of the mycoherbicide and GA_3, AP, or KIN application resulted in further enhancement of pepper competitiveness, reducing yield loss to <10%.

(35)

INFLUENCE OF GROWTH SUPPRESSION ON STATURE REDUCTION, PANICLE DEVELOPMENT, AND CROP PRODUCTION IN RICE

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Lodging and red rice (noxious weed) have a negative impact on rice production in the United States. Trinexapac-ethyl and imazethapyr are growth suppressants. Earl, a lodging susceptible variety, received foliar treatments of trinexapac-ethyl (0.013 and 0.026 lb/A) during the stem (culm) formation stages of growth. Trinexapac-ethyl reduced plant height, eliminated lodging, increased grain yield, and reduced grain moisture. CL121, an imidiazolinone tolerant variety, grown in an area naturally infested with red rice, received foliar treatments of imazethapyr (0.0625 lb/A) during the reproductive phase of growth. Growth of rice and red rice is synchronous. Imazethapyr suppressed panicle development of red rice and had no effect on grain production of CL121. Growth suppressants have the potential to improve rice production in the United States.

(36)

ENHANCEMENT OF PROPAGULE FORMATION OF *HEMEROCALLIS* AND *HOSTA*

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Bare-root perennial field production is relatively new to Nova Scotia, but it presents a potential for economic growth for the region if done efficiently. In the commercial system under consideration, bare-root plants are field-grown for one season to produce as many divisions as possible from the plants harvested. The objective of this study is to evaluate the effects of practical manipulations on the propagule formation of *Hemerocallis* and *Hosta*. Greenhouse and field experiments evaluated the effects of plant growth regulators on the propagule formation of the two species. Root dip, single and sequential foliar applications as well as the Rossizing method of propagatio were evaluated. Positive effects of selected PGR's and some mechanical disturbance were observed; results from these experiments will be reported.

(37)

PRODUCTION APPLICATIONS OF PACLOBUTRAZOL AND ANCYMIDOL AFFECTS LANDSCAPE PERFORMANCE OF PANSIES

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Germination of cool season annuals scheduled for fall sales may occur as early as August. This often necessitates applications of growth regulators to control excessive stem elongation. In response to observations of stunted, but otherwise healthy, cool season annuals, a study was initiated to determine if residual effects of growth regulators used in production might be responsible. *Viola* × *wittrockiana* H. Gams 'Crown Yellow' seeds were germinated in plug trays. Pansies were sprayed with paclobutrazol (Bonzi) or ancymidol (A-Rest) at plug stage (3 Oct. 2002), at 10 days after transplant from plugs to jumbo six-packs (14 Oct. 2002), or at both stages. Paclobutrazol was applied at 0, 5, 10, and 15 mg·liter^{-1} and ancymidol at 0, 2, 4, and 8 mg·liter^{-1}. Plants were transplanted on 11 Nov. 2002 to landscape beds to access residual effects on growth and flowering. Mid- to high range rates of both chemicals tended to reduce growth of pansies in the landscape. This suggests typical commercial application rates during production may be detrimental to subsequent landscape performance of pansies.

(38)

OPTIMUM PGR RATES FOR PRODUCTION OF SPIDERWORT

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Little is known of cultural requirements for greenhouse production of the herbaceous perennial spiderwort (*Tradescantia virginiana*). We screened three plant growth regulators (PGRs) on three cultivars of *T. virginiana.* PGR treatments included a foliar application of paclobutrazol at 0, 40, 80, 120 or 160 mg•L^{-1}; uniconazole at 0, 15, 30, 45 or 60 mg•L^{-1}; or flurprimidol at 0, 15, 30, 45, 60 or 75 mg•L^{-1}. Paclobutrazol, at rates tested, did not reduce plant size. Uniconazole rates between 30 and 45 mg•L^{-1} and flurprimidol rates between 45 and 60 mg•L^{-1} resulted in adequate height control. 'Blue Stone' and 'Red Cloud' appeared more responsive to both uniconazole and flurprimidol than 'Angel Eyes'. These results suggest cultivars respond differently to PGR rates.

(39)

HEIGHT CONTROL OF HERBACEOUS PERENNIALS FORCED USING NIGHT-INTERRUPTED LIGHTING UNDER NURSERY CONDITIONS

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In previous studies, night-interrupted lighting (NIL) promoted earlier flowering of summer-blooming herbaceous perennials grown under outdoor nursery conditions in the southeastern U.S. However, NIL promoted excessive plant height, thus reducing product quality. Our objective was to control height of *Coreopsis grandiflora* 'Early Sunrise' (ES), *Coreopsis verticillata* 'Moonbeam' (MC) and *Rudbeckia fulgida* 'Goldsturm' (RG) grown under NIL with plant growth retardants. Treatments under NIL were 3 rates of daminozide, daminozide plus chloromequat, flurprimidol, paclobutrazol, and NIL and non-NIL controls. Height and growth index were reduced and time to flower increased by daminozide, daminozide plus chloromequat and flurprimidol, but much less so with paclobutrazol, in ES and MC compared to the NIL control. A similar trend was found for RG but only with daminozide plus chloromequat. Most plants under NIL were larger and flowered earlier than non-NIL plants.

(40)

EFFECT OF A SEAWEED-DERIVED BIOSTIMULANT ON THE YIELD OF PURPLE NUTSEDGE-INFESTED BELL AND CUBANELLE PEPPERS

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A study was conducted to determine the effects of a kinetin-rich biostimulant derived from seaweed (KIN) on the yield of weed-free and purple nutsedge-infested cubanelle and bell peppers. KIN (30 $mg \cdot L^{-1}$) was sprayed on pepper transplants (15 cm-tall, 4-5 true leaves) 24 hours before transplanting. 'Wizard' bell pepper and 'Cubanelle' pepper were grown with purple nutsedge (*Cyperus rotundus*) at density ratios of 0, 3, 6, 9 and 12 nutsedges per pepper plant. Increasing purple nutsedge density resulted in reduced pepper growth and yield in both KIN-treated and control plants. However, in plants treated with KIN, leaf area was larger and yield losses were less severe than in untreated pepper. At a given density, bell pepper losses were higher than in cubanelle pepper. These results indicate that KIN-treated bell and cubanelle peppers plants may be more competitive with purple nutsedge, reducing potential yield loss due to purple nutsedge interference.

(41)

CYP72B1 INACTIVATES BRASSINOSTEROIDS TO POSITIVELY MODULATE PHOTOMORPHOGENESIS

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We investigated CYP72B1, an Arabidopsis cytochrome P450, to determine the biochemical and physiological functions of this enzyme. Using a yeast functional assay, we have demonstrated that CYP72B1 is a steroid C-26 hydroxylase that converts BL to 26-OHBL and CS to 26-OHCS. We tested the ability of an Arabidopsis CYP72B1-null mutant, the wild type, and a CYP72B1 over-expressor to metabolize BL or CS. Reduced levels of 26-OHBL and 26-OHCS were detected in the null mutant, and increased levels were detected in the over-expressor, demonstrating that 26-hydroxylation of BRs is an endogenous biochemical function of CYP72B1. Bioassays with BL and 26-OHBL have provided evidence that 26-hydroxylation is an inactivation step. We also showed that CYP72B1-mediated BR inactivation provides positive modulation of photomorphogenesis.

(42)

BRASSINOSTEROID INDUCE *IAA* GENES AND AN AUXIN-RESPONSIVE ELEMENT DR5

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Recently, we have revealed that brassinolide (BL) induced some of the early-auxin-inducible genes, including *IAA5* and *IAA19*. The genes were induced with different kinetics by indole-3-acetic acid (IAA) and BL. We found that BL induce a fusion of DR5, a synthetic auxin-responsive element, and *ß-glucronidase* (*GUS*) gene with similar kinetics to that of the *IAA* genes. Endogenous IAA levels per gram fresh weight did not increase when arabidopsis wild type and brassinosteroid (BR)-deficient mutant *det2* were treated with BL. These results suggested that BR signaling pathway cross-talk with auxin signaling pathway at or upstream from the transcriptional system of the *IAA* genes via same *cis*-element without increase endogenous IAA level.

(43)

A DWARF STRAIN OF *PHARBITIS NIL*, UZUKOBITO, IS A BRASSINOSTEROID-DEFICIENT MUTANT

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A recessive mutant Uzukobito of *P. nil* shows strong dwarfism with dark-green rugose leaves. The phenotype was rescued by brassinolide, indicating that Uzukobito was a BR-deficient mutant. Uzukobito had decreased levels of BRs downstream of (24*R*)-5á-ergostan-3-one and (22*S*, 24*R*)-22-hydroxy-5á-ergostan-3-one compared to those in wild-type plant, while their immediate precursors, (24*R*)-ergost-4-en-3-one and (22*S*, 24*R*)-22-hydroxyergost-4-en-3-one, were rather accumulated in Uzukobito. These results indicated that Uzukobito had defect in the conversion catalyzed by steroid 5á-reductase, which is DET2 in Arabidopsis. The *P. nil* ortholog of *DET2* gene (*PnDET2*) has been obtained as a clone with highest similarity to *DET2* among all putative genes in Arabidopsis. Uzukobito had one amino acid substitution from Glu^{62} to Val^{62} in the deduced amino acid sequence of PnDET2. The recombinant PnDET2 expressed in COS-7 cells was shown to be functional as steroid 5á-reductase, while the PnDET2 with the mutation was not. All these results clearly demonstrated that the Uzukobito phenotype was caused by the mutation on *PnDET2*.

(44)

BRASSINOSTEROID-INDUCED GRAVITROPISM IS MEDIATED BY BRASSINOSTEROID RECEPTOR IN *ARABIDOPSIS* ROOTS

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Exogenously applied brassinosteroids (BRs) activated gravitropic curvature of *Arabidopsis* roots. The mechanism of the BRs-induced gravitropic response in *Arabidopsis* roots was thus examined by the use of wild-type and several mutants related to BRs signaling. The *bri1-201* and *bak-1* mutant showed less gravitropic activity than that of wild-type. *BRI-GF*P exhibited much gravitropic response compared with that of wild-type. Application of brassinazole, a BRs biosynthetic inhibitor, did not decrease the gravitropic activity in wild-type. Therefore it was thought that the BRs-induced gravitropic curvature was mediated not by increase of endogenous level of BRs but by enhancement of BRs signal perception in *Arabidopsis* roots. In the presentation, a possible involvement of IAA in the BRs-induced gravitropic response of *Arabidopsis* roots will be also discussed.

(45)

CASTASTERONE CAN BE BIOSYNTHESIZED FROM CHOLESTEROL VIA 28-NORBRASSINOSTEROIDS IN PLANTS

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A cell-free enzyme solution prepared from young tomato plants successfully catalyzed conversions of cholesterol to cholestanol, 6-deoxo-28-norteasterone to 28-norcastasterone via 6-deoxo-3-dehydro-28-norteatserone, 6-deoxo-28-nortyphasterol, and 28-norteasterone to 28-norcastasterone via 3-dehydro-28-norteasterone and 28-nortyphasterol. In addition, the enzyme solution mediated conversion of 28-norcastasterone to castasterone in the presence of *S*-adenosylmethionine and NADPH. These results indicate that castasterone can be biosynthesized from 28-norcastasterone, which is biosynthesized from cholesterol via two parallel biosynthetic pathways, namely the early and late C6-oxidation pathway for 28-norbrassinosteroids in the tomato plants. The conversion of 28-norcastasterone to castasterone was also detected in cell-free enzyme solutions prepared from *P. vulgaris* and *A. thaliana*, suggesting that the biosynthesis of castasterone from cholesterol via 28-norbrassinosteroids is common in plants.

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EXPANSIN5 AND ROOT GROWTH IN *ARABIDOPSIS THALIANA*

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Arabidopsis expansin5 (AtEXP5)-knockout mutants (*AtEXP5*) showed a slightly longer root than that of wild-type *Arabidopsis (Columbia-0)*, indicating that growth of *Arabidopsis* roots may be controlled by AtEXP5, most likely negatively. Exogenously applied brassinosteroid (BR) inhibited growth of *Arabidopsis* roots, and gene expression of AtEXP5 by BR application was detected several times higher in roots than in shoots, which suggested that AtEXP5 and BR were associated in *Arabidopsis* roots growth. In fact, application of BR to *AtEXP5* mutant diminished the growth inhibition shown in wild-type *Arabidopsis* roots. In addition, expression of *BRI1* and *BAK1* in *AtEXP5* mutant was several times higher than that in wild-type plants, proposing that the BR-induced growth inhibition of *Arabidopsis* roots was expressed through AtEXP5 and negatively regulated by a BR signaling to express AtEXP5. In the presentation, gravitropic response and lateral roots formation of *Arabidopsis* in relation to AtEXP5 expression will be also discussed.

(47)

SEED TREATMENTS WITH TRINEXAPAC-ETHYL AND ABSCISIC ACID ENHANCE DROUGHT RESISTANCE IN WHEAT SEEDLINGS

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Grain sown in semi-arid regions can be germinated by light autumn rain that is insufficient to maintain the resulting seedlings. Seedlings from wheat seeds that were imbibed in 1250 ppm of the gibberellic acid synthesis inhibitor trinexapac-ethyl (TE) with or without 100ìM ABA resisted drought more than control seedlings or seedlings from seeds that had been imbibed in ABA alone. Fully irrigated seedlings from TE-treated seeds were delayed in emergence by 1-2 days and were 40-50% shorter than seedlings from the control or ABA treatments. Under limited irrigation, followed by a dry period of 2 weeks and a further irrigation period, fresh weight of control and ABA seedlings was less than 50% of TE-treated seedlings. Nearly 30% of control seedlings wilted beyond recovery. Leaves of seedlings from TE-treated seeds were broader, thicker, more succulent, higher in chlorophyll and carotenoids, and had heavier wax coatings than those from control or ABA treatments. TE treatment led to the induction of dehydrin mRNAs and of a 14 kDa protein whose function is as yet unknown.

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THE INTERACTION BETWEEN BIOSYNTHESIS AND RESPONSE OF ABA DURING SEED GERMINATION IN *ARABIDOPSIS THALIANA*

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To reveal the feedback regulation of ABA biosynthesis, we examined ABA contents in dry seed and imbibed seed using two ABA-insensitive mutants *(abi4, abi5).* The *abi5* mutant contained higher levels of ABA in dry seeds compared to that of wild type. Moreover, when we monitored transcript levels of the *NCED* genes, which encode key enzymes involved in ABA biosynthesis, only *NCED6* showed higher transcript levels in the *abi5* mutant than wild type. These results indicate that ABI5 is involved in the feedback regulation of ABA biosynthesis in the seed. By contrast, the ABA content in the *abi4* mutant imbibed seed was lower than that in wild type. Moreover, the reduction of *NCED6* mRNA levels in the *abi4* mutant was significant compared to that observed in wild type during imbibition. These results suggest that ABI4 is the positive regulator of *NCED6* during imbibition.

(49)

A NEW DIRECT PATHWAY FOR BIOSYNTHESIS OF ABSCISIC ACID IN FUNGI

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Two pathways, the direct pathway via ionylideneethanol and indirect pathway via carotenoids, have been proposed in fungal abscisic acid (ABA) biosynthesis, and this controversy has not come to a conclusion. We investigated the biosynthetic pathway of ABA in a fungus, Botrytis cinerea, by a labeling experiment with $^{18}0_2$. The result showed that C-1, 1, 1' and 4' of ABA were oxidized with molecular oxygen. The fungus did not produce carotenoids except for a trace of phytoene, but produced 2E-farnesa-2,4,6,10 tetraene, 2Z-farnesa-2,4,6,10-tetraene and 2Z-á -ionylideneethane. [2-^{13}C] 2Z-á-Ionylideneethane was converted to ABA in an incorporation ratio of 17%. These findings led us to propose a new direct pathway via an ionylideneethane. This new direct pathway is probably working in *Cercospora cruenta* since this fungus produces 2Z-ã-ionylideneethane.

(50)

METABOLISM OF THE LONG-LASTING ANALOG OF ABSCISIC ACID IN RADISH (*RAPHANUS SATIVUS*)

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The long-lasting analogs of abscisic acid (ABA) were designed so that it can resist the inactivation caused by the catabolic 8'-hydroxylation in plants. The biological activity of 5'α,8'-cyclo-ABA was 3-40 times stronger than that of ABA. Is this analog highly potent due to their long life that is caused by resisting the 8'-hydroxylation? We have examined its metabolism in radish seedlings to verify their stability in plants. 5'α,8'-cyclo-ABA, which was applied to 7-day-old seedlings of radish via transpiration stream for three days, was found 3-4 times more than ABA in the methanol extracts of the plants. The only metabolite was the C-1 glucosyl ester, which is a minor metabolite in the case of ABA. This finding suggests that plants raise the glucosyltransferase activity against the extraordinarily high level of ABA-activity which is caused by administration of the 8'-hydroxylase-resistant analog. Thus the long-lasting analogs of ABA should be useful tools for probing the mechanism of ABA metabolism in plants.

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DEUTERIUM LABELED PHASEIC ACID AND DIHYDROPHASEIC ACIDS FOR INTERNAL STANDARDS

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[1]International Innovation Center, Kyoto University, Kyoto 606-8501, Japan; [2]School of Bioresources, Hiroshima Prefectural University, Hiroshima 727-0023, Japan; [3]Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan Concentration of abscisic acid (ABA) in plants is regulated not only by biosynthesis but also by metabolism. ABA is metabolized to phaseic acid via 8' hydroxy-ABA, and phaseic acid is converted to dihydrophaseic acid and its epimer. Quantitative analysis of these metabolites is important as well as that of ABA to understand changes in concentration of ABA in plants. However, internal standards of the metabolites suitable for the quantitative analysis have not been reported. We prepared T-deuterium labeled phaseic acid with deuterium content of 86%, using the equilibrium reaction between phaseic acid and 8' hydroxy-ABA. 7'-Deuterium labeled dihydrophaseic acids were obtained by reduction of 7'-deuterium labeled phaseic acid. Contents of the metabolites in plant organs were determined using the deuterated metabolites as internal standards.

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SUCROSE ENHANCING RESPONSE OF DINITROSOCIFROL IN SUGARCANE

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Artificial ripening of sugarcane through existing foliar application echnologies is quite difficult where land holdings are small and cane is interspersed with other crops. Application of dinitrosocifrol (PSR, Phytotron India) @ 8-10 kg/ ha through limited irrigation water at the end of grand growth phase, elicited positive ripening response in many cane varieties under different agro-climatic conditions. Cane quality attributes evaluated at 100th day after dinitrosocifrol treatment in sugarcane genotypes grown under sub-tropical climate viz., CoS 95222, CoJ 64, CoS 8436 and CoS 767 showed 2.88, 1.52,0.72 and 0.76 unit increase in pol % cane, respectively. At 120th day after application increase in pol % cane was in order of 2.56, 2.39, 1.24 and 0.39. Associated quality parameters viz., Brix, Pol% juice and CCS% also showed significant improvement. Application of dinitrosocifrol through irrigation water did not produce any adverse effect on growth of succeeding ratoon crop, cane tonnage and top feed quality. A granular formulation of dinitrosocifrol was equally effective.

(53)

USE OF THE TREE GROWTH REGULATOR PACLOBUTRAZOL TO CONTROL APPLE SCAB

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Paclobutrazol as a systemic fungicide for apple scab was investigated in mature and sapling crabapples. Treatments consisted of a control and paclobutrazol applied at one or two times the recommended rate. Disease assessments throughout the summer showed apple scab symptoms in treated trees were as severe as in untreated ones. Growth reduction occurred in all treated trees, suggesting that paclobutrazol levels needed for growth reduction are not sufficient to control apple scab in the year of treatment. In contrast, a one-time foliar application of paclobutrazol reduced apple scab incidence to levels found in saplings treated every two weeks with propiconizole, a fungicide commonly recommended for apple scab control. Delayed uptake and transport of paclobutrazol to the crown may account for the lack of apple scab control the year of treatment.

(54)

EFFECT OF FASCINATION™ ON POSTHARVEST PERFORMANCE OF CUT RACEMES OF BIG BEND BLUEBONNET

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Attractive racemes of Big Bend bluebonnet (*Lupinus havardii* Wats.) hold considerable promise as a new specialty cut flower crop. As a result of our breeding and selection efforts, we have developed several lines of improved germplasm with different flower colors. This study was conducted to evaluate the effect of Fascination™ (FAS), a commercial formulation of 1.8% $GA_{4/7}$ plus 1.8% BA (Valent Biosciences), on parameters related to postharvest performance and longevity of cut racemes of two blue flowered lines (Blue Select 2002, BS; 'Texas Sapphire', TS), two white flowered lines (White Select 2002, WS; 'Texas Ice', TI) and a dark pink flowered line (DP) of Big Bend bluebonnet. An aqueous solution of FAS (6, 12, 24, 48 and 96 ppm) was supplied through the base of the cut racemes placed in glass vases at 22±2ºC under fluorescent lamps. The results indicated that in the improved germplasm, the senescence of flowers during vaselife constituted a key component of the display life. The response of the different lines varied considerably to the presence of FAS. In WS, TI and DP, low concentrations of FAS (6, 12 ppm) delayed the senescence of flowers, but a promotion were recorded in BS and TS. Except in WS, and to certain degree in TI, high concentrations of FAS (48, 98 ppm) exhibited toxic symptoms both in flowers and inflorescence axis. In a separate study, GA_3 alone was found to be relatively more effective, and less toxic, than BA in influencing flower senescence in cut racemes of bluebonnet.

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CHLOROPHYLL FLUORESCENCE, PHOTOSYNTHESIS AND ENZYME ACTIVITIES IN BER (*ZIZIPHUS ROTUNDIFOLIA*) UNDER SALINITY STRESS

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One year old plants of ber, when subjected to salinity stress, indicated reduced growth and elevated levels of proline, but no effect was observed on leaf pigments. Treatment with salt resulted in an immediate inhibition of net photosynthetic rate, but at low concentrations of salt the plants exhibited considerable recovery with time. However, at the highest salt concentration used, not only the net photosynthetic rate, but the chlorophyll fluorescence characteristics were also drastically affected. The efficiency of photochemistry declined, and as a result of lowered efficiency of photochemistry and the highly reduced state of Q/A quantum yield of the electron transport also decreased. Eventually, the photoinhibition of assimilation rate coupled to the toxic effects of salt on cellular metabolism resulted in death of the plants. Under salt stress, the different enzymes responded quite differently, and their activities depended on the concentration of salt and the duration of the treatment. The possible correlation of these responses to adaptation under salt stress has been evaluated.

(56)

IN VITRO STUDIES ON CHICKPEA SEEDLINGS: EFFECT OF SALT ON GROWTH AND ANTIOXIDANT ACTIVITY

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Plants with high levels of antioxidants, either constitutive or induced, are reported to have greater potential to cope up with an array of abiotic stresses. Chickpea (*icer ariethinum* L.) is one of the most important grain legumes of Asia, Africa and Latin America. However, like many legumes, it is sensitive to salinity. We have studied the effect of salt on growth and antioxidant activity in cultivars of chickpea differing in sensitivity to salt. Depending upon the concentration used (50-200 mM) although salt inhibited the growth, but promoted the activities of catalase, peroxidase, superoxide dismutase, ascorbate peroxidase, monodehydroascorbate reductase and glutathione reductase. A slight increase was also recorded in malondialdehyde content in the shoots at high salt concentration. Depending on the cultivars, simultaneous incorporation of paclobutrazol in the culture media, considerably modulated the effect of salt on growth and activities of enzymes related to antioxidant metabolism. Thus, it appears that paclobutrazol may have a role in salt tolerance of chickpea seedlings. Overall, the results indicated that cv. C-235 is relatively more sensitive to salt than cv. H-208.

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EFFECT OF GIBBERELLIN BIOSYNTHESIS INHIBITORS ON *IN VITRO* GROWTH AND ANTIOXIDANT ACTIVITY IN CHICKPEA SEEDLINGS

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Gibberellin biosynthesis inhibitors (GBIs) are the most potent group of growth retardants which act primarily by inhibiting GA-biosynthesis followed by secondary modulation of ABA, ethylene, cytokinins and polyamines. In fact, they have been credited as multiple "stress-protectants". We have studied the effect of paclobutrazol (PACLO), uniconazole (UNI) and prohexadione-Ca (PROHEX) on *in vitro* growth and antioxidant activities in chickpea (*Cicer ariethinum* L.) seedlings. Of the three GBIs, PACLO and UNI were found to be more effective than PROHEX in retarding growth. In PACLO and UNI, the lateral roots continued to grow equally deep in the medium, became thick and imparted a characteristic 'brush-like' appearance. The leaves also became thick and developed an intense dark green color. PACLO was found to be substantially much more effective in promoting the activities of catalase, peroxidase, ascorbate peroxidase, monodehydroascorbate reductase and glutathione reductase than the other two GBIs. An increase in the level of ascorbate and glutathione was also observed. Overall, the effects of PROHEX were found to be the mildest in comparison to PACLO and UNI.

(58)

REDUCTION OF ETHYLENE-INDUCED FLOWER ABSCISSION AND LEAF YELLOWING IN CUT INFLORESCENCES OF PHLOX BY THIDIAZURON AND SUCROSE

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In cut flowerheads of perennial phlox (*Phlox paniculata* L. 'John Fanick'), a recently identified superior selection for Texas landscapes, the display life and longevity is primarily influenced by abscission of flowers, opening of flower buds during display and the quality of leaves on the axis. Flower abscission may be initiated within 72 hours via 'corolla shedding', whereas yellowing of leaves is a late event seen after 7-10 days. Addition of 2-chloroethylphosphonic acid (CEPA) in the vase medium (10-200 µM) promoted flower abscission as well as leaf yellowing. The effect of CEPA (10-50 µM) on flower abscission and leaf senescence was considerably reduced if thidiazuron (TDZ) and sucrose were present in the vase solution. TDZ and sucrose, when added together, were found to be more effective than if added separately. Earlier, we reported that both 1-MCP and STS also counteracted CEPA-induced flower abscission in phlox. Thus, it is possible that the effects of TDZ and sucrose are, at least partially, mediated via their effect on ethylene production/sensitivity.

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NITRIC ACID ENHANCES FLOWER ABSCISSION AND SENESCENCE IN CUT RACEMES OF *LUPINUS HAVARDII* WATS

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Big Bend bluebonnet *(L. havardii* Wats), a winter annual native to the Chihuahuan desert, produces attractive flowers on a long raceme. Over the years, by recurrent phenotypic selection, we have identified and developed blue, white, and pink flowered lines of bluebonnet which differ in their sensitivity to ethylene. In this study, we have evaluated the effect of nitric oxide (NO*) a highly bioreactive endogenous molecule which is reported to down regulate ethylene production, on flower abscission and senescence of bluebonnet racemes. Sodium nitroprussside (SNP) was used as the source of NO* donor. Depending upon the concentration of SNP (10-200 μM) used, the various lines of bluebonnet exhibited differential response which varied from promotion of flower abscission to senescence. In general, the blue flowered lines were found to be more sensitive to NO* than the white flowered lines. The pink flowered lines exhibited an intermediate response. Visible signs of flower senescence included wilting of the tip of the standard petal and a change in the color of the banner spot. In Blue Select-2002 germplasm the color of the banner spot changed from light yellow to muddy-brown/black in the presence of high SNP concentrations. Addition of sucrose and thidiazuron, or pretreatment with 1-MCP/STS, reduced the effect of NO* on flower abscission and senescence.

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FLURPRIMIDOL FOLIAR SPRAYS CONTROL GROWTH OF NEW GUINEA IMPATIENS

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Flurprimidol (0.38%; trademark Topflor) foliar sprays of 5 to 80 mg.L^{-1} were applied to 'Pure Beauty Fuchsia' New Guinea impatiens for comparison with 10 mg.L^{-1} paclobutrazol and 5 mg.L^{-1} uniconazole for growth control. A 10 mg.L^{-1} flurprimidol application resulted in 16% shorter and 14% smaller diameter plants compared with the nontreated control. Uniconazole at 5 mg.L^{-1} provided similar plant height and plant diameter control as the 10 mg.L^{-1} flurprimidol application. Paclobutrazol (0.4%; Trademark Bonzi) at 10 mg.L^{-1} provided similar height control as the 10 mg.L^{-1} flurprimidol, but less plant diameter control: therefore >10 mg.L^{-1} paclobutrazol would be required for comparable control.

(61)

ANCYMIDOL, FLURPRIMIDOL AND PACLOBUTRAZOL LINER DIPS CONTROL GROWTH OF VEGETATIVE PETUNIA AND ANGELONIA

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Commercially available plugs of 'Improved Charlie' vegetative petunia and 'Angel Mist Purple Improved' angelonia were dipped for 10 minutes in 4, 8 or 16 ppm solutions of ancymidol, flurprimidol (0.38%; trademark Topflor), or paclobutrazol (0.4%; trademark Piccolo). Ancymidol was effective for controlling plant growth of both plants at 16 ppm, but higher concentrations will be required for greater control. Flurprimidol significantly controlled growth of both plants at 4 ppm and for less vigorous cultivars, lower concentrations are suggested. For growth control of both plants, 8 ppm of paclobutrazol was required. Results suggest flurprimidol and paclobutrazol liner dips are a suitable, cost effective option for controlling excessive plant growth of vigorous vegetative annuals.

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RESPONSE OF MULTIFLOWERING LINES OF *PISUM SATIVUM* TO LIGHT AND GIBBERELLINS

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The number of flowers produced per node is an important characteristic in both agronomic and ornamental legumes. In *Pisum sativum*, one to several flowers are produced from a secondary inflorescence meristem (I2) at each node following the transition to reproductive development. Multiflowering lines exhibit an extended I2 phase resulting in the production of usually up to five flowers at each node. One line identified in our lab, *ultramulti*, produces up to twelve flowers per node under short day conditions or altered light quality. The flowering response of this line has been characterized with respect to daylength, end-of-the-day light quality, altered light quality during the entire photoperiod and gibberellin treatments. The *ultramulti* line is very sensitive to photoperiod and though flower number is related to photoperiod sensitivity, the two processes are separable.

(63)

EFFECTS OF THE COMBINED APPLICATION OF ETHEPHON AND GIBBERELLIN ON THE RICE SEEDLING GROWTH GROWING UNDER DIRECT SEEDING CONDITION

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Seedling establishment is one of the most important agronomic traits in direct seeding rice cultivations. We investigated the effects of two plant growth regulators (PGRs), including gibberellin (GA) and ethephon (ET) on the seedling growth under flooded soil conditions. Seedling growth was increased by the single treatment of GA or ET over that of the control. However, effects of the combined applications of GA and ET were more pronounced than that of GA or ET alone. The growth of different organs of rice seedling, such as coleoptiles, first leaves and second leaves were also increased by the PGRs treatment. In conclusion, high seedling establishment rate in the direct seeding cultivation will be possible by using the proper combinations of PGRs. Effects of PGRs on the nutrients uptake by rice seedling will be also assessed.

(64)

EFFECT OF 5-AMINOLEVULINIC ACID ON GROWTH AND NUTRIENT UPTAKE OF LEAF VEGETABLES IN ALKALINE SOIL

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Alkaline soil (pH8.5) was prepared by an addition of natural calcium carbonate (Kaikaseki). When Spinach or Komatsuna was grown in the alkaline soil, the growth and fresh yield decreased remarkably as compared with those in natural soil (control). However, this decreasing growth rate in alkaline soil was retard by the folial application of 5-aminolevulinic acid (5-ALA) solution (30ppm) alone. In the case of spinach, the content of nitrate per total nitrogen in leaf tissues treated with 5-ALA solution alone decreased. An increase of crop growth rate (CGR) or net assimilation rate (NAR) was obvious in cabbage seedlings treated with 5-ALA+pentakeep V (liquid fertilizer) solution. From these results obtained here, we would like to discuss about the plant growth regulating-activities of 5-ALA alone and of the combination of 5-ALA and chelating iron or pentakeep V.

(65)

A FUNCTIONAL FERTILIZER "PENTAKEEP V" CONTAINING 5-AMINOLEVULINIC ACID (ALA) AS THE EFFECTIVE COMPONENT

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ALA is a key precursor in the biosynthesis of porphyrins such as chlorophyll and heme. We have found promotive effects of ALA on the growth and yield of several crops and vegetables at lower concentrations. In addition, ALA was found to increase salt tolerance and cold resistance. We have developed a new functional fertilizer "PENTAKEEP V" containing ALA as the effective component. In this poster, we introduce physiological activity of ALA and excellent performance of "PENTAKEEP V" enforcement in farm.

(66)

SALICILATES EFFECT ON AFRICAN VIOLET

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Aqueous solutions of 10^{-6} to 10^{-10} M concentrations of Salicylic acid were sprayed on the ornamental vitroplants of "African violet" grown in greenhouse conditions, to evaluate its effect on the bioproductivity of the plant. They were sprayed on three occasions to the plant shoots at 21, 28 and 35 days after potting. The results showed that the best treatment was that of 10^{-10} M where significant results were found in the growth development pattern, i.e., number of leaves, where an increase of 19% over the control was detected. Similarly a 50% increase in the number of flower primordia was recorded. It is of great importance to stress again that low concentrations of salicylic acid had the best effect as we have been reporting in recent years. (Plant Cell Rep (2001) 20:679-684).

(67)

POSITIVE EFFECTS OF SALICYLIC ACID ON THE FLOWERING OF GLOXINIA

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Gloxinia is an ornamental plant of economic importance that has been selected for indoors environments for the beauty of it flowers. Salicylic acid as a hormone was tested in order to increase the quality of the plant as well the flowering expression of this plant. Salicylic acid at concentrations of 10^{-6} to 10^{-10} M was sprayed on four occasions to gloxinia vitroplants cultivated in greenhouse conditions. The results showed that SA at concentrations of 10^{-8} M increased by 49% the leaf area and 37% the number of flower primordia in comparison with the control. The final length of the flower was increased by 11% and they were 17% wider due to the 10^{-6} M SA treatment giving a better looking and appearance to the plants. All treatments induced flowering six days early.

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CULTIVAR EFFECTS ON RADISH SENSITIVITY/RESISTANCE TO CHRONIC ETHYLENE EXPOSURES

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The Radish Assimilation in Spaceflight Testbed Atmospheres (RASTA) experiment is developed to determine the effects of volatile organic compounds on growth and development in microgravity. Three candidate cultivars of Raphanus *sativa*, Sora, Cherry Belle and Cherry Bomb Hybrid II, were evaluated for resistance to ethylene effects. The cultivars were exposed to ethylene concentrations of 0, 250 and 750 ppb, which corresponded to control, maximal, and phytotoxic concentrations in Cherry Belle radish (Eraso et al., 2002). Single leaf photosynthesis rates, growth rate analysis, final biomass, and morphological analysis of the plants were made. There was no apparent effect of ethylene concentration on single leaf photosynthesis rate of any cultivar at concentrations up to 750 ppb. However, there was a cultivar difference in leaf morphology at the 250 and 750 ppm ethylene treatments. All cultivars exhibited characteristic symptoms of stem swelling, height reduction, and severe leaf epinasty at the 750 ppb concentration, but cultivars Sora and Cherry Bomb were more resistant than Cherry Belle at the 250 ppb concentrations. Additional evaluations are required to determine the sensitivity/resistance to biologically active volatile organic compounds found in spacecraft for these cultivars.

(69)

RIPENING STIMULATION AND ETHYLENE EVOLUTION IN RED PEPPER (*CAPSIUM ANNUUM* L.) AS INFLUENCED BY LYSOPHOSPHOLIPIDS

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This experiment was carried out to evaluate the effects of lysophospholipids (LPLs) on the ripening stimulation in red peppers (*Capsium annuum* L.) from 2000 to 2002. The LPA stimulated the fruit coloring of red pepper. The most effective effect was significantly shown at LPA 50mg·L^{-1}, which showed yield increase by 75.3%. No significant difference was found in fruit quality as compared with untreated control. No phytotoxicity was observed when LPA was applied on red peppers. LPA was the most effective on fruit ripening, followed by LPE without Ca, LPA+LPE without Ca and LPE with Ca in that order. Among the tested chemicals and surfactant, combination of LPA and surfactant was more effective on fruit ripening. LPA treatment stimulated ethylene evolution by 67%. These results suggest that LPA can strongly stimulate the ripening of red pepper, which was closely related to ethylene evolution.

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ACETYLTHIOPROLINE SEED TREATMENT AFFECTS VEGETATIVE BIOMASS AND GRAIN YIELD OF MAIZE

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A field study was conducted to determine the effect of acethylproline (AP) seed treatment on the accumulation of shoot dry biomass and the grain yield of 'Francés Largo' maize. The AP rates tested were 0, 0.4, 1.2, 2.0, 2.8, and 4.0 g per Kg of seed. The treatments were arranged in a randomized block design with four replications and maize was grown according to local recommendations. Regression analysis was performed on the resulting data. No phytotoxic effects from AP were detected. Maize shoot dry biomass and grain yield tended to increase as AP rates increased. When the AP rate of 4.0 g per Kg of seed was used, shoot dry biomass accumulation and grain yield were about 20% higher than in control plants. These results show that AP treatment may enhance the yield of grain and and/or vegetative tissue in maize.

(71)

OKRA (*ABELMOSCHUS ESCULENTUS*) GROWTH AND YIELD AS AFFECTED BY GIBBERELLIC ACID TIME, FREQUENCY, AND RATE OF APPLICATION

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Okra plants ('Clemson Spineless' and 'Cuerno de Chivo') were sprayed with 0, 10, 20, and 30 mg·L^{-1} of gibberellic acid 3 (GA_3). Each rate was applied once (one day after flowering, DAF), twice (1 and 7 DAF), or three times (1, 7, and 14 DAF). In the spring, there was no response to treatments. In the summer, both cultivars responded to GA_3. 'Clemson Spineless' plants sprayed three times with 30 mg·L^{-1} of GA_3 were taller, had longer fruit, and higher fruit weight yield than plants with other treatments. 'Cuerno de Chivo' plants sprayed two or three times with 20-30 mg·L^{-1} of GA_3, had longer fruit and higher yield as compared to other treatments. Growth and yield response of okra to GA_3 appeared to depend on rate, cultivar, and environment.

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ROOTING AND EARLY GROWTH OF 'CRIOLLA DOMINICANA' GRAPE CUTTINGS ARE AFFECTED BY SELECTED GROWTH REGULATORS

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A study was conducted to determine the effect of acetylthioproline (AP, 0, 75, 150, 225, 300 mg·L^{-1}), 5-nitroguaicol + ortho-para-nitrophenol (NG, 125, 250, 375, 500 mg·L^{1}), napthaleneacetic acid (NAA) and indolebutyric acid (IBA) (500, 750, 1000, and 1250 mg·Kg^{-1}) on rooting and early growth of 'Criolla Dominicana' grape (*Vitis vinifera*). The basal part of the cuttings (partially lignified, 30-cm long) was soaked for 3 minutes (IBA, NAA) or 30 minutes (AT, NG) before planting them in growth substrate. AP, IBA, and NAA, but not NG, accelerated root production and bud breaking in cuttings as compared to the control. AP (225-300 mg·L^{-1}) resulted in higher shoot biomass accumulation and apparent vigor than treatments with the other substances and the control.

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PLANT GROWTH REGULATORS AND NITROGEN AFFECT RATOON PRODUCTION IN PAPAYA

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A field study was conducted to determine the effect of nitrogen (N) fertilization (20, 40, 60, and 80 g N per plant) combined with monthly foliar applications of gibberellic acid (GA_3) (50 and 75 $mg \cdot L^{-1}$), acethylproline (AP) (100 and 200 $mg \cdot L^{-1}$), kinetin (KIN) (65 and 130 $mg \cdot L^{-1}$), and benzyladenine (BA) (250 and 500 $mg \cdot L^{-1}$) on the ratoon growth and fruit yield of 'Sunrise' papaya (*Carica papaya*). Treatments with N but without plant growth regulators were included. The length and diameter of ratoon branches was positively correlated with fruit yield. As N rate increased, fruit yield increased. Combining N and KIN, AP and GA_3 resulted in further yield enhancement. Application of GA_3 promoted ratoon length, and KIN increased the number of ratoon branches. No significant differences were detected between rates in a given growth regulator.

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REGULATION OF BIOMASS PARTITIONING IN HYDROPONICALLY-GROWN POTATO BY ALTERING NITROGEN CONCENTRATIONS

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Potatoes have long been grown hydroponically as a staple crop to be included in NASA's Advanced Life Support systems research as a human life support component during long duration spaceflight or planetary inhabitation. However, a typical nutrient solution consisting of excess nitrogen (N) results in the accumulation of inedible biomass that may lower overall life support system efficiency. Three N management protocols were evaluated as a means of regulating excessive vegetative growth of potatoes. Tests included reduction of overall nutrients via electrical conductivity (EC) setpoint, reduction of only the nitrate, and providing a mixed-N (nitrate + ammonia) source. Additionally, each test included a phasic treatment in which the [N] was maintained at the control concentration (7.5 mM) for the first half of the test and then maintained at the lowest N treatment. The phasic treatments resulted in tuber yields comparable to control treatments. Reducing EC, nitrate, or using mixed-N resulted in lower tuber yields, but higher tuber N-use efficiency and significantly reduced vegetative growth and plant canopy were observed. Increasing plant density coupled with N management practices may be a feasible method to maintain high tuber yield while reducing vegetative biomass

(75)

USE OF A MINIATURE TOMATO CULTIVAR AS A REPOSITORY OF HORMONAL MUTATIONS

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Single-gene plant mutants serve as powerful tools for investigating plant development. As the *Arabidopsis* model, tomato has many features favorable for such kind of studies: it has a relatively small genome with hundreds of mapped mutations and the possibility of introducing new traits by *Agrobacterium*-mediated transformations. Furthermore, tomato has an important economic status. Using the same rationale underlying the *Arabidopsis* success, i.e., small size and short life cycle, in the present work twelve hormonal mutations were introduced into a miniature tomato cultivar by conventional breeding. The cv Micro-Tom can complete its short life cycle (70-90 days from sowing to fruit ripening) in a pot of only 100 mL of substrate. Among the mutations introduced, there are auxin (*diageotropica*), abscisic acid (*sitiens, flacca, notabilis*), gibberellin (*gibberellin deficient-1, -2, -3, procera*), ethylene (*Never ripe, Epinastic*) and brassinosteroid (*dumpy, Curl-3*) mutants. This approach opens the possibility to use such mutant collection as nearly isogenic lines (NILs) which could be explored to study many aspects of the hormonal control of plant development.

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ESTABLISHMENT OF A NEW *IN VITRO* SYSTEM OF LICORICE (*GLYCYRRHIZA URALENSIS*)

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The roots and stolons of some *Glycyrrhiza* plants (Licorice, Leguminosae) is one of the most important drugs in oriental traditional medicine for anti-inflammatory, antiallergenic and anti-ulcer activities. Licorice is also an important commercial product used as a sweetener and a flavor in the tobacco and confectionary industries worldwide. This study describes the establishment of *in vitro* stolon-like tissue culture system of *Glycyrrhiza uralensis*. The formation of stolon-like tissue was induced from stem bud in liquid culture in the dark. The tissues grew vigorously in liquid Murashige-Skoog (MS) medium supplemented with NAA. The growth (fresh weight) rate was over 6 times per 4 weeks. Shoot regeneration was easily achieved on solid MS medium with NAA under light. These stolon-like cultures system offers possibilities for the *in vitro* propagation and genetic manipulation of *G. uralensis*.

(77)

THE INHIBITORS OF ADVENTITIOUS ROOT FORMATION FROM A DWARF APPLE, JM7

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We found the inhibitors of adventitious root formation, during the investigation of plant growth regulators from a dwarf apple, JM7. Japanese radish seedlings were used for the bioassay of root formation. The aqueous fraction obtained from the 80% methanol extract of JM7 branches (5 kg) showed the activity. Two active fractions were separated by gel filtration. The lower molecular weight fraction was further purified by HPLC, and two active compounds were obtained. One compound was identified as *trans*-ribosylzeatin, and another is a major inhibitory compound which does not seem to be a cytokinin derivative. The structure of this inhibitor is under investigation. Further studies are required to establish the relationship between these compounds and dwarfism.

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SCREENING OF POLLEN TUBE GROWTH INHIBITORS: IDENTIFICATION OF CLETHRAMYCIN, A NOVEL INHIBITOR FROM PLANT-ASSOCIATED ACTINOMYCETE

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In pollen tube growth, actin/myosin cytoskeleton plays an important role in the transport of the precursors for cell wall biosynthesis from cytoplasm to the growing tip. This process is interfered by cytochalasin B, an inhibitor of actin polymerization, and so is pollen tube growth. Inhibitors of cytoskeletal function are expected to be a tool to probe the cell function and further to be a candidate for therapeutic agents. We screened for the pollen tube growth inhibitors from microbial secondary metabolites and identified clethramycin in the fermentation broth of *Streptomyces* sp. TP-A0623 which was isolated from a root of *Clethra barbinervis*. Clethramycin is a linear polyene polyketide with the molecular formula of $C_{63}H_{99}N_3O_{18}S$ and showed pollen tube growth inhibition and potent antifungal activity.

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DISTRIBUTION OF STRIGOLACTONES, GERMINATION STIMULANTS FOR *STRIGA* AND *OROBANCHE* AMONG HOST AND NONHOST PLANTS

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The seed of *Striga* spp. and *Orobanche* spp., weedy root parasites, requires stimulants (strigolactones) released from roots of host or nonhost plants to germinate. To examine possible distribution of strigolactones in the plant kingdom, the root exudates from cotton, red clover, sorghum, soybean, and some other plants were analyzed by LC/MS/MS. Cotton, a nonhost, was confirmed to produce strigol and acetyl-strigol, and the amounts of strigolactone production/day were quantified from 1 to 10 days after germination. In addition, isolation and characterization of novel strigolactones will be presented.

(80)

METABOLIC PROFILING OF COUMARINS IN MORNING GLORY AFTER VARIOUS STRESSES

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Coumarins are secondary metabolites found in many plants. They are biosynthesized via phenylpropanoid pathway. Details of the biosynthesis and biofunction of coumarins in plants are unclear. Metabolic profiling of coumarins in morning glory subjected to various kinds of stresses was performed in order to elucidate the mechanism controlling the coumarin biosynthesis. Analysis in coumarins was performed by HPLC and LC/ESI-MS. Scopoletin, scopolin, umbelliferone, skimmin, and esculetin were detected in extract of morning glory, which is resistant against pathogenic *Fusarium* by treatment with non-pathogenic *Fusarium*. Coumarins in morning glory after various kinds of stresses were quantified. Changes of the coumarin profile were found after stress treatments. The coumarin biosynthesis is considered to be controlled by the stress factors.

(81)

SYNTHESIS AND CHEMICAL REACTIVITY OF (11*E*,13*E*)-LABDA-11,13 DIENE-8á,15-DIOL, A NOVEL SIGNAL TRANSDUCER IN DEFENSE RESPONSES IN TOBACCO PLANTS

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Recently, we identified the title compound, a novel labdane-type diterpene, from tobacco mosaic virus (TMV)-infected tobacco leaves as a wound-induced protein kinase-activating factor-1 (WAF-1). This compound increases rapidly in tobacco leaves during a hypersensitive response to TMV-infection and after wounding, and activates mitogen-activated protein kinases (MAPKs), WIPK and SIPK, at nanomolar levels. Since both MAPKs are respectively located at control points in the signal transduction network of plant defense, WAF-1 is considered to be one of the critical signal transducers in defense responses in tobacco plants. Here we report the synthesis, structural elucidation, and chemical reactivity of WAF-1. In addition, we will show that WAF-1 is a promising bio-probe for elucidation of the complicated and intractable signal network of plant defense.

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MOLECULAR CLONING AND CHARACTERIZATION OF cDNAs ENCODING DITERPENE CYCLASES INVOLVED IN BIOSYNTHESIS OF PHYTOALEXINS IN SUSPENSION-CULTURED RICE CELLS

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We found that at least two putative diterpene cyclase genes, *OsDTC1* and *OsDTC2*, were expressed in suspension-cultured rice cells treated with a chitin elicitor, and isolated a full-length OsDTC1 cDNA by RT-PCR followed by RACE-PCR. OsDTC1 functioned as *ent*-cassa-12,15-diene synthase which is considered to play a key role in the biosynthesis of (-)-phytocassanes which were recently isolated as rice phytoalexins. Isolation of a full-length OsDTC2 cDNA is now in progress.

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IN SITU LOCALIZATION OF POLYISOPRENE IN A RUBBER PRODUCING PLANT, *EUCOMMIA ULMOIDES* OLIVER

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The localization of polyisoprene in young stem tissues of *Eucommia ulmoides* Oliver was investigated by histochemical staining and Fourier transform infrared microspectroscopy (FT-IR). The fibrous structures were stained with Oil Red O. FT-IR microspectroscopy analysis proved that the fibrous structures were indeed *trans*-polyisoprene. The presence of granular structures clearly stained with the dye and having a characteristic absorption at 2960 cm^{-1} in FT-IR suggested that *trans*-polyisoprene accumulated in the vicinity of the cambium layer. We have successfully showed the localization of *trans*-polyisoprene in plant tissues for the first time, and our histological investigation allowed us to presume the main sites of biosynthesis and accumulation of rubber.

(84)

SYSTEMIC EMISSION OF (-)-GERMACRENE D FROM HYBRID POPLAR INDUCED BY HERBIVORY

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The sesquiterpene (-)-germacrene D [(-)-GD] is released as a major volatile component in a rhythmic, diurnal fashion from systemic leaves of hybrid poplar trees upon feeding by the forest tent caterpillar (FTC). The terpene synthase gene, (-)-GD synthase (*PtdTPS1*), was isolated and functionally characterized. Expression of *PtdTPS1* is rapidly induced in leaves in response to wounding, FTC feeding, and methyl jasmonate. In systemic leaves, transcript levels of *PtdTPS1* followed a diurnal pattern. Transcriptional regulation of insect-induced, systemic (-)-GD emission is likely to function in some form of plant-insect multitrophic signaling, such as attraction of predators or parasites of forest tent caterpillars.

(85)

HEAVY-ION BEAM MUTAGENESIS FOR HERBICIDE RESISTANT PLANTS

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Heavy-ion beams are very effective tools of mutagenesis for seed embryos at a fertilization stage. This new technique was subjected to screening of herbicide-resistant mutants, using tobacco plants. Intact embryos were irradiated with N-ions, and the plants were allowed to grow until M_1 seed maturation and harvested. M_1 plants were used in the resistance test against S-23142 and bensobicyclon hydrolysate (BZB). Two resistant plants to S-23142 were selected from 94 M_1 plants, and one strain exhibited 1000-fold more resistance than wild-type (WT). Twenty-three resistant plants to BZB were selected from 5840 M_1 seeds. Two strains showed 10-fold more resistance than WT. They were also resistant to sulcotrione.

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ANALYSIS OF GIBBERELLINS IN A BRACHYTIC TOMATO MUTANT INDUCED BY SEED RADIATION WITH CARBON ION BEAM

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Analysis of gibberellins (GAs) was conducted in a brachytic tomato mutant induced by radiation with carbon ion beam to seeds cv. First. Internodes of the mutant above the first true leaf were shortened to 44% of the original plant, but the elongation of hypocotyl and leaf was similar to that of the original plant. C-13-hydroxylated GAs ($GA_{19, 20, 29, 44, 53, 97}$) and C-13-non-hydroxylated GAs ($GA_{9, 12, 15}$) were identified by GC-MS in stems of the mutant. Stems of the original plant contained the same classes of GAs. Leaves of these two plants contained only C-13-hydroxylated GAs, including GA,. There was little difference in the GAs activities in stems and leaves estimated by the dwarf rice micro-drop assay between these two plants.

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SILICON ENHANCES GIBBERELLIN BIOSYNTHESIS IN RICE

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Response of gibberellin biosynthesis by elevated silicon supply was investigated in rice plant (*Oryza sativa* L. cv. Dongjinbyeo). Experiments were conducted with silicate fertilizer (blast furnace slag containing 40% Si), silicic acid, and sodium meta-silicate as a source of silicon. Silicate fertilizer was mixed with soil and five days old rice seedlings were transplanted to pots. Two weeks after transplanting, shoots were harvested for analysis of GAs. Levels of all endogenous GAs (GA_{12}, GA_{53}, GA_{19}, GA_{20} and GA_1) in early 13-hydroxylation pathway in rice shoots were significantly increased by the application of silicate fertilizer. Levels of all GAs were proportionally increased with the increase of silicate levels. Solution culture was also carried out to clarify a sole effect of silicon on gibberellin biosynthesis. Silicic acid (Sigma Co., USA) and sodium meta-silicate (Sigma Co., USA) as a silicon source were supplied to the rice seedlings grown for two weeks, then plants were harvested at 6, 12 and 24 h after silicon addition in culture solution. Within six hours, level of bioactive GA, GA_1, increased two-fold compared with the control. However, level of GA_{20}, a precursor of GA_1 biosynthesis, was not changed. This result suggests that the activity of 3â-hydroxylase which catalyze GA_{20}?GA_1 biosynthetic step may be up-regulated by the enhanced silicon supply, and implies possibly that the elevated level of GA_1 may exert some role in growth of rice plant as a beneficial element (Supported by a grant from the APSRC [R11-2001-09203002-0] funded by KSEF).

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GIBBERELLINS INDUCE á-AMYLASE AND CONCERN THE DEVELOPMENT OF COTYLEDON IN IMMATURE SEEDS OF *P. NIL*

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Immunohistochemical analysis showed that active gibberellins (GAs) and GA-responsive á-amylase, PnAmy1, localized around starch granules in integument of developing seeds of *P. nil*, and that the appearance of active Gas proceeded to that of PnAmy1. Following the disappearance of starch granules, development of cotyledon became clear, which suggests GAs possibly concern the development of cotyledon through the induction of á-amylase in the seeds. We cloned the cDNA homologs of GA20-oxidase, GA3-oxidase, and GA2-oxidase from the immature seeds, and analyzed their expression patterns by *in situ* hybridization. Signals of these GA biosynthesis genes and *PnAmyl* were not observed in integument, but in seed coat overlapping spacially and timely, suggesting that GAs and PnAmy1 are synthesized in seed coat and secreted to integument.

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MOLECULAR PHENOTYPING OF *ARABIDOPSIS* WILD TYPE AND *abi5* MUTANT DURING IMBIBITION BY MICROARRAY COMPREHENSIVE EXPRESSION ANALYSIS

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We have performed molecular characterization of WT and the *abi5* mutant by microarray expression analysis. A statistical search for any cis-element in highly expressed genes in WT dry seed revealed one of the most typical ABRE that contains ACGT core sequence. Combinational analysis of ABRE with another cis-element CE (Coupling element) showed a more apparent effect for high expression in dry seed. On the other hand, the correlation between high level expression and ABRE diminished in imbibed seeds. This result is consistent with the endogenous ABA level that increases during seed maturation and dramatically decreases upon imbibition. In *abi5* dry seed, the correlation between ABRE and high expression level is largely weakened. These results indicate that the selected ABRE is one of the main elements that provides ABA inducibility during seed maturation, and ABI5 plays an important role on expression of those genes.

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CLONING AND CHARACTERIZATION OF TWO SOLANESYL DIPHOSPHATE SYNTHASES FROM *ARABIDOPSIS*

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From *Arabidopsis*, we have isolated two cDNAs encoding solanesyl diphosphate (SSP, C_{45}) synthases (At-SPS1 and At-SPS2), which catalyze the condensation of isopentenyl diphosphate (C_5) with allylic diphosphate to give SPP. SPP is the precursor of the side chain of ubiquinone and plastoquinone in *Arabidopsis*. Both of the enzymes utilized the C_{15} and C_{20} but not either the C_5 or C_{10} allylic disphosate as a primer. At-SPS1 and At-SPS2 contain the putative chloroplastic or mitochondrial transit signal, suggesting that they might participate in the biosynthesis of plastoquinone and ubiquinone, respectively.

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STUDIES ON CHEMICAL INDUCTION OF LATERAL ROOT INITIATION OF COTTON SEEDLINGS

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The effect of plant growth regulators NAA and DPC (N,N—dimethyl piperidinium chlorid) on lateral root initiation of upland cotton (G.hirsutum Li. cv. CCRI12) seedling was observed from 1989 to 1990. Soaking cotton seeds in 20 ppm NAA or 200ppm DPC for 12hrs, and dip seedling in 20ppm NAA or 100ppm DPC for 2hrs before transplanting increased the number of lateral roots. This effect of NAA was especially significant in cotyledon-seedlings, which had the highest rooting ability before the fourth leaf stage. The content of IAA, CTK and GA_3 in seedling root was enhanced by NAA or DPC. The value of IAA/CTK and IAA/GA_3 were increased also. The activity of peroxidase in root was inhibited by NAA and DPC. NAA and DPC also decreased the content of Gossypol in root but enhanced the activity of Polyphenol Oxidase. In addition, soaking the root of cotton seedling in 30ppm Ca^{2+}($CaCl_2$) for 12hrs before transplanting increased the number of lateral roots. IAA content in the roots was enhanced. But Ca^{2+} treatment had no significant effect on Gossypol content. *General projects founded by NSFC (39870483).

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MORPHOLOGICAL AND HORMONAL RELATIONSHIPS IN SHOOTS OF PILLAR AND STANDARD PEACH TREES

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Fruit tree crown size and shape are managed genetically and culturally to enable high density plantings and to facilitate orchard operations such as pest control. In peach trees (*Prunus persica*) different crown shapes can be attained with scion of genetically-selected tree growth habits that were grafted to seedling rootstock. Scion of Pillar peach tree growth habits have narrow crowns that may be amenable to high density plantings. Research is being conducted to determine relationships between morphological characteristics and auxin and cytokinin quantities in shoots of Pillar and Standard peach trees.

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APPLICATIONS FOR REAL-TIME PCR

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The advent of real-time PCR has allowed for the rapid, sensitive, and specific detection of a multitude of genetic products. Real-time PCR incorporates a fluorescent tag which allows one to view amplification as it occurs using a graphical software interface. The primer and probe sequence are specific for a particular agent and will only detect and amplify the agent in question. This technique has allowed private labs as well as state and federally funded laboratories to quickly and efficiently detect pathogens. Real-time PCR is particularly well suited as a screening tool for pathogens from environmental samples. In fact, the recent anthrax exposure due to contaminated mail in New York as well as the anthrax contamination of the Hart building have underscored the importance of being able to detect pathogenic agents in a quick efficient manner.

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PRODUCTION OF SEEDLESS FRUITS IN SOME DATE PALM CULTIVARS

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Department of Arid Land Agriculture, Faculty of Meteorology, Environment and Arid Land Agriculture. King Abdul Aziz University, Jeddah, Saudi Arabia.

The effect of spraying unpollinated flowers of date palm cultivars (Nebut-Saeif, Sakaie, Seleg and Khudari) with GA3, IAA and 2,4,5-T at various concentrations of single or combined regulators and in one or two sprays on the production of seedless fruits was studied. Different cultivars responded to the treatments at various degrees. The treatments resulted in the production of seedless fruits, but the percentages obtained differed greatly with the concentration and the number of sprays. Most of the seedless fruits maintained color characteristic of the Khalal stage. Few of the seedless fruits reached the rutab stage. Weight of the seedless fruits was relatively less as compared with the normal fruits.

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PLANT GROWTH REGULATION IN ORNAMENTAL NURSERIES: UNREALIZED OPPORTUNITIES

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Sales of floriculture and nursery crops reached $13.3 billion in 2001. Of this total $8.6 billion was from sales of nursery crops and $488 million from herbaceous perennials, with four states (California, Florida, Texas, and North Carolina) accounting for one half of the total crop value. Consumer perception of nursery crops demands compact, well branched shrubs and herbaceous perennials with dark green foliage and, if of ornamental value, the presence of flowers or flower buds. Production of high quality crops requires frequent pruning to increase branching, and additionally to control size of many herbaceous perennials. While desirable when marketed, the presence of flowers often suppresses vegetative growth and prolongs production. Chemical PGRs are available for use in nurseries, however they are not widely used to increase branching, control plant size or to alter flowering. Other opportunities and limitations to PGR use in the nursery industry will be discussed.

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BIOREGULATOR APPLICATIONS IN NURSERY FRUIT-TREE PRODUCTION

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Fruit-tree nurseries in the USA produce many millions of trees each year. Interestingly, few uses for bioregulators have been developed for the nursery fruit-tree industry. The principal objective for which bioregulators might be useful is the induction of branching under nursery conditions. On the West Coast, a few nurseries in Washington now use proprietary mixtures of 6-benzyladenine and gibberellins A_4 and A_7 to stimulate feathering (lateral branching) on apple trees destined for high-density plantings as well as for back-yard plantings. One nursery in California reports the use of a foliar nutrient product for stimulation of branch development in apple trees. Because of the absence of bioregulator products that can induce lateral branching in many fruit-tree species, bioregulator use has not become a common component in fruit-tree production. Recent research underway in Washington has suggested that a new bioregulator product, cyclanilide®, may have considerable promise for induction of lateral branch development in fruit trees under nursery conditions.

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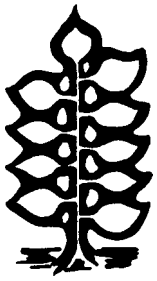

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