

PHYTOCHEMICAL SOCIETY OF NORTH AMERICA

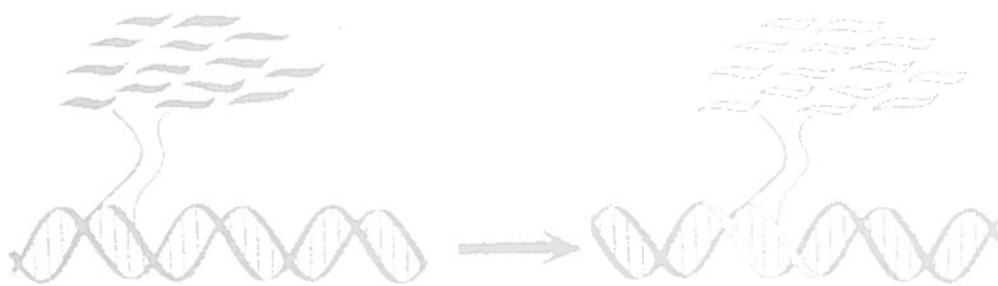
Vol. 34, No.3 • Mar. 95

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Newsletter

• Volume 34, Number 3 • March 1995 •

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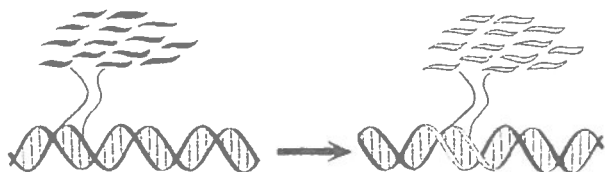
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Dr. David Seigler (1996)
Dr. Brian Ellis (1997)

Dr. Murray Isman (1998)
Dr. James Saunders (1999)

PSNA Newsletter

Editor: **Dr. Alicja M. Zobel**
Associate Editor: **Dr. Stewart A. Brown**



The Phytochemical Society of North America is a nonprofit scientific organization whose membership (currently over 400) is open to anyone with an interest in Phytochemistry, the role of plant substances, and related fields. Annual membership dues are U.S. \$20.00 for regular members and \$10.00 for student members. Annual meetings featuring symposium topics of current interest and contributed papers by conference participants are held throughout the United States, Canada and Mexico. A newsletter is circulated to members several times a year to keep them informed of upcoming meetings and developments within the society.

If you would like additional information about the PSNA or if you have material to be included in the newsletter, please contact to the Society Secretary. Annual dues and changes in addresses should be sent to the Society Treasurer.

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From the Editor

You will find in this issue a centre section containing information about this year's annual meeting in Sault Ste. Marie, Ontario: general information on the site and on the meetings, forms for meeting registration and hotel reservations, a preliminary program, call for abstracts and an abstract submission form, and information about tours. Elsewhere we have included detailed information about the mini-symposium which has been organized by Dr. Vincenzo De Luca. Meeting organizer Mamdouh Abou-Zaid informs us as we go to press that the Avis company has made members eligible for its Worldwide Discount if you wish to rent a car. Contact them toll-free at 800 331-1600,

and quote group number B712430.

We look forward to a good response to this meeting, which will be held in Ontario's scenic and rugged north country near the three largest of the Great Lakes.

Here, also, are the usual reports from our Treasurer, names of new members of the Society, and updated E-mail addresses. Norman Lewis of the Institute of Biological Chemistry in Pullman, Washington, has provided a research report.

May I remind you that the *Newsletter* will be happy to publish letters to the editor on topics which you believe should be aired to the membership at large. If you have something relevant to the

Society which you want to publicize, let's hear from you!

Correction

The Editor again offers apologies that, on account of one of those nasty gremlins which specialize in tormenting journalists of all stripes, the first digit '3' of the volume numbers on all issues of the *Newsletter* in volume 33, and 34 No. 1 were omitted. Will you please, therefore, manually insert the missing '3' in the appropriate places of your file copies of these issues? We again apologize most sincerely for the inconvenience.

The Editor

Research Report

Norman G. Lewis

*Institute of Biological Chemistry,
Washington State University*

Two of the most fascinating aspects of phytochemistry to me are its impact upon almost every area of daily life and its pertinence to many topical issues. Its significance lies in the fact that the ca. 350 000 different plant species existing today produce a fantastic spectrum of compounds of immense biological importance, many of which exhibit profound effects on the metabolism of other organisms. Indeed, in the broadest sense, our knowledge of phytochemistry has a critical bearing on issues surrounding sustainability of agricultural and forestry resources, conservation of biodiversity and the environment (including dependent organisms), design of healthy foods and nutrition, sources of pharmacologically active medicinal compounds (e.g., anticancer/antiviral agents), flavors, fragrances, and so on. It should not be forgotten that, even today, only a very small percentage of plant species has been evaluated or exploited for their chemical constituents, or even assayed for biological activity.

My current research interests address phenylpropanoid metabolism and cell wall assembly in plants. Ongoing activities include investigations directed to elaboration of the biochemical pathways to lignins/neolignans, such as the antitumor agent podophyllotoxin (as its etoposide or teniposide derivative) and the

antiviral agent, trachelogenin; the enzymology (regulation and control) of lignin formation; the mechanisms of cell wall assembly (regulation) and the effects of microgravity; suberin formation and deposition of wound-healing layers; cofactor metabolism in the phenylpropanoid pathway; interrelationships between carbon and nitrogen metabolism during phenylpropanoid synthesis (with G.H.N. Towers); and formation of taxanes in Pacific yew (with R. Croteau).

Several recent findings on some of these projects include: discovery of the first stereoselective phenol oxidase, (+)-pinoresinol synthase, which catalyzes the conversion of two coniferyl alcohol molecules to give (+)-pinoresinol (Tet. Lett., 1994); discovery and purification of pinoresinol reductase, the first benzylic ether reductase in plants, leading to the lignans, (+)-lariciresinol and (-)-secoisolariciresinol (J. Biol. Chem., 1993), and its corresponding dehydrogenase to give (-)-matairesinol. Thus, an orderly progression of biochemical events into the various lignan skeleta (e.g., to podophyllotoxin/trachelogenin, is now emerging. This, in turn, should enable us to genetically modify plants with respect to enhanced biocidal and antioxidant properties, to design plant fibers with improved cancer-preventing properties, and to increase the levels of antiviral and anticancer agents in such plants of commercial significance.

Our studies in lignin synthesis and cell wall formation address questions of metabolite transport, coupling mecha-

nisms, lignin structure, and wall assembly mechanisms. Although several reports have implied that laccases and peroxidases are involved in lignin formation, this is not the case for its synthesis in cell culture. Rather, eliminating H₂O₂ formation in cell cultures results in a loss of lignin synthesizing ability, while maintaining the ability to generate monolignols and to transport them into the cell filtrate, i.e., through the plasma membrane (Phytochemistry, 1995, in press). As a consequence, the cell walls resemble cellulose. These studies are now beginning to provide insights into mechanisms of cell wall assembly, and should be pertinent in defining how morphogenesis and differentiation occur. Practical implications should have a bearing on processes such as pulp and paper production.

Recent studies on formation of wound-healing layers, i.e., suberin, have revealed that the polymer has an intriguing hydroxycinnamate-derived polymer rather than lignin (J. Biol. Chem., 1995, in press). Understanding how this wound healing is induced and regulated should enable us to understand more fully how these processes can be exploited further in wound repair and defense.

Another area of current interest addresses how gravity affects cell wall formation. In 1993 we conducted a study to examine cellulose microfibril orientation in space (Space Shuttle), and in 1995 we will also examine how microgravity environment affects compression wood in gymnosperms in space. ■

Report of the Treasurer

The treasury of the Phytochemical Society of North America ended the year with \$33 133.92 in accounts in Peoria. The attached financial statement shows that the major sources of receipts during 1994 were from membership dues (\$5488.47) and royalties from the sales of Recent Advances in Phytochemistry (\$3066.02). In addition, we received \$1907.00 from Plenum for secretarial expenses and page charges. Savings are currently in rising rate CD accounts.

The largest expenditures during 1994 were directed to the annual meetings: \$9916.68 from the treasury in meeting-related expenses for the 1994 meeting in Mexico City. \$2000 has been advanced for the 1995 Sault Ste. Marie meeting and \$200 for the 1996 meeting. Production and postage for the new directory cost \$1050.00

There are 439 members current in their dues through 1994. During 1994, 103 new members joined PSNA, 84 as a result of

attendance at the Mexico City meeting. At the end of 1994, 78 members with dues in arrears were dropped from the membership.

Included in this Newsletter is a current E-mail address list. This information is based on information provided by the membership. Please let me know if errors have occurred. Members who expect to retire during 1995 are reminded that they are eligible for "emeritus status" and exemption from annual dues. Please notify me if you are retiring but wish to remain a member of PSNA.

Respectfully submitted,
Susan P. McCormick,
Treasurer

Final Financial Report

(01 January 1994 - 31 December 1994)

Receipts

Membership dues	5488.47
Plenum Publishing - royalties on RAP	3066.02
-secretarial expenses and page charges	1907.00
Interest on checking account	253.20
Rental of mailing lists	300.00
Total Receipts	\$11 014.49

Assets

Checking	4579.12
Savings	28,554.00
Total	\$33 133.12

Expenditures

Meetings	
- Advance for 1995 meeting	2000.00
- Advance for 1996 meeting	200.00
- Executive Committee travel, 1994	673.25
- Speaker travel, 1994	7964.68
- Student travel awards, 1994	1932.00
Executive Committee Expenses	
- Secretary	4000.00
- Treasurer	1553.18
Checking account service charges	69.43
Total Expenditures	\$18 412.54

New Members

Telephone and FAX numbers and E-mail addresses, where available, follow the names and addresses in that order.

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**PHYTOCHEMICAL SOCIETY OF NORTH AMERICA
SOCIEDAD FITOQUIMICA DE AMERICA DEL NORTE
SOCIÉTÉ PHYTOCHIMIQUE DE L'AMÉRIQUE DU NORD**

**1995 MEETING-SAULT STE. MARIE, ONTARIO, CANADA
PHYTOCHEMICAL REDUNDANCY IN ECOLOGICAL INTERACTIONS
AUGUST 12-16, HOLIDAY INN**

PRELIMINARY PROGRAM

The program will include symposium sessions, contributed paper and poster sessions. The meeting site is in Sault Ste. Marie, Ontario, Canada, which is surrounded by some of the most dramatic Canadian wilderness scenery. A registration form is enclosed. The organizers suggest the use of a credit card for hotel reservation payment

Urge your students to apply for travel grants and best student paper awards. Now is a good time to encourage students to join the Phytochemical Society of North America. An application form is on the inside back cover of every newsletter and copies of the PSNA brochure are available from the organizers. For further information, contact Mamdouh Abou-Zaid.

PROJECTED SCHEDULE

Saturday, 12 August	3:00 - 6:00pm	Registration
	7:00 - 10:00pm	Mixer
Sunday, 13 August	AM	Opening session Symposium presentation (2 talks) Contributed papers (session 1)
	PM	Symposium presentation (1 talk) Contributed papers (session 2) Posters (session 1)
	Evening	Lock Cruise
Monday, 14 August	AM	Symposium presentation (2 talks) Contributed papers (session 3)
	PM	Symposium presentation (2 talks) Posters (session 2)
Tuesday, 15 August	AM	Symposium presentation (3 talks)
	Evening	Banquet
Wednesday, 16 August	AM	Symposium presentation (2 talks) Contributed papers (session 4)
	PM	Contributed papers (session 5) Symposium presentation (1 talk)

IMPORTANT DEADLINES

May 5, 1995	Deadline for submission of abstracts
	Deadline for submission of registration forms (without late charge)
June 9, 1995	Deadline for submission of hotel reservation form
	Deadline for reservations for post-conference tours & companion's program

Please note that abstract submission and registration forms should be mailed to Dr. M. Abou-Zaid, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, Ontario, Canada P6A 5M7; fax: (705) 759 5700; e-mail: MABOUZAID@eecnpcled.FPMI.FORESTRY.CA (Chameleon, NFS). Hotel reservation forms should be mailed directly to: Holiday Inn, 208 St. Mary's River Dr., Sault Ste. Marie, Ontario, Canada P6A 5V4 Phone (705) 949-0611/1-800-465-4329; Fax: (705) 945-6972; e-mail HOLIDEX YAMCA.

**PHYTOCHEMICAL SOCIETY OF NORTH AMERICA
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**1995 MEETING-SAULT STE. MARIE
PHYTOCHEMICAL REDUNDANCY IN ECOLOGICAL INTERACTIONS
AUGUST 12-16, HOLIDAY INN**

Welcome to Sault Ste. Marie, Canada

The PSNA will hold the 1995 meeting in Sault Ste. Marie, Ontario, Canada. The Sault is located at the hub of the Great Lakes, and during the early history of Canada served as an important site along the trail of voyageurs and explorers of the continent to the west. The Sault is located in a setting of extreme natural beauty, surrounded to the north by the Canadian Shield and to the south by the three largest Great Lakes. The St. Mary's River, which flows between Sault Ste. Marie, Ontario and Sault Ste. Marie, Michigan, is one of the world's busiest waterways. August is the best time of year to experience the outdoors in Sault Ste. Marie. The Agawa Tour Train and the lock cruises offer excellent opportunities to view this part of the world.

Climate:

While you could expect temperatures between 18-25° C (66-75°F) it can still be cool in Sault Ste. Marie in August, especially on the waterfront and in the evenings. Please bring appropriate protective outdoor clothing. Rain gear might also be useful.

Travel:

To get to Sault Ste. Marie by air from within Canada it is necessary to go through Toronto. Both Air Ontario (Air Canada) and Canadian Airlines fly to Sault Ontario. If you are travelling through the U.S., United Airlines flies to Sault Ste. Marie, Michigan from Detroit and Chicago. The Holiday Inn will send a van to meet travellers at the Sault Ontario and Sault Michigan airports. If you are driving to the conference, take Highway 17 in Ontario and the I-75 if you are driving through Michigan.

General information:

To travel to Canada, U.S. citizens will require travel documents (valid passport or birth certificate). Other nationalities should check with the Canadian consulate in your country to find out the proper documents you need. The Ontario Travel and Exchange Centre is located near the International Bridge and is a ten-minute walk from the Holiday Inn on the river front boardwalk. They will exchange U.S. money 7 days a week and are open from 8:00 a.m. to 8:00 p.m. Mexican, European and Japanese travellers, please exchange your money at the Toronto, Detroit, or Chicago airports.

Conference Location:

The Holiday Inn is located on the St. Mary's River, right in the heart of downtown Sault Ste. Marie. From the hotel, visitors can watch freighters ply one of the busiest waterways in the world.

PHYTOCHEMICAL SOCIETY OF NORTH AMERICA
SOCIEDAD FITOQUIMICA DE AMÉRICA DEL NORTE
SOCIÉTÉ PHYTOCHIMIQUE DE L'AMÉRIQUE DU NORD

1995 Meeting, Sault Ste. Marie, Ontario

Scenic Tours of Sault Ste. Marie and Surrounding Area

(Time and date to be arranged. All prices \$CDN per person.)

- Tour No. 1** Lock Tours Canada: scenic 3-hour dinner cruise of St. Mary's River, locking through the World's Biggest and Busiest Locking System. Cost \$41.
- Tour No. 2** Agawa Canyon Tour: scenic nine-hour train ride aboard one of the most spectacular train excursions in North America. Cost \$46 adult, \$17.85 age 5-18, \$8.25 child.
- Tour No. 3** Lake Superior Wilderness Tour: a one-day excursion by two means of transportation (train and double-decker bus) through the rugged wilderness and along the shores of Lake Superior. Cost \$35, with a very tasty lunch included.
- Tour No. 4** Vegas Kewadin Fun Run: hop aboard the Vegas Kewadin Casino's Fun Run for some Vegas-style entertainment filled with games, music and draws enroute. Cost \$7.
Note that travel documents to USA are required for this tour!

Post-Conference Relaxation

THE OUTPOST on Lake Jobamageshig

The Outpost Lodge: a modern housekeeping and American plan resort in the magnificent wilderness (situated just off the Chapleau highway 45 km (28 mi.) north from Thessalon, which is 88 km (55 mi.) east of Sault Ste. Marie. The Outpost is conceded to be one of the most modern and beautifully laid-out camps in all of the Algoma district of Ontario. Departure August 16 at 4 p.m. Cost \$595, all-inclusive.

See descriptive material later in this insert, and for complete details write to Kiki Networking Inc. at the address given there.

PHYTOCHEMICAL SOCIETY OF NORTH AMERICA
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1995 MEETING-SAULT STE. MARIE, ONTARIO, CANADA
PHYTOCHEMICAL REDUNDANCY IN ECOLOGICAL INTERACTIONS
AUGUST 12-16, HOLIDAY INN

CALL FOR ABSTRACTS

Registrants are invited to present papers or posters on **any topic related to phytochemistry**. Please read the instructions carefully, and note the abstract deadline of **May 5, 1995**. All abstracts should be sent to Dr. M. Abou-Zaid, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, Ontario, Canada P6A 5M7; fax: (705) 759 5700; e-mail: MABOUZAID@cecnpcled.FPMI.FORESTRY.CA (Chameleon, NFS).

GENERAL INFORMATION. Oral presentations will be limited to 15 minutes (12 minutes for presentation and 3 minutes for questions). A standard 35 mm slide projector and overhead projector will be provided. Additional equipment may be arranged by special request. Please indicate equipment requests on the abstract form. It may be necessary to restrict the number of oral presentations. If this happens, some authors may be assigned to a poster session. Should this be necessary, authors will be notified 4 weeks in advance of the meeting.

POSTERS. Individuals presenting posters will have a space 1.2 m high by 1.0 m wide. Posters should contain lettering and photos that can be seen from a distance, and information should be arranged in vertical columns. Materials must be anchored by push pins. Posters can be in Spanish or French with an English summary.

ABSTRACTS. Abstracts should be submitted in English on the enclosed Abstract Submission Form and must fit entirely within a rectangle 16.5 x 7.6 cm (6.5 x 3 inch) when printed. You may use the box provided, or use a plain piece of white paper. Two copies of the abstract (unfolded) should be forwarded by mail to Dr. M. Abou-Zaid, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, Ontario, Canada P6A 5M7; fax: (705) 759 - 5700; e-mail: MABOUZAID@cecnpcled.FPMI.FORESTRY.CA (Chameleon, NFS). Please follow the example below when preparing your abstract.

HOW TO PREPARE THE ABSTRACT, AND SUGGESTIONS TO IMPROVE THE QUALITY OF ORAL PRESENTATIONS

Dr. M. Abou-Zaid, Forest Pest Management Institute, Canadian Forest Service, P.O. Box 490, Sault Ste. Marie, Ontario, Canada P6A 5M7.

An informative abstract contains a concise statement of the problem/objectives, experimental methods, and results. The text should cite data from representative experiments, and should state findings and draw conclusions.

Use one idea per slide. For a 35 mm slide, the narrow dimension of your copy should be 0.7 X the long dimension; double space lines, and use bold type. If more than a 4.5" x 3" area is used for typed copy, the final copy will not be visible!

TRAVEL ASSISTANCE. Graduate students and recent Ph.D.'s (within one year of graduation) are eligible for partial travel assistance (up to 50% of air fare or equivalent). Everyone applying for travel assistance must be a member of the PSNA, and present a paper (oral or poster) at the meeting.

BEST PAPER/POSTER AWARDS. Cash awards (\$ 100.00 USA each) will be given for the outstanding oral and poster presentations by graduate students or recent Ph.D.'s. Please indicate if you wish to be considered for one or both awards on the Abstract Submission Form.

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1995 MEETING-SAULT STE. MARIE, ONTARIO, CANADA
PHYTOCHEMICAL REDUNDANCY IN ECOLOGICAL INTERACTIONS
AUGUST 12-16, HOLIDAY INN

ABSTRACT SUBMISSION FORM - PLEASE TYPE

Name: _____

Professional Address: _____

City, State, Estado, Prov.: _____

Country: _____ Postal Code: _____

Phone: _____ Fax: _____ E-mail: _____

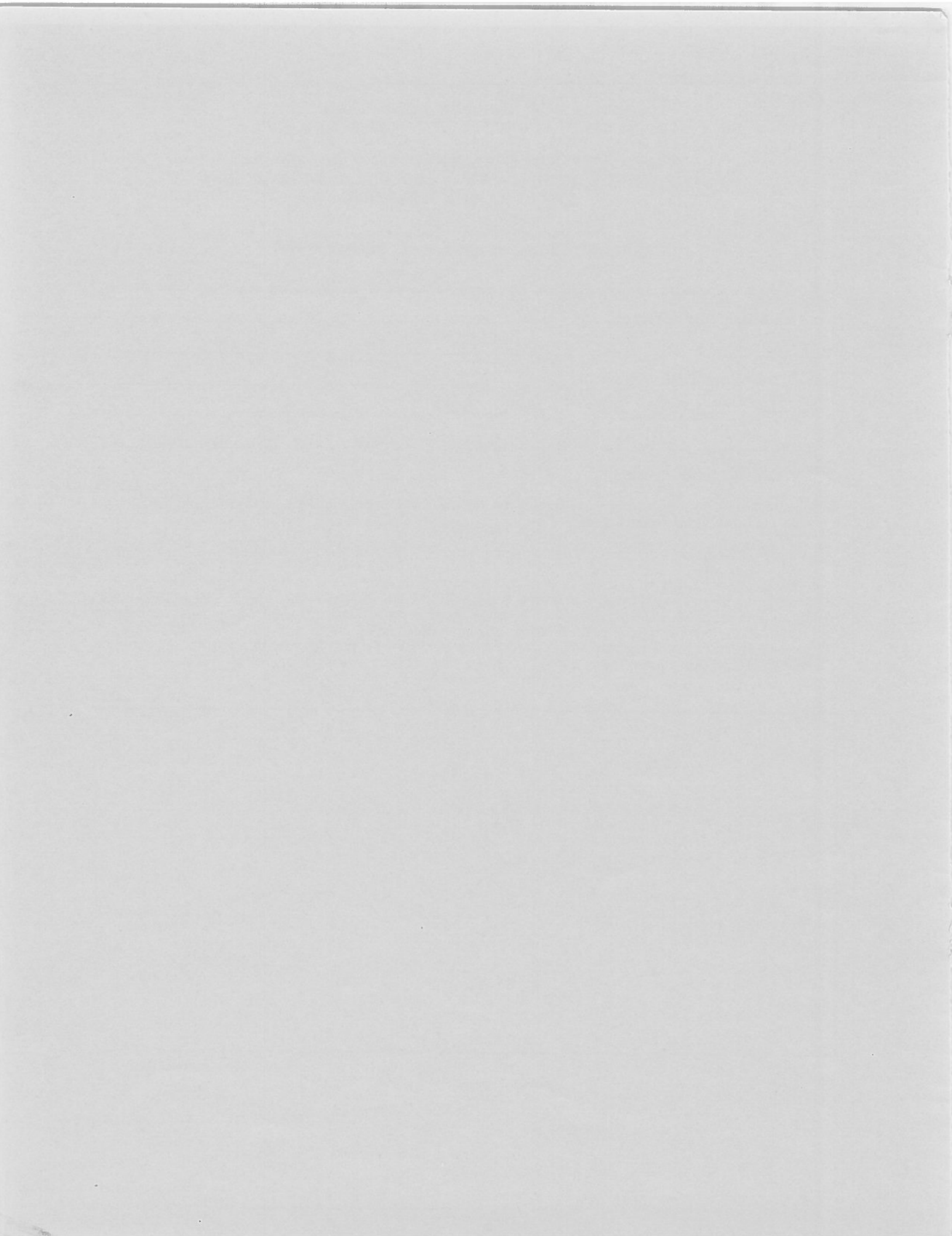
Preferred presentation medium: _____ Oral _____ Poster

Please indicate if you would like to be considered for one or both of the following awards (intended for graduate students and recent PhDs)

___ Travel Assistance ___ Best Paper/Poster ___ Date of Ph.D. (if recent)

Abstracts must be received by **May 5, 1995** Send or fax to: Dr. M. Abou-Zaid, Forest Pest Management Institute, P.O. Box 490, Sault Ste. Marie, Ontario Canada P6A 5M7; fax: (705) 759-5700 or send by *E-mail* to MABOUZAID@eecnpcled.FPMI.FORESTRY.CA (Chameleon, NFS).

Type your abstract in the box provided or on plain paper. Be sure that no part of the abstract extends beyond the 16.5 x 7.6 cm size limit.



Presents ...

"ECOSENSE: Getting in Touch with Our Environment"

A four day tour that circles the Algoma District from Sault Ste. Marie, Ontario, Canada, the hub of the Great Lakes; along the Mississagi River; into the forest; and beside the mighty Gitchee Gumee (Lake Superior). Lodging will be at comfortable Northern Ontario wilderness resorts with fire-places, hot and cold running water with bath and shower.

An opportunity to take time out

to relax

to walk in the forest

to experience

to listen to

to sense the forest

to flow like a river

perhaps ... to dance in the spirit

a challenge to put what you have learned at the conference into perspective ...

TOUR INCLUDES:

- * Transportation by mini-van with interpretive guide
- * 3 nights - "Outpost Lodge"; 1 night - "Salzburger Hof Resort"
- * Wake-up to walk, hike, aerobics, meditation or tai chi
- * 3 delicious mouth-watering home-cooked meals daily
(includes a special: Tibbles' Famous "Fish-Boil")
- * Swim in the mighty Gitchee Gumee if you dare
- * Visit aboriginal 'pictographs' on the shore of Lake Superior
- * Climb awesome Rock Candy Mountain
- * Walk in an old-growth hemlock forest
- * Tour Kirkwood Forest; visit the tallest white pine in Ontario
- * Hike Grindstone Creek that tumbles over the Cambrian Shield

WE SPECIALIZE IN:

- * Story-telling
- * Wolf-howling
- * Dream-catching
- * Loon-calling
- * Unicorn-hunting
- * Fishing for fur-bearing trout
- * Getting in touch with the spirit of the stone
- * poet-tree

(please turn over)

The tour will be designed to meet your needs. Just answer the accompanying ECOQUEST and we will make it happen. Bring hiking boots, camera and an appetite for the eco-experience of your lifetime.

ECOSENSE: GETTING IN TOUCH WITH OUR ENVIRONMENT
Aug. 16-20, 1995 (Departure immediately after conference)

Transportation, meals and lodging	\$599.95
Deposit due on or before May 14/95	\$100.00 per person***
Balance due on or before June 14/95	\$499.95 per person

*** Please Note: Ecotour is limited to 21 participants, register early.

Please make cheque or money-order out to:

Kiki Networking Inc.

145 Princess Cres.,

Sault Ste. Marie, Ontario,

Canada, P6B 3P4

For further information call Gordon Stone at: (705) 949-6396

Who are we?

Barnett (Barney) W. Smith, Associate

I have been an environmentalist, of a kind, long before this was vogue. As my bumper sticker states, "For a Forester, Every Day is Earth Day". After more than 30 years of education, training and experience, as a forester, I have an understanding of forest areas of North America. Throughout my career, it was essential to speak to many levels of audiences. A cross-section of audiences includes, school children, advisors to management board of cabinet, a tree geneticist, media, diplomats, technocrats, and translators. I have been part of organizational groups that have planned conferences for over 300. I have also planned and executed tours and conferences on my own.

Gordon (Gord) L. Stone, President

As a true environmentalist, I have always been concerned about relationships between our earth, water, air, and all living things that grow to produce the environment in which we live. I believe in the interconnectedness of all things. With 35 years of experience, as a forester, ecologist, writer, adult educator, learning facilitator, consultant, field tour guide, natural resource interpreter, college professor and program designer, I have the necessary knowledge, understanding and skills to provide an eco-experience that you will always remember.

***NOTE: Wilderness resort brochures and final itinerary will be mailed to you when registration is confirmed with \$100.00 deposit/person.

1995 Annual Meeting

Mini-Symposium

Molecular Biology of Phytochemical Pathways

The mini-symposium will be held on the afternoon of

Tuesday, August 15.

Speakers and titles will be:

Dr. Nicholas Bate:

Quantitative relationships between phenylalanine ammonia-lyase and phenylpropanoid accumulation establish PAL as a major determinant of flux into the phenylpropanoid pathway.

Dr. Clint Chapple:

Secondary metabolism in *Arabidopsis thaliana*:
from mutants to clones.

Dr. P. Constabel:

Polyphenol oxidase as a component of the inducible defence response of tomato against insect herbivores:
Regulation by wounding, systemin and methyl jasmonate.

Dr. Peter Facchini:

Regulation of alkaloid biosynthesis in opium poppy:
differential, tissue-specific and inducible expression of
a tyrosine/DOPA decarboxylase gene family.

Dr. Nancy Paiva:

Isoflavonoid phytoalexin genes.

Dr. Luc Varin:

The sulfonation reaction in plant secondary metabolism:
Molecular and functional aspects.

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 Metz
 Moran
 MORTON
 Muhitch
 NAIR
 Nessler
 NETZLY
 NIGG
 O'Keefe
 OWENS
 PAIVA
 PAYNE
 PHINNEY
 Pichersky
 Poulton
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 REINECKE
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Upcoming Meetings

Phytochemical Society of North America

Complete information about the 1995 meeting on August 15-17 in Sault Ste. Marie, Ontario, and forms for registration and abstracts, are enclosed in this issue. The 1996 meeting is planned for New Orleans in early August, and the topic will be in the area of the phytochemistry of foods. Tentative arrangements are being made to hold the meetings in the Hotel Monte Leone in the old French quarter. Watch future issues for further details.

Other Meetings of Interest

Keystone Symposia, Concurrent Meetings

Hilton Head, South Carolina, 1995 March 26-April 1. (1) Frontiers of Plant Morphogenesis. The issues will concern the broad area of the interface between the cytoskeleton, cell wall and plasma membrane in morphogenesis, and how new insights can be synthesized using molecular, cellular and biochemical approaches. (2) Signal Transduction in Plants. Several recent developments which have strongly impacted research in this area are the dramatic explosion in our knowledge of the molecular, cellular and developmental biology of plants, genetic approaches using model systems, use of PCR to clone plant homologues of components of signal transduction systems in microbes and animals, and purification and cloning of the first putative plant receptors. Contact Keystone Symposia, Drawer 1630, Silverthorne, CO 80498, U.S.A. (Telephone 303 262-1230)

Mass Spectrometry

Joint meeting with Phytochemical Society of Europe, Swansea, UK, 1995 March 27-30. Contact Dr. C.J. Smith, Department of Biochemistry, University College of Swansea, Singleton Park, Swansea SA2 8PP, UK. (Telephone 44-(0)792-295378, FAX 44-(0)792-295447)

International Symposium on Weed and Crop Resistance to Herbicides

University of Cordoba, Spain, 1995 April 3-6. Jointly sponsored by the European Weed Research Society and the Spanish Weed Science Society. General topics: herbicide target sites and resistance mechanisms associated with them, resistance mechanisms associated with herbicide metabolism and detoxification, other resistance mechanisms, biotechnological approaches to develop herbicide resistance in crops, integrated mechanical, chemical and biological methods for weed control. Deadline for abstracts has passed. Contact Dr. J. Jorin, Departamento de Bioquímica y Biología Molecular, University of Cordoba, Apartado 3048, Cordoba, Spain. (Telephone 57-218439, FAX 57-218563)

Third International Conference on the Biogeochemistry of Trace Elements

Paris, France, 1995 May 15-19. Themes will be biogeochemistry of trace elements, impacts and mode of exposure pathways, and evaluation and management of risk. The deadline for submission of abstracts has passed. Contact INRA-Versailles, Dr. René Prost, Route de Saint-Cyr, F-78026 Versailles Cedex, France. (Telephone 33 (1) 30.83.32.50, FAX 33 (1) 30.83.32.59)

Phytochemicals and Health

Days Inn Penn State, State College, Pennsylvania, 1995 May 18-20. Topics will be presented under the sections: biochemistry and regulation of phytochemicals, flavonoids and polyphenols in plant health, nitrogenous compounds, terpenoids and steroids, and the future of phytochemical diversity. Twenty-four symposium speakers. Contact Dr. Jack C. Shannon, Penn State, 102 Tyson Building, University Park, PA 16802, U.S.A.. (Telephone 814 863-2192, FAX 814 863-6139)

Photostability of Drugs — 1st International Meeting

Oslo, Norway, 1995 June 8-9. Fourteen invited lecturers, and contributed communications. Contact Dr. Hanne Hjorth Tonnesen, Dept. of Pharmaceutics, Institute of Pharmacy, University of Oslo, Box. 1068, Blindern, 0316 Oslo, Norway. (FAX 47-22-85 74 94)

9th International Symposium on Insect-Plant Relationships

Gwatt, Switzerland, 1995 June 24-30. Topics will be multitrophic interactions and mutualism, variability of insects, variability of plants (basic and applied aspects), behavior and sensory physiology of insects, insect ecophysiology and evolution of insect-plant relationships, and techniques. Contact Dr. Erich Städler, Eidgenössische Forschungsanstalt, Schloss 334, CH-8820 Wädenswil, Switzerland. (Telephone 41 1 783 61 11 or 783 63 34, FAX 41 1 780 63 41, E-mail STAEDLER@FAW.ETHZ.CH)

Upcoming Meetings

(Continued from the previous page.)

7th International Symposium on Preharvest Sprouting in Cereals

Abashiri, Hokkaido, Japan, 1995 July 2-7. Specific topics will include: physiology and molecular biology of grain development and germination; influence of environmental, physical and agronomic factors on sprouting; genetics and plant breeding; effects of sprouting damage on cereal end products. Contact the Secretariat, 7th International Symposium on Preharvest Sprouting in Cereals, Kitami Agricultural Experiment Station, Kunneppu, Hokkaido 099-14, Japan (Telephone 0157-47-21-46), or Dr. M.K. Walker-Simmons, USDA-ARS, 209 Johnson Hall, Washington State University, Pullman, WA 99164-6420 (Telephone 509 335-8696, FAX 509 335-8674, e-mail simmons@wsuvm1.edu)

9th International Rapeseed Congress

Cambridge, England, 1995 July 4-7. Topics will be breeding, biotechnology, animal and human nutrition, industrial uses, crop protection and physiology. Contact Congress Secretariat, Concorde Services Ltd., 10 Wendell Road, London W12 9RT, or Dr. Eric Evans, Dept. of Agriculture, The University, Newcastle upon Tyne England.

European Symposium on Photomorphogenesis in Plants

Sitges, Barcelona, Spain, 1995 July 9-13. Specific topics will include Blue-UV light photoreception, phytochrome properties and phytochrome genes, photoregulation of gene expression, signal transduction in

photomorphogenesis, photocontrol of plant growth, photomorphogenesis in lower plants and photomorphogenesis in natural conditions. Contact Dr. Carmen Bergareche, Departamento de Biología Vegetal, Facultad de Biología, Diagonal 645, 08028 Barcelona, Spain. (Telephone 34-3- 4021464, FAX 34-3-4112842)

15th International Conference on Plant Growth Substances

Minneapolis, Minnesota, 1995 July 14-18. Held in conjunction with the Plant Growth Regulator Society of America. Twenty symposia are planned, each consisting of 3-5 speakers, on topics including hormone biosynthesis, hormone metabolism, tropisms, flowering, hormone perception/sensitivity, and interactions of hormones with other signaling systems. Plenary sessions will cover signal transduction, integration of growth processes, hormonally regulated gene expression, and generation of fundamental knowledge and applications using transgenic plants. There will be posters and workshops. Contact Dr. Gary Gardner, Department of Horticultural Science, University of Minnesota, 305 Alderman Hall, St. Paul, MN 55108, U.S.A. (FAX 612 624-3606, e-mail ggardner@maroon.tc.umn.edu)

Saponins: Chemistry and Biological Activity

Chicago, 1995 August 20-25. American Chemical Society Symposium No. 582. Contact Dr. George R. Waller, Dept. of Biochemistry and Molecular Biology, Oklahoma State University, Stillwater, OK 74078-0454, U.S.A. (Telephone 405 744-6692, FAX 405 744-7799)

Secondary Products — Physiologically Active Compounds

Halle an der Salle, Germany, 1995 September 3-7. Main topics are general features of secondary metabolism and secondary products, the evolution of secondary metabolism, secondary products as drug constituents and as leads in the development of new drugs, and gene technology and the improvement of drugs. Contact Prof. Dr. Beate Diettrich, Institut für Pharmazeutische Biologie der Martin-Luther-Universität Halle, Weinbergweg 15, D- 06120 Halle/S., Germany. (Telephone 0345 622 379, FAX 0345 55 11 966)

Phytochemistry of Fruits and Vegetables

Murcia, Spain, 1995 September 20-24. Contact Dr. F.A. Tomás-Barberán, CSIC, Centro de Edafología y Biología Aplicada del Segura, Apartado 4195, Murcia 30080, Spain. (Telephone 34-68- 215717, FAX 34-68-2666)

Chemical Ecology:

12th Meeting of the International Society of Chemical Ecology

Near Santiago, Chile, 1995 October 2-6. Among topics to be covered are chirality and bioactivity, plant and insect semiochemicals in pest management, multitrophic interactions, and nitrogen compounds in plant-herbivore interactions. Contact Dr. Hermann M. Niemeyer, Departamento de Ciencias Ecologicas, Fac. de Ciencias, Univ. de Chile, Casilla 653, Santiago, Chile. E-mail: niemeyer@abello. (Telephone 56-2-271-1116 or 271-7503)

PHYTOCHEMICAL SOCIETY OF NORTH AMERICA

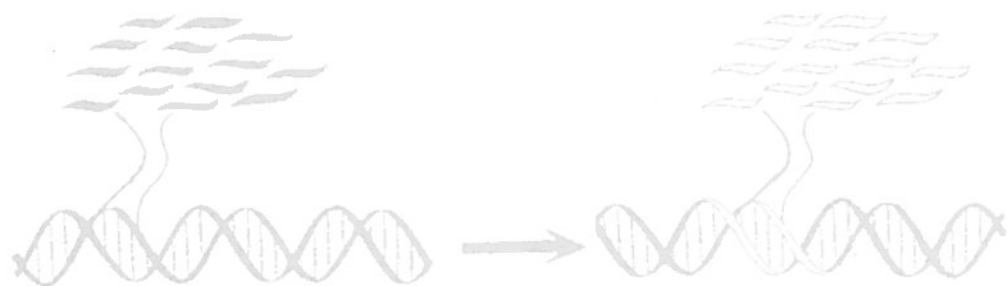
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Newsletter

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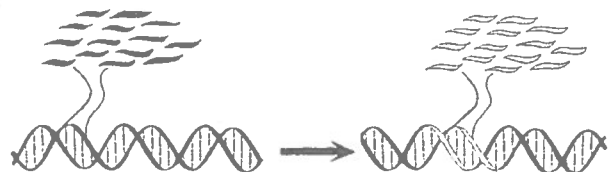
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PSNA Newsletter

Editor: **Dr. Alicja M. Zobel**
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The Phytochemical Society of North America is a nonprofit scientific organization whose membership (currently over 400) is open to anyone with an interest in Phytochemistry, the role of plant substances, and related fields. Annual membership dues are U.S. \$20.00 for regular members and \$10.00 for student members. Annual meetings featuring symposium topics of current interest and contributed papers by conference participants are held throughout the United States, Canada and Mexico. A newsletter is circulated to members several times a year to keep them informed of upcoming meetings and developments within the society.

If you would like additional information about the PSNA or if you have material to be included in the newsletter, please contact to the Society Secretary. Annual dues and changes in addresses should be sent to the Society Treasurer.

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From the Editor

Our summer issue contains, as usual, the abstracts of the symposium papers and contributed papers for this year's annual meeting in Sault Ste. Marie, Ontario. I hope to see you there in August. Also in this issue we have for the first time included a research report from one of our European PSNA members, Dr. Kazimierz Glowniak of the Medical Academy in Lublin, Poland.

This is your *Newsletter*, and you as individuals can help maintain its traditional high quality by contributing to it. I have pointed out several times that your submission of research reports is an important contribution,

but please remember that there are other ways, too. We especially welcome announcements of positions open, and if you are seeking a position we shall be happy to include "position wanted" advertisements from members. Be sure to send any important news about our members and other phytochemists, such as awards, moves, and obituaries, and any other news relevant to phytochemistry you'd like to have brought to the attention of the membership. Don't worry about duplication; I'd much prefer this to missing something important!

I wish to apologize for the late mailing of this issue, as well as the fact that the

program abstracts contain some uncorrected mistakes, none of which is very serious. Both problems were caused by severe incompatibilities we encountered with word processing programs. We hope to circumvent these problems before the summer issue of 1996.

The Editor

1995 PSNA Annual Meeting Program

Saturday, August 12

14:00 - 18:00 Registration,
Holiday Inn lobby
19:00 - 21:00 Mixer (Algoma Ballroom)
20:30 - 22:00 PSNA Executive Meeting

Sunday, August 13

Registration will be open from 8:00 to 12:30

All posters should be put up on Sunday, August 13,
for viewing for the entire conference.

All sessions will be held at the Algoma Ballroom

8:30 - 9:00 Welcome -
Dr. Ed Kondo & Errol Caldwell
Canadian Forest Service
Dr. J. T. Arnason, PSNA President

SYMPOSIUM SESSION I -

Chair, C. Van Sumere

9:00 - 9:50 Symposium Paper 1-
PHYTOCHEMICAL DIVERSITY,
ADAPTATION OR RANDOM VARIATION?
May R. Berenbaum

9:50 - 10:20 Coffee Break

10:20 - 11:10 Symposium Paper 2-
PLANT PHENOLICS AND
PHYTOCHEMICAL REDUNDANCY
Simon Mole

11:10 - 12:00 Symposium Paper 3-
THE ROLE OF SECONDARY
METABOLITES IN EVOLUTION
Bruce B. Jarvis

12:00 - 13:00 Lunch

CONTRIBUTED

ORAL PRESENTATION SESSION I

Chair, H. Stafford

STUDENT ORAL

PRESENTATION COMPETITION

13:00 - 13:15 Contributed Paper 1-
DOES MECHANICALLY STIMULATED
RAPID GABA SYNTHESIS CONSTITUTE
A PLANT DEFENCE AGAINST
PHYTOPHAGOUS INSECTS?
A. Ramputh and A. Bown

13:15 - 13:30 Contributed Paper 2-
VOLATILES EMITTED BY CONES
AND FOLIAGE OF *PICEA* SPP.
E. G. Brockerhoff, J.J. Turgeon,
D.A. Lombardo and G.G. Grant

13:30 - 13:45 Contributed Paper 3-
FOLIAGE EXTRACTS AND ISOLATED
COMPOUNDS FROM DECIDUOUS
TREES THAT ARE ACTIVE AGAINST
THE FOREST TENT CATERPILLAR
(*MALACOSOMA DISSTRIA* HÜBNER).
R.W. Nicol, J.T. Arnason,
B. Helson and M.M. Abou-Zaid

13:45 - 14:00 Contributed Paper 4-
CHEMICAL ECOLOGY OF A FRASS
BASED DEFENSE
T.C. Morton and F. VencI

14:00 - 14:15 Contributed Paper 5 -
MECHANICAL STRESS AND ALTERED
GROWTH FORM CONDITION RESPONSES
OF PLANTS TO PESTS
D. F. Cipollini, Jr.

14:15 - 14:30 Contributed Paper 6 -
INTERACTIONS BETWEEN INSECTS
AND PATHOGENS IN SQUASHES, AND
THE ROLE OF PLANT CHEMISTRY
P. J. Moran and Jack C. Schultz

14:30 - 14:45 Contributed Paper 7 -
PHENOLICS FROM PINE SPECIES:
DO THEY PROVIDE PROTECTION FROM VIRAL
INFECTION IN LATE INSTAR GYPSY MOTH?
Clifford W. Beninger and Mamdouh M. Abou-Zaid

14:45 - 15:00 Contributed Paper 8 -
IMPLICATION OF SOLUBLE PHENOLICS
IN THE DEFENSE RESPONSE OF SILICON-FED
CUCUMBER TO POWDERY MILDEW
(*SPHAEROTHECA FULIGINEA*).
A. Fawe, J. Menzies and R.R. Belanger

15:00 - 15:30 Coffee Break

STUDENT ORAL PRESENTATION COMPETITION CONT.

Chair, C. Nozzolillo

15:30 - 15:45 Contributed Paper 9 -
ANTI-MYCOBACTERIAL CONSTITUENTS
FROM *INULA HELENIUM*
C. L. Cantrell, G. Franzblau, and N.H. Fischer

15:45 - 16:00 Contributed Paper 10 -
EFFECT OF PURE COMPOUNDS AND
EXTRACTS FROM NONHOST PLANTS
ON THE GERMINATION OF *STRIGA*
HERMONTICA SEEDS
J. K. Rugutt, D. K. Berner and N.H. Fischer

16:00 - 16:15 Contributed Paper 11 -
INVOLVEMENT OF ISOCHORISMATE
SYNTHASE IN THE BIOSYNTHESIS
OF 2,3-DIHYDROXYBENZOIC ACID IN
ELICITED *CATHARANTHUS ROSEUS* CELL
SUSPENSION CULTURES
P.R.H. Moreno, L.J. Van Tegelen
and R. Verpoorte

16:15 - 16:30 Contributed Paper 12 -
A NEW APPROACH TO DEFINING
REGULATORY PROCESSES IN
LIGNIN ASSEMBLY.
P. van Heerden, Z. -Q. Xia, M. Nose,
M. Bernardo and N.G. Lewis

1995 PSNA Annual Meeting Program

16:30 - 16:45 Contributed Paper 13 -
CHARACTERIZATION OF A HYDROXYLASE
INVOLVED IN THE FIRST STEP IN
THE BIOSYNTHESIS OF VINDOLINE
FROM TABERSONINE
B. St-Pierre and V. deLuca

16:45 - 17:00 Contributed Paper 14 -
MOLECULAR CLONING AND
CHARACTERIZATION OF A 2-OXOGLUTARATE
DEPENDENT DIOXYGENASE INVOLVED
IN VINDOLINE BIOSYNTHESIS
F. Vázquez-Flota, E. de Carolis,
A.M. Alarco and V. deLuca

17:00 - 17:15 Contributed Paper 15 -
THE MOLECULAR CONFORMATIONS
AND DYNAMICS OF HELENALIN
T. J. Schmidt, D. Vargas and N.H. Fischer

17:15 - 17:30 Contributed Paper 16 -
CHORISMATE UTILIZING ENZYMES AND
TERPENOID INDOLE ALKALOID BIOSYNTHESIS.
R.J.M. Bongaerts, M.S. Scheffers,
J.H.C. Hoge, R. Verpoorte

19:00 Lock Cruise and Dinner

Monday, August 14

SYMPOSIUM SESSION II

Chair, G. Strunz

8:30 - 9:20 Symposium Paper 4-
PHYTOCHEMISTRY OF THE *MELIACEAE*:
SO MANY TERPENOID, SO FEW INSECTICIDES
Murray B. Isman

9:20 - 10:10 Symposium Paper 5-
TERPENOID DIVERSITY: INSIGHTS INTO THE
ROLE OF CHEMICAL DIVERSITY IN PLANT -
HERBIVORE - PATHOGEN INTERACTIONS
Rex Cates

10:10 - 10:30 Coffee break

CONTRIBUTED

ORAL PRESENTATION SESSION III

Chair, G. Strunz

10:30 - 10:45 Contributed Paper 17-
VARIATION AND GENETIC CONTROL OF
VOLATILE TERPENES IN UPLAND COTTON
(*GOSSYPIUM HIRSUTUM* L.)
A.A. Bell, R.D. Stipanovic and H.J. Williams

10:45 - 11:00 Contributed Paper 18-
GERMACRANOLIDES FROM *NEUROLAENA*
COBANENSIS AND THEIR ACTIVITIES
AGAINST *SPODOPTERA LITTORALIS*
C.M. Passreiter, B. Schwarz, P. Proksch,
P. Moreno, B. Medinilla and R. Velasquez

11:00 - 11:15 Contributed Paper 19-
TISSUE CULTURE PRODUCTION
OF CUCURBITACINS
F. T. Halaweish and D. W. Tallamy

11:15 - 11:30 Contributed Paper 20-
INTERACTION OF VISUAL AND CHEMICAL
CUES IN HOST EXTRACT RESPONSES OF
A DIURNALLY OVIPOSITING MOTH,
CHORISTONEURA FUMIFERANA
(LEPIDOPTERA: TORTRICIDAE)
G.G. Grant and D. Langevin

11:30 - 11:45 Contributed Paper 21-
PROTECTION OF COTTON LEAF TISSUE
FROM SUNLIGHT-ACTIVATED TOXICITY
OF ITS OWN PHYTOALEXIN BY RED
EPIDERMAL CELLS
M. Essenberg, W.R. Edwards, A.R. Rowlan,
K. Willis, T. Barfield-Schneider, and J. A. Hall

11:45 - 12:00 Contributed Paper 22-
PHYTOCHEMICAL REDUNDANCY IS
EXPLAINED BY THE JONES-FIRN MODEL
OF SECONDARY CHEMICAL DIVERSITY
R.D. Firm and C.G. Jones

12:00 - 13:00 Lunch

SYMPOSIUM SESSION III

Chair, E. Conn

13:00 - 13:50 Symposium Paper 6-
RELATIONSHIPS BETWEEN THE DEFENSE
SYSTEMS OF PLANTS AND INSECTS, THE
CYANOGENIC SYSTEM OF THE MOTH
ZYGAENA TRIFOLLI
Adolf Nahrstedt

13:50 - 14:40 Symposium Paper 7-
DUAL DEFENSES OF CRUCIFERS
AGAINST ADULTS AND LARVAE OF
CABBAGE BUTTERFLIES.
J. Alan A. Renwick

14:40 - 15:00 Coffee break

15:00 - 15:50 Symposium Paper 8-
MODERN BIOASSAY TECHNIQUES FOR THE
ISOLATION OF PLANT ALLELOCHEMICALS
ACTIVE AGAINST INSECTS
Pierre Escoubas

CONTRIBUTED

ORAL PRESENTATIONS SESSION IV

Chair, E. Conn

15:50 - 16:05 Contributed Paper 23-
HYDROXAMIC ACID CONTENT AND
PLANT DEVELOPMENT OF MAIZE IN
RELATION TO DAMAGE CAUSED BY
THE WESTERN CORN ROOTWORM
R. A. Assabgui, R.I. Hamilton and J.T. Arason

16:05 - 16:20 Contributed Paper 24-
CYANOGENESIS IN *TURNERA ULMIFOLIA* L.
(TURNERACEAE): MEDIATING
INTERACTIONS ON MULTIPLE LEVELS
P.J. Schappert and J.S. Shore

16:20 - 17:40 Annual Business Meeting

18:00 - 19:00 Dinner.

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POSTER SESSION (INCLUDING BEST POSTER COMPETITION)

19:00 - 20:00 Authors of Posters 1 - 25
are asked to be present at their posters.

20:00 - 21:00 Authors of Posters 25 - 50
are asked to be present at their posters.

Tuesday, August 15 SYMPOSIUM SESSION IV

Chair, R. Ibrahim

8:30 - 9:20 Symposium Paper 9-
SYSTEMIC ACQUIRED RESISTANCE
SIGNAL TRANSDUCTION.
Scott Uknes

9:20 - 10:10 Symposium Paper 10-
MULTIPLE DEFENSES AND SIGNALS
IN PLANT DISEASE RESISTANCE
Ray Hammerschmidt

10:10 - 10:40 Coffee break

MINI SYMPOSIUM

Chair, R. Ibrahim

10:40 - 11:10 Mini symposium Paper 1-
POLYPHENOL OXIDASE AS A COMPONENT
OF THE INDUCIBLE DEFENSE RESPONSE
OF TOMATO AGAINST INSECT HERBIVORES:
REGULATION BY WOUNDING, SYSTEMIN
AND METHYL JASMONATE
C. P. Constabel, D.R. Bergey, and C. A. Ryan

11:10 - 11:40 Mini symposium Paper 2-
QUANTITATIVE RELATIONSHIP
BETWEEN PHENYLALANINE AMMONIA-
LYASE (PAL) AND PHENYLPROPANOID
ACCUMULATION ESTABLISHES PAL AS
A MAJOR DETERMINANT OF FLUX INTO
THE PHENYLPROPANOID PATHWAY
N. J. Bate

11:40 - 12:10 Mini symposium Paper 3-
SECONDARY METABOLISM IN *ARABIDOPSIS*

THALIANA: FROM MUTANTS TO CLONES.
C. Chapple, M. Lorenzen, K. Meyer, V. Raciocot,
D. Strack, and J. Cusumano

12:10 - 13:00 Lunch

MINI SYMPOSIUM CONT'D

Chair, V. deLuca

13:00 - 13:30 Mini symposium Paper 4-
ISOFLAVONOID BIOSYNTHETIC GENES
N. L. Paiva

13:30 - 14:00 Mini symposium Paper 5-
THE SULFATION OF NATURAL PRODUCTS:
BIOCHEMICAL AND MOLECULAR ASPECTS
L. Varin, F. Marsolais, L. Nicolle and M. Richard,

14:00 - 14:30 Mini symposium Paper 6-
MYSTERIES OF THE OPIUM POPPY:
MOLECULAR REGULATION OF ALKALOID
BIOSYNTHESIS IN *PAPAVER SOMNIFERUM*
P. J. Facchini and V. De Luca

CONTRIBUTED

ORAL PRESENTATION SESSION V

14:30 - 14:45 Contributed Paper 25-
CDNA CLONING OF A PARTIALLY METHYLATED
FLAVONOL O-METHYLTRANSFERASE
A. Gauthier, P. Gulick & R. Ibrahim

14:45 - 15:00 Contributed Paper 26-
PRENYLATION OF ISOFLAVONES
IS CATALYZED BY DISTINCT
PRENYLTRANSFERASES, AND IS
STIMULATED BY METHYL JASMONATE
IN LUPIN ROOT CELL CULTURES
R. Ibrahim, E. Bleichert, P. Laflamme,
J. Seguin, H. Gagnon, J. Saleeba & P. Gulick

15:00 - 15:30 Coffee break

15:30 - 15:45 Contributed Paper 27-
(+)-PINORESINOL SYNTHASE:

THE FIRST STEREOSELECTIVE
PHENOL COUPLING ENZYME.
L.B. Davin, D. L. Bedgar, H. Wang
and N.G. Lewis

15:45 - 16:00 Contributed Paper 28-
THIS CONIFER DOES HAVE
A FAMILY OF PAL GENES
S. Butland, M. Lam and B. Ellis

16:00 - 16:15 Contributed Paper 29-
RECEPTORS FOR FUNGAL β -GLUCAN
ELICITORS IN CELL MEMBRANES OF SPECIES
OF THE PLANT FAMILY FABACEAE
E. G. Cosio, L. Antelo, M. Feger,
C. Miller and J. Ebel

16:15 - 16:30 Contributed Paper 30-
ISOLATION AND CHARACTERIZATION
OF NEW ANTIFUNGAL PROTEINS IN
TUBERS OF PARTIALLY DOMESTICATED
ANDEAN PLANT SPECIES.
P. Alfonso and E. Cosio

18:00 - 19:00 Social Hour

19:00 - Banquet

Wednesday, August 16

SYMPOSIUM SESSION V

Chair, A. Retnakaran

9:00 - 9:50 Symposium Paper 11-
DIVERSITY AND REDUNDANCY IN THE
CHEMICAL DEFENSE SYSTEMS OF ASPEN.
R. L. Lindroth

9:50 - 10:40 Symposium Paper 12-
THE ROLE OF DEFENSIVE CHEMICALS IN
GRASS-FUNGAL ENDOPHYTE ASSOCIATIONS.
M. R. Siegel and L.P. Bush

10:40 - 11:10 Coffee break

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CONTRIBUTED

ORAL PRESENTATION SESSION VI

Chair, A. Bel

11:10 - 11:25 Contributed Paper 31-
OVIPOSITION STIMULANTS FOR THE
MONARCH BUTTERFLY: FLAVONOL
GLYCOSIDES FROM *ASCLEPIAS CURASSAVICA*
M. Haribal and J. A. Renwick

11:25 - 11:40 Contributed Paper 32-
BIOLOGICAL ACTIVITY OF FLAVONOIDS
FROM *CHROMOLAENA ODORATA*
O. Crescente, W. Henríquez, D. Hidalgo,
A. R. Romero, J.C.Herrera and R. Compagnone

11:40 - 11:55 Contributed Paper 33-
INFLUENCE OF CYCLOHEXIMIDE ON
PHENOLIC COMPOUNDS IN COLUMELLA
OF GERMINATING CANOLA SEEDS
M. Stefanowska-Wronka, M. Kuras,
T. Tykarska & A. Zobel

11:55 - 12:10 Contributed Paper 34-
MONOPHENOL EXUDATION BY
NUPHAR LUTEA SEEDLINGS,
PROVOKED BY LOW NITROGEN SUPPLY
R. Suetfeld

12:10 - 13:00 Lunch

CONTRIBUTED

ORAL PRESENTATIONS SESSION VII

Chair, G. Grant

13:00 - 13:15 Contributed Paper 35-
STERYL FERULATE AND *p*-COUMARATE ESTERS
FROM CORN, RICE AND OTHER CEREALS
R. A. Norton

13:15 - 13:30 Contributed Paper 36-
ANTIBACTERIAL AND PHOTOTOXIC
ACTIVITIES OF AN EXTRACT OF
CHROMOLAENA MORITZIANA (ASTERACEAE)
D.Hidalgo, C. de los Rios, O. Crescente and
A.Caserta.

13:30 - 13:45 Contributed Paper 37-
SIMPLE FLAVONES POSSESSING
COMPLICATED BIOLOGICAL ACTIVITIES

Satoshi Tahara, Hiroyuki Katsuta,
Hirototo Kikuchi & Junya Mizunti

13:45 - 14:00 Contributed Paper 38-
CLAISEN REARRANGEMENTS IN THE
ORGANIC SYNTHESIS OF PRENYL FLAVONOIDS

D. Barron, A. Desfougères,
D. Nougoué-Tchamo and H. Raguenet

14:00 - 14:15 Contributed Paper 39-
NOVEL HIV-INHIBITORY PLANT
PEPTIDES AND PROTEINS

K. R. Gustafson, J. H. Cardellina II,
and M. R. Boyd

14:15 - 14:30 Contributed Paper 40-
PHYTOCHEMICAL DEFENSE AS
MEDIATED BY THE BINOMIAL
ISOENZYMES OF NADH-GLUTAMATE
DEHYDROGENASE

G.O. Osuji, R.G. Cuero, and W.C. Madu

14:30 - 14:45 Contributed Paper 41-
ETHNOBOTANICAL PROSPECTING
FOR BIOACTIVE PHYTOCHEMICALS
FROM BOREAL FOREST PLANTS

R. J. Marles, N. Spence, T. Clavelle,
D. Burns, and L. Monteleone

14:45 - 15:00 Contributed Paper 42
BLACK SPRUCE GROWTH
INHIBITION BY *KALMIA ANGUSTIFOLIA*:
RESOURCE TOXIN HYPOTHESIS

A.U. Mallik

Phytochemical Redundancy in Ecological Interactions

Symposium Paper 1 - Sunday, 9:00

PHYTOCHEMICAL DIVERSITY, ADAPTATION OR RANDOM VARIATION?

May R. Berenbaum and A.R. Zangerl,

Department of Entomology, 320 Morrill Hall,

University of Illinois at Urbana-Champaign, 505 S. Goodwin, Urbana, IL 61801-3795

The tremendous allelochemical diversity of angiosperm plants is due not only to a proliferation of biosynthetic pathways leading to structurally distinct classes of compounds but also to diversification along individual pathways leading to series of biosynthetically related compounds within any given species. The ubiquity of such series has led to speculation that they have adaptive value in defense against herbivores through mechanisms such as analogue synergism, the ability of certain compounds to interfere with the metabolism of structurally related compounds. In the case of furanocoumarins, benz-2-pyrone compounds found principally in Apiaceae and Rutaceae, ample evidence exists for analogue synergism against lepidopterous herbivores of these plants. Moreover, the presence of genetic variation for cytochrome P450-mediated metabolism of these compounds in combination as well as individually supports the idea that insects can respond to selection exerted by combinations of chemicals, as well as to individual compounds, and may thus act in turn as selective agents on combinations of chemicals in plants.

Symposium Paper 2 - Sunday, 10:20

PLANT PHENOLICS AND PHYTOCHEMICAL REDUNDANCY.

Simon Mole, School of Biological Sciences,

University of Nebraska, Lincoln, Nebraska 68588-0118 USA.

Symposium Paper 3 - Sunday, 11:10

THE ROLE OF SECONDARY METABOLITES IN EVOLUTION.

Bruce B. Jarvis, Department of Chemistry & Biochemistry,

University of Maryland, College Park, M.D. 20742 USA.

J. David Miller, Plant Research Centre, Central Experimental Farm, Agriculture Canada, Ottawa, Ontario K1A 0C6.

The role of secondary metabolites in evolution will be examined with the view that they are chemicals released within a system by one component that have evolved to affect other component(s) within the system. Secondary metabolites are a natural outgrowth and consequence of an increase in complexity, and they are a critical part of the chemical glue that holds a system together. An analysis of secondary metabolites from a broad perspective (e.g., genetics, ecology, evolution, etc.), suggests that the nature of secondary metabolism can be viewed as a critical component of an emergent system (ecological) arising from a host interlocking cycles and feedback processes.

Symposium Paper 4 - Monday, 8:30

PHYTOCHEMISTRY OF THE MELIACEAE:

SO MANY TERPENOIDS, SO FEW INSECTICIDES.

Murray B. Isman¹, Shawna MacKinnon², Hideuki Matsuura³, Tony Durst², G.H. Neil Towers³ and John T. Arnason⁴

¹Department of Plant Science, University of British Columbia, Vancouver, B.C., Canada V6T 1Z4.

²Department of Chemistry, University of Ottawa, Ontario Canada K1N 6N5

³Department of Botany, University of British Columbia, Vancouver, B.C., Canada V6T 1Z4

⁴Department of Biology, University of Ottawa, Ontario Canada K1N 6N5

The outstanding biological activity of the C-*seco*-limonoid, azadirachtin, against pest insects, and the emerging commercial success of botanical insecticides derived from the neem tree, *Azadirachta indica* (Meliaceae), for which azadirachtin is the main active ingredient, has provided the impetus to examine other members of the Meliaceae as suitable sources for additional botanical insecticides. Screening members from more than 20 genera in the family for inhibition of larval growth of the caterpillars *Peridroma*, *Spodoptera*, and *Ostrinia*, reveals a number of interesting leads with significant bioactivity.

The Meliaceae are chemically characterized by the production of limonoid-type triterpenes. In most cases, the insect-inhibitory activity can be related to one or more such chemicals. Although more than one hundred such compounds have been isolated and tested on insects, our understanding of structure-activity relations and mode-of-action, is rudimentary, at best. We can, however, now make some preliminary generalizations about the nature of these secondary compounds. First, individual species appear to synthesize *families* of closely related compounds, usually differing by patterns of acetylation or other ester groups alone. Second, the resulting *mixtures* of related compounds may act *synergistically* against a particular target organism, or they may broaden the spectrum of activity. Third, many of the limonoids tested, at least in our bioassays, are inactive against insects at biologically realistic concentrations. However, most of these have not been widely screened against other organisms, e.g., plant pathogens and other microbes. Finally, some of the limonoids, such as azadirachtin, attack unique endocrine targets in insects, and may not, therefore, be detected in common cytotoxicity bioassays (e.g., brine shrimp assay, human cell culture assays). With few exceptions, there are vast differences in efficacy among insect species and between bioassays with different endpoints (e.g., behavioral versus physiological) and between insects and other organisms. At this point, we cannot predict the bioactivity of individual, novel limonoids to insects or other target organisms at our current state of knowledge.

Symposium Abstracts

Symposium Paper 5 - Monday, 9:20

TERPENOID DIVERSITY: INSIGHTS INTO THE ROLE OF CHEMICAL DIVERSITY IN PLANT - HERBIVORE - PATHOGEN INTERACTIONS.

Rex Cates, Chemical Ecology Laboratory, Department of Botany and Range Science, Brigham Young University, 425 WIDB, Provo, UT 84602 USA.

Terpenoids are one of the better understood groups of natural plant products with respect to biosynthesis, occurrence in plants, and their physiological and ecological roles. Regarding their ecological role, multiple selection pressures due to herbivore, pathogen, and plant-plant interactions have resulted in numerous types of variation in their production. These include tissue-dependent induction vs. constitutive production, within-individual variation, among-individual variation, developmental variation within a season, and among-season variation. Monoterpenes are known to facilitate the deployment of other chemical defenses, to function in defense as mixtures and synergistically with primary nutrients, and perhaps lead to resistance due to their absence. Information on terpenoids reinforces the premise that in natural systems variation in defense is the name of the game.

Symposium Paper 6 - Monday, 13:00

RELATIONSHIPS BETWEEN THE DEFENSE SYSTEMS OF PLANTS AND INSECTS, THE CYANOGENIC SYSTEM OF THE MOTH *ZYGAENA TRIFOLII*

Adolf Nahrstedt, Institut für Pharmazeutische Biologie und Phytochemie, Westf. Wilhems-Universität, D-48149 Münster, Germany.

Cyanogenesis is widespread over the plant kingdom and depends on the occurrence of cyanogenic glycosides and degrading enzymes, such as β -glucosidases and hydroxynitrile lyases. The whole system starts working after disruption of the plant's tissue (so-called cyanide bomb) and is considered to be for defense. Cyanogenesis is also realized in insects, in particular in the moth genus *Zygaena*. Many biochemical similarities exist between the moth's and the plant systems, which will be described in detail; differences exist in the regulation of cyanogenesis. Interestingly *Zygaena* larvae not only biosynthesize their cyanogenics but additionally sequester them from their host. Such a system is unique in the relationships between plants and insects.

Symposium Paper 7 - Monday, 13:50

DUAL DEFENSES OF CRUCIFERS AGAINST ADULTS AND LARVAE OF CABBAGE BUTTERFLIES.

J. Alan A. Renwick, Boyce Thompson Institute for Plant Research Ithaca, N.Y. 14853.

The cabbage butterfly, *Pieris rapae* L., is a specialist on crucifers and a few individual species in other plant families that are characterized by the presence of glucosinolates. However, despite the fact that almost all crucifers contain glucosinolates, some species are rejected by butterflies for oviposition and may be unsuitable for feeding by the larvae. Oviposition deterrents and feeding deterrents have been isolated from *Erysimum cheiranthoides* and from *Iberis amara*. These were identified as cardenolides and cucurbitacin glycosides, respectively. However, different insect stages respond differently to specific compounds within these groups. The results suggest that different plant compounds may serve to discourage oviposition and feeding, but some overlap in activity of these defensive compounds also occurs.

Symposium Paper 8 - Monday, 15:00

MODERN BIOASSAY TECHNIQUES FOR THE ISOLATION OF PLANT ALLELOCHEMICALS ACTIVE AGAINST INSECTS.

Pierre Escoubas, Suntory Institute for Bioorganic Research, Mishima-Gun, Shimamoto-Cho, Wakayamadai, Oasaka 618 Japan.

Understanding the chemical nature and roles of plant allelochemicals is key to a better comprehension of their importance in plant-insect interactions, as well as the determination of their potential use as pest-control agents. In the search for new bioactive compounds from plants, bioassay-guided fractionation is the common approach, and a number of techniques, adapted to the visualization of antifeedant, growth-inhibitory or oviposition-repellent activities, have been developed in past decades. In recent years, a number of new or improved techniques have been devised to speed up or improve the accuracy of the isolation process. They include techniques based on TLC-Bioautography, digitalization of leaf surfaces or new delivery methods for the compounds to be tested. A review of the most recent developments in this field will be presented, illustrated by examples of successful identification of anti-insect compounds in African medicinal plants and Japanese or European Lauraceae.

Symposium Abstracts

Symposium Paper 9 - Tuesday, 8:30

SYSTEMIC ACQUIRED RESISTANCE SIGNAL TRANSDUCTION.

Scott Uknes, Eric Ward, Michelle Hunt, Kris Weymann, Danielle Chandler, Sharon Potter, Leslie Friedrich and John Ryals
Agricultural Biotechnology Research Unit, Ciba-Geigy Corporation,
Research Triangle Park, N.C 27709.

Systemic acquired resistance (SAR) has been well-characterized in tobacco and cucumber; however the signal transduction pathway leading to SAR is not well understood. Recently, Arabidopsis was shown to display SAR following infection by pathogens or by treatment with immunization compounds. We have taken two approaches to dissect the signal transduction pathway leading to SAR. First, we isolated mutants of Arabidopsis with constitutive expression of the SAR genes. Plants with constitutive SAR gene expression are resistant to pathogens. Second, the role of salicylic acid (SA) was assessed by engineering transgenic Arabidopsis to produce salicylate hydroxylase. Salicylate hydroxylase converts SA to catechol, a compound that does not induce SAR. Pathogens caused more severe disease symptoms on salicylate hydroxylase plants, implicating a general role for SA in the restriction of disease symptoms.

Symposium Paper 10 - Tuesday, 9:20

MULTIPLE DEFENSES AND SIGNALS IN PLANT DISEASE RESISTANCE.

Ray Hammerschmidt, Department of Botany and Plant Pathology,
Michigan State University, East Lansing, Michigan 48824 USA.

Resistance of plants to pathogens is characterized by the presence of preformed chemical or physical barriers and/or by inducible defenses. The latter is most common, and is thought to be triggered by recognition of the pathogen by the plant. The types of defense responses that often occur include localized hypersensitive host cell death, phytoalexins, cell wall modifications, pathogenesis-related proteins (including lytic enzymes), and the production of active oxygen species. Frequently, an initial pathogen attack results in the systemic development of resistance to a broad range of pathogens. This is known as systemic acquired resistance or SAR. The systemic nature of SAR also suggests that translocated signal or signals are required for the induction of this resistance. Current evidence suggests that more than one signal, as well as multiple defenses, may be involved in the expression of SAR. The nature of these defenses and signals and how the role of each is being evaluated will be discussed in light of work being done on cucumber and Arabidopsis. Comparisons to systemic defense responses to arthropod herbivores will also be made.

Symposium Paper 11 - Wednesday, 9:00

DIVERSITY AND REDUNDANCY IN THE CHEMICAL DEFENSE SYSTEMS OF ASPEN.

R. L. Lindroth, Department of Entomology,
University of Wisconsin, Madison, WI 53706, USA

Quaking aspen is the most widely distributed tree species in North America. A fast-growing, pioneer species, it is subject to attack by a host of organisms, including insects, mammals, birds and fungi. Considerable intraspecific variation exists in resistance to attack, which is related to plant secondary chemistry. The major chemical defense compounds include phenolic glycosides, coniferyl benzoate and condensed tannins, all products of the shikimic acid pathway. Aspen chemistry is influenced by both environmental (e.g., resource availability) and genetic factors, and in turn influences bi- and tri-trophic interactions. Preliminary evidence indicates that strong, negative genetic correlations exist between growth and defense in young aspen trees. The evolutionary success of aspen is likely linked to marked genetic variation in commitment to defense, modified by local differences in resource availability, resulting in a mosaic of chemical types within early successional habitats.

Symposium Paper 12 - Wednesday, 9:50

DEFENSIVE CHEMICALS IN GRASS-FUNGAL ENDOPHYTE ASSOCIATIONS.

M. R. Siegel, Department of Plant Pathology, L.P. Bush, Agronomy
Department, University of Kentucky, Lexington, Kentucky 40546-0091. USA.

The symbiotic associations of seed-borne, ascomycetous fungal endophytes (*Clavicipitaceae*, genus *Epiclloe*) and C3 grasses (*Pooideae*) are important for improved fitness of the hosts. Fitness components include synthesis of secondary metabolites, particularly the pyrrolizidine (loline), ergot, pyrrolopyrazine (paramine), and indole diterpene (lolitrem) alkaloids that confer host tolerance to biotic stresses, such as predation by insect and mammalian herbivores. Although the debilitating symptoms suffered by animals grazing endophyte-infected pasture grasses lead to significant economic losses, the symbioses are ecologically mutualistic. Topics to be discussed include the biology and ecology of the symbiosis and associated multitrophic interactions; chemistry and detection of the alkaloids and their spectrum of biological activity and modes of action; effects of environment, host genotype, and fungal genotype on toxin production; and how manipulations of grass-endophyte symbiota can affect levels of toxins and, hence, spectra of biological activity. Useful manipulation of alkaloid spectra should not affect other fitness enhancements, such as drought tolerance and increased plant growth.

Molecular Biology of Phytochemical Pathways

Mini Symposium Paper 1 - Tuesday, 10:40

POLYPHENOL OXIDASE AS A COMPONENT OF THE INDUCIBLE DEFENSE RESPONSE OF TOMATO AGAINST INSECT HERBIVORES: REGULATION BY WOUNDING, SYSTEMIN AND METHYL JASMONATE

C. Peter Constabel, D.R. Bergey, and C. A. Ryan,

Institute of Biological Chemistry, Washington State University, Pullman, WA, USA 99164-6340.

Tomato plants respond to herbivore damage or wounding with a systemic activation of defensive genes. The mobile wound signal thought to be responsible for this induction is a peptide called systemin. Transgenic tomato plants overexpressing the systemin precursor prosystemin exhibit a constitutively wounded phenotype. Leaves of these plants were shown to contain up to 70-fold higher polyphenol oxidase (PPO) activity than control plants. Treating young wild-type tomato plants with systemin or methyl jasmonate induced increased levels of PPO activity, and wounding of the lower leaf caused an increase in PPO activity in the upper leaf. The induction of PPO activity correlated with elevated levels of PPO protein and PPO mRNA, and generally paralleled the induction of other defensive proteins. The data suggest that PPO is coordinately regulated with other tomato defenses via the octadecanoid pathway, and indicate that systemin has a broader role in wound signaling than was previously known. Supported in part by a fellowship from NSERC (CPC) and grants from the National Science Foundation (CAR).

Mini Symposium Paper 2 - Tuesday, 11:10

QUANTITATIVE RELATIONSHIP BETWEEN PHENYLALANINE AMMONIA-LYASE (PAL) AND PHENYLPROPANOID ACCUMULATION ESTABLISHES PAL AS A MAJOR DETERMINANT OF FLUX INTO THE PHENYLPROPANOID PATHWAY

N. J. Bate: Dept. Mol. Biol. Genetics, University of Guelph, Guelph, Ontario, Canada

Phenylalanine ammonia-lyase (PAL) catalyzes the first reaction in the biosynthesis of a wide variety of phenylpropanoid natural products. Transgenic tobacco that are co-suppressed in PAL gene expression exhibit an instability in PAL suppression in later generations of transgenic plants, thus generating the equivalent of an "allelic series" of plants differing in PAL activity from severely suppressed to near wild-type levels. We have used these plants as tools to analyze the quantitative relationship between PAL activity and phenylpropanoid product accumulation. In leaf tissue, PAL is a major factor regulating accumulation of the soluble phenolic compounds chlorogenic acid and rutin. Similarly, in stem tissue, PAL activity appears to be a major contributing factor toward the accumulation of lignin as indicated by phloroglucinol staining and thioglycolic acid extraction. These data indicate that PAL is a key step in the regulation of overall flux into the pathway and toward the accumulation of major phenylpropanoid products.

Mini Symposium Paper 3 - Tuesday, 11:40

SECONDARY METABOLISM IN *ARABIDOPSIS THALIANA*: FROM MUTANTS TO CLONES.

C. Chapple¹, M. Lorenzen², K. Meyer¹, V. Raciocot³, D. Strack², and J. Cusumano¹

¹Department of Biochemistry/³Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47907.

²Institute für Pflanzenbiochemie, Halle (Salle), Germany

We have begun a systematic study of phenylpropanoid secondary metabolism in *Arabidopsis*. Our overall goal is to dissect this entire pathway using a combination of classical genetics, molecular genetics and biochemical approaches. We have previously reported on the *fab1* mutant of *Arabidopsis* that is blocked in the synthesis of sinapic acid-derived secondary metabolites and syringyl lignin. This mutant is defective in the gene encoding ferulate-5-hydroxylase, a cytochrome P-450 dependent monooxygenase (P450) of the general phenylpropanoid pathway. The difficulty of cloning genes encoding plant P450s make them ideal candidates for the alternative cloning strategies available in *Arabidopsis*. We have used T-DNA tagging to clone the gene for ferulate-5-hydroxylase and are currently studying its structure and regulation. The *smg1* (sinapoyl glucose accumulating) mutant of *Arabidopsis* accumulates sinapoyl glucose in its leaves instead of sinapoyl malate. In the study of this mutant, we have characterized the effect of the mutation on the secondary metabolites accumulated throughout the life cycle of the plant, and characterized the biochemical defect that leads to the phenotype observed in the mutants.

Mini Symposium Paper 4 - Tuesday, 15:15

ISOFLAVONOID BIOSYNTHETIC GENES

N. L. Paiva, Plant Biology Division, Samuel Roberts Noble Foundation, P.O. Box 2180, Ardmore, OK 73402, USA.

We are studying the biochemistry and regulation of isoflavonoid metabolism in alfalfa, particularly the steps leading to the isoflavonoid/pterocarpan phytoalexin medicarpin. We have recently found that what was thought to be the final enzyme in medicarpin biosynthesis, the enzyme described as "pterocarpan synthase", is actually two separate enzymes, vestitone reductase and 7,2'-dihydroxy-4'-methoxy-isoflavanol dehydratase. We have purified and cloned the reductase and found that it is essential in determining the stereochemistry of the final pterocarpan. The promoter region from the gene preceding vestitone reductase, isoflavone reductase, has been isolated and is being used to study the regulation of the medicarpin pathway. Our understanding of medicarpin biosynthesis in alfalfa, along with the genes we have cloned, can now be applied to the manipulation of secondary metabolite levels and structure.

Mini-Symposium Abstracts

Mini Symposium Paper 5 - Tuesday, 15:45

THE SULFATION OF NATURAL PRODUCTS:
BIOCHEMICAL AND MOLECULAR ASPECTS

L. Varin, F. Marsolais, L. Nicolle and M. Richard,
Département de biologie, Université Laval, Ste-Foy, Québec, G1K 7P4

Collective evidence from animal and plant studies suggests that sulfoconjugation plays an important role not only in the detoxification of reactive functional groups but also in modulating the activity of several endogenous metabolites. Research to elucidate the role of sulfated metabolites in plant development and adaptation to stress led to the characterization of a number of sulfotransferases (ST) at the biochemical and molecular level. The results of our studies on the sulfation reaction in *Mimosa pudica* and *Brassica napus* will be presented to illustrate the importance of this enzymatic reaction. *Mimosa pudica* reacts to touch by lowering its leaves. It has been proposed that gallic acid sulfate (PLMF-1) acts as a chemical messenger in this response. We characterized a gallic acid glucoside ST and a PLMF-1 sulfatase, which may be involved in the modulation of PLMF-1 biological activity. We also isolated genes encoding desulfoglucosinolate ST(s) from *B. napus*. We will present the results of our molecular studies on the characterization and expression of these genes in relation to plant development and elicitor treatments.

Mini Symposium Paper 6 - Tuesday, 16:15

MYSTERIES OF THE OPIUM POPPY: MOLECULAR REGULATION
OF ALKALOID BIOSYNTHESIS IN *PAPAVER SOMNIFERUM*

P. J. Facchini and V. De Luca, Institut de recherche en biologie végétale,
Université de Montréal, Montréal, Québec, H1X 2B2

Tyrosine/dopa decarboxylase (TYDC) catalyzes the first steps in tetrahydroisoquinoline alkaloid biosynthesis. In opium poppy two such alkaloids, morphine and sanguinarine, accumulate in shoots and roots, respectively. The TYDC gene family is divided into two groups (represented by TYDC1 and TYDC2) that share less than 75% identity, but that are catalytically similar. *In situ* hybridization analysis reveals that TYDC1-like genes are expressed in root phloem, whereas TYDC2-like genes are expressed mainly in the phloem of stems. Thus TYDC1-like genes appear to be coordinately expressed with other genes specific to sanguinarine biosynthesis, whereas TYDC2-like genes are linked to genes involved in morphine biosynthesis. TYDC genes also exhibit differential and temporal-specific expression in response to fungal elicitors that induce sanguinarine accumulation as a putative phytoalexin. TYDCs may be key defense response genes with a central role much like that of phenylalanine ammonia lyase (PAL) in plant defense. Further characterization of the molecular regulation of alkaloid biosynthesis in opium poppy is in progress.

Abstracts of Oral Contributed Papers

Oral Paper 1* - Sunday, 13:00

DOES MECHANICALLY STIMULATED RAPID GABA SYNTHESIS CONSTITUTE A PLANT DEFENCE AGAINST PHYTOPHAGOUS INSECTS?

Al-Idrissi Ramputh and A. Bown, Department of Biological Sciences, Brock University, St. Catharines, Ontario, L2S 3A1

Glutamate decarboxylase (GAD) is a cytosolic enzyme, which catalyses the decarboxylation of L-Glu to GABA. Recent published and unpublished data demonstrate that GAD is a calmodulin binding enzyme whose activity is stimulated dramatically by increased cytosolic H^+ or Ca^{2+} ion concentrations. Mechanical stimulation is known to elevate cytosolic Ca^{2+} , and mechanical damage to cells will release high concentrations of vacuolar H^+ and Ca^{2+} ions to the cytosol. Consequently GAD activity and GABA synthesis will increase. This increase may represent a plant defence mechanism in which damage resulting from leaf-eating insects stimulates GABA synthesis. GABA is a known inhibitory neurotransmitter. Many organic insecticides are targeted towards GABA receptors in the insect neuromuscular systems. Mechanical damage to soybean leaves resulted in a 1,000% increase in GABA levels within 30 sec. Non-damaging mechanical stimulation resulted in a 400% increase within 30 sec. Larvae of the oblique handed leafroller (*Choristoneura rosaceana*) were grown on artificial diets containing 0, 1 and 10 mM GABA. Results demonstrate a significant decrease in mean body weight, percentage survived, and percentage reaching pupation when GABA is present. The data are consistent with the hypothesis.

Oral Paper 2* - Sunday, 13:15

VOLATILES EMITTED BY CONES AND FOLIAGE OF *PICEA* SPP.

E. G. Brockerhoff¹, J.J. Turgeon², D.A. Lombardo² and G.G. Grant²

¹University of Toronto, Faculty of Forestry and

²Canadian Forest Service, Sault Ste. Marie, Ontario Canada P6A 5M7.

Volatiles from intact cones, and new and old foliage were collected on Porapak, *Q in situ* from *Picea glauca*, *P. mariana* and *P. abies* to assess their potential in host location by cone maggots, *Strobilomyia* spp. (Diptera: Anthomyiidae). Analyses of volatile collections by GC and GC-MS revealed the presence of monoterpenes with only traces of unknown compounds. Relative abundances of terpenes are species specific, which may enable *Strobilomyia* flies to recognize host trees. Only slight quantitative differences were detected between volatiles emitted by cones and new foliage within each species. Differences between these organs and old foliage were greater. However, it appears these within-tree differences in volatiles are of limited use for location of oviposition sites by *Strobilomyia*.

Oral Paper 3* - Sunday, 13:30

FOLIAGE EXTRACTS AND ISOLATED COMPOUNDS FROM DECIDUOUS TREES THAT ARE ACTIVE AGAINST THE FOREST TENT CATERPILLAR (*MALACOSOMA DISSTRIA* HÜBNER).

R.W. Nicol, J.T. Arnason¹, B. Helson² and M.M. Abou-Zaid²

¹Ottawa-Carleton Institute of Biology, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

²Canadian Forest Service, Sault Ste. Marie, Ontario Canada P6A 5M7

The forest tent caterpillar (FTC) is a lepidopteran pest of many deciduous forest trees. Observers in the field have noticed that FTC will avoid red maple (*Acer rubrum* L.) and starve to death before eating this foliage. As the trend today in forestry is pest control via non-traditional methods (i.e., using botanical pesticides, and/or biocontrol), this project was undertaken with the hopes of determining the mechanism(s) of resistance red maple possesses and using this knowledge in an applied way. Extracts and isolated compounds of two host trees (sugar maple and trembling aspen) and one non-host (red maple) were fed to FTC in a life cycle and nutritional indices bioassay. Both maples reduced larval growth and fitness to about the same degree in the life cycle bioassay. Aspen also reduced test parameters but not to the same extent as the maples (larvae continued to grow at all concentrations, 25-200 ppm, whereas they would not grow at the higher concentrations of maple extracts). Nutritional indices revealed that the extracts worked via an antifeedant and toxic mechanism and that two compounds, a phenolic acid and phenolic ester were effective in the same way. Work will continue on the factors causing the potent field deterrence of red maple.

Oral Paper 4* - Sunday, 13:45

CHEMICAL ECOLOGY OF A FRASS BASED DEFENSE

T.C. Morton¹ and F. Vencel², ¹Department of Entomology and ²Department of Neurobiology and Behavior, Penn State University, University Park, Pennsylvania 16802, USA.

Criocerinae (Chrysomelidae) leaf feeding beetles are common in both natural and agricultural systems. Larvae have a dorsally situated anus and accumulate frass to form a fecal shield. This fecal shield is unique among frass based defenses in that host plant chemistry forms the basis of defense. Criocerine species each specialize on different host plant taxa and can incorporate a number of classes of plant secondary compounds into their frass. Hosts with more diverse or noxious chemistries are expected to provide either a better (fewer losses to all predators) or broader (targeted toward specific predators) defense if generalist predators are to drive dietary specialization among herbivorous insects. Preliminary assays with a generalist ant found that host plant chemistry made no difference to defense in spite of differences in chemistry. Current work involves use of a wider array of generalist predators in an attempt to test the predation-specialization hypothesis.

Abstracts of Oral Contributed Papers

Oral Paper 5* - Sunday, 14:00

MECHANICAL STRESS AND ALTERED GROWTH FORM CONDITION RESPONSES OF PLANTS TO PESTS

D. F. Cipollini, Jr., Department of Entomology, Penn State University, University Park, Pennsylvania 16802, USA.

Plants resist or tolerate diverse environmental stressors. Altered peroxidase activity and lignin content are common responses of plants to both mechanical stress and pathogen attack. Such responses may be part of a "generalized stress response" that toughens the plant against further stresses, restricts the movement of pathogens into and within the plant, and/or increases resistance to arthropod herbivores. They also play a role in plant development and resource allocation patterns. I exposed common bean (*Phaseolus vulgaris*) plants to wind and gibberellic acid treatments to determine whether mechanical stress or altered growth form could condition interactions with pests. Peroxidase activity, lignin content, leaf toughness, or overall biomass allocation pattern were altered by both treatments, as were interactions with the two-spotted spider mite, *Tetranychus urticae*, and the fungus, *Colletotrichum lindemutbianum*.

Oral Paper 6* - Sunday, 14:15

INTERACTIONS BETWEEN INSECTS AND PATHOGENS IN SQUASHES, AND THE ROLE OF PLANT CHEMISTRY

P. J. Moran and Jack C. Schultz, Pesticide Research Lab, Department of Entomology, Penn State University, University Park, PA 16802.

Whether or not plants produce similar resistance responses to herbivorous insects and plant diseases is a subject of current debate, in spite of the abundant information about the effects of insects and pathogens in isolation on plants. In squashes, toxic cucurbitacins have been linked to resistance to insects. Enzymes capable of degrading fungal cell walls and killing cells, peroxidases, increase rapidly after inoculation of plants with fungi, bacteria, or viruses. We examined resistance and part of its chemical basis in hybrids of domestic zucchini and the bitter Texas gourd. Insect densities, leaf damage, mildew coverage and number of leaves showing each of four disease symptoms were recorded. Fruit and leaf samples were analyzed chemically for cucurbitacins and peroxidase enzyme activity. Aphids associated positively with plants with mildew, while beetles avoided plants with past damage. Nonsignificant trends included greater numbers of aphids on plants with past damage. Nonsignificant trends included greater numbers of aphids on plants with damage, greater leaf damage on plants with chlorosis on leaves, and higher densities of summed insects on plants with vein clearing. Only petiolar cucurbitacin concentration tended to associate with any insect or disease symptom. Peroxidase enzyme activity tended to be higher in plants with prior leaf damage. Interactions within the exploiter community of these plants appear to be isolated and are not closely related to the plant chemistry measured.

Oral Paper 7* - Sunday, 14:30

PHENOLICS FROM PINE SPECIES: DO THEY PROVIDE PROTECTION FROM VIRAL INFECTION IN LATE INSTAR GYPSY MOTH?

C. W. Beninger and M.M. Abou-Zaid, Canadian Forest Service, Sault Ste. Marie, Ontario Canada P6A 5M7

It has been proposed that non-outbreak populations of gypsy moth feed on pines because phenolics provide protection from nuclear polyhedrosis virus (NPV) infection. Crude phenolic extracts from four pine species (jack, red, scotch, and white pine) common to Canada were obtained and the pure compounds rutin, quercetin, and quercetin-3-O-glucoside (Q30) isolated and identified. Third instar larvae infected with NPV (60,000 PIBs/larva) did not derive any short-term benefit from feeding on artificial diet containing pine extracts (0.1%) based on nutritional indices. However, survivorship for infected 3rd instars was higher at the end of 15 days when feeding on extract from all four pine species. Survivorship to adulthood was significantly greater than the control for infected 3rd and 4th instars which were fed jack pine extract. Quercetin, Q30, and rutin all had significant negative effects on growth of infected 3rd and 4th instars, but there was no significant difference in survivorship for infected larvae fed these pure compounds in diet. Protection from NPV infection may be conferred by one or more phenolic compounds present in pine that remain to be tested.

Oral Paper 8* - Sunday, 14:45

IMPLICATION OF SOLUBLE PHENOLICS IN THE DEFENSE RESPONSE OF SILICON-FED CUCUMBER TO POWDERY MILDEW (*SPHAEROTHECA FULIGINEA*).

A. Fawe, J. Menzies, and R.R. Bélanger, CRH, Laval University, Québec, P.Q. Canada G1K 7P4, PARC, Agassiz, B.C. Canada VOM 1A0

Greenhouse-grown cucumber plants are commonly treated with hydroponic nutrient solutions amended with soluble silicon to reduce diseases caused by pathogens such as *Sphaerotheca fuliginea* and *Pythium* spp. The mode of action of silicon in increasing plant resistance to these diseases is unclear. Recently, evidence was provided for an induction of a multicomponent defense response by silicon in cucumber roots, including an enhanced and precocious accumulation of fungitoxic compounds, which were apparently phenolics. To the best of our knowledge, phytoalexins have not been reported in cucurbits. In this study, we report an accumulation of soluble phenolic compounds in leaves of cucumber plants treated with silicon. Initially, leaves were subjected to a 80% methanol extraction. The aqueous extract was subsequently submitted to a differential extraction of free, ester- and glycosidically-linked phenolics. Chromatographic techniques were used to analyse the chemical composition of the different fractions and to identify the major compounds. Fungitoxicity of the extracts was determined using the *Cladosporium* bioassay. Compared with infected controls, infected plants treated with silicon showed a differential accumulation of several

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compounds normally implicated in the lignification process. This was combined with an enhanced and precocious accumulation of potentially toxic conjugates. These findings suggest that silicon acts by sensitizing the plant to react more quickly when facing a pathogen infection.

Oral Paper 9* - Sunday, 15:30

ANTI-MYCOBACTERIAL CONSTITUENTS FROM *INULA HELENIUM*

C. L. Cantrell¹, S.G. Franzblau² and N.H. Fischer¹, ¹Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana 70803, and ²G.W.L. Hansen's Disease Center, P.O. Box 25072, Baton Rouge, LA 70894, USA

Inula helenium (Asteraceae), commonly known as Elecampane, has been used for centuries in traditional herbal medicine against pulmonary diseases. In North America, several major native Indian tribes (Cherokee, Iroquois and Mohegans) used infusions and decoctions of various parts of this plant for lung disorders and against tuberculosis. In a bioassay-guided search for anti-tuberculosis natural products from higher plants, we have investigated root extracts of *I. helenium* for their activity against *Mycobacterium tuberculosis* and *M. avium*, using a radiorespirometric method. The dichloromethane extracts exhibited significant inhibition of *M. tuberculosis* and *M. avium*. Therefore, a chemical analysis of the root extracts was carried out. The structure of the root constituents will be described and their *in vitro* anti-tuberculosis activities reported.

Oral Paper 10* - Sunday, 15:45

EFFECT OF PURE COMPOUNDS AND EXTRACTS FROM NONHOST PLANTS ON THE GERMINATION OF *STRIGA HERMONTICA* SEEDS

J. K. Rugutt, D.K. Berner* and N.H. Fischer, Department of Chemistry, Louisiana State University, Baton Rouge, Louisiana, LA 70803, *International Institute of Tropical Agriculture, Oyo Road, P.M.B. 5320 Ibadan, Nigeria

The genus *Striga* (Scrophulariaceae) is composed of obligate root parasites, some of which are among the most damaging parasites of cereal and legume crops in Africa (*S. hermonthica* alone is estimated to cause annual losses on cereals of \$7 billion). Rotations with non-host crops that stimulate *S. hermonthica* seed germination and reduce the amount of parasite-seed inoculum in the soil is an effective control measure. However, little has been known about the relative efficacy of nonhost cultivars or the cultivar-specific compounds that stimulate *S. hermonthica* seed germination. Through petri bioassays, we have identified high stimulant producing cultivars and have isolated various pure compounds that stimulate *S. hermonthica* seed germination across a broad concentration range, from 10^{-3} to 10^{-20} M.

Oral Paper 11* - Sunday, 16:00

INVOLVEMENT OF ISOCHORISMATE SYNTHASE IN THE BIOSYNTHESIS OF 2,3-DIHYDROXYBENZOIC ACID IN ELICITED *CATHARANTHUS ROSEUS* CELL SUSPENSION CULTURES

P.R.H. Moreno, L.J. Van Tegelen* & R. Verpoorte, Division of Pharmacognosy, Leiden/Amsterdam Center for Drug Research, Gorlaeus Laboratories, P. O. Box 9502, 2300 RA Leiden, *NOVAPLANT Cell Biotechnology Group, Department of Experimental Botany, University of Nijmegen

Cell cultures of *Catharanthus roseus* are known to increase alkaloid production and to excrete phenolic compounds into the culture medium after elicitation with fungal elicitors. The major phenolic compound produced after elicitation was identified as 2,3-dihydroxybenzoic acid (DHBA). The formation of DHBA in elicited cultures was correlated with the induction of the enzyme isochorismate synthase (ICS). DHBA is synthesised from chorismate in *Aerobacter aerogenes* with isochorismate as an intermediate. Due to its biological activity, DHBA could also play a role in the defence mechanism of *C. roseus*. In order to isolate the gene for ICS from *C. roseus* we are purifying the enzyme from elicited cell suspension cultures. Partial purification of ICS showed the probable presence of at least two isoenzymes. The molecular weight, determined by native PAGE, of the purest enzyme preparation is approximately 100 kD.

Oral Paper 12* - Sunday, 16:15

A NEW APPROACH TO DEFINING REGULATORY PROCESSES IN LIGNIN ASSEMBLY.

P. Heerden, Z.-Q. Xia, M.Nose, M.Bernards and N.G. Lewis
Institute of Biological Chemistry, Washington State University, Pullman, WA 99164-6340, USA.

Modification of lignin deposition is an important biotechnological goal in forestry, agricultural and forage feedstock industries. The approaches utilized thus far have targetted putative rate-limiting steps, and while technologically successful, have no significant effect on lignin deposition. Using *Pinus taeda* lignifying cell cultures, it has been possible to comprehensively examine metabolic flux in the pathway, establish precise relationships between carbon and nitrogen metabolism and during lignification and disrupt lignin synthesis by judicious targetting of co-factors involved in lignin assembly.

Oral Paper 13* - Sunday, 16:30

CHARACTERIZATION OF A HYDROXYLASE INVOLVED IN THE FIRST STEP IN THE BIOSYNTHESIS OF VINDOLINE FROM TABERSONINE.

B. St-Pierre and V. de Luca, Institut de Recherche en Biologie Végétale, Université de Montréal, 4101 est, rue Sherbrooke, Montréal (Québec) Canada H1X 2B2.

Hydroxylation at the C-16 position of the indole alkaloid tabersonine has been suggested as the first step toward vindoline biosynthesis in *Catharanthus roseus*. Tabersonine 16-hydroxylase (16-OH) activity was

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detected in total protein extracts from young leaves of *C. roseus* using a coupled assay system. Enzyme activity was dependent on NADPH and molecular oxygen, and was inhibited by CO, clotrimazole, miconazole and cytochrome C. 16-OH was localized to the endoplasmic reticulum by linear sucrose density gradient centrifugation. These data suggest that 16-OH is a cytochrome P450-dependent monooxygenase. In agreement with the developmental regulation of vindoline biosynthetic pathway, the 16-OH is found in young leaves of the intact plant and is developmentally and light regulated in germinating seedlings. However, in contrast to enzymes which catalyze the last four steps of vindoline biosynthesis, enzymes responsible for the first two steps from tabersonine (16-OH and 16-O-methyltransferase) were detected in *C. roseus* cell suspension cultures.

Oral Paper 14* - Sunday, 16:45

MOLECULAR CLONING AND CHARACTERIZATION OF A 2-OXOGLUTARATE DEPENDENT DIOXYGENASE INVOLVED IN VINDOLINE BIOSYNTHESIS

F. Vázquez-Flota, E. de Carolis, A.M. Alarco and V. de Luca
Institut de Recherches en Biologie Végétale, Université de Montréal,
4101 est rue Sherbrooke, Montréal, Québec Canada. H1X 2B2

The 2-oxoglutarate dependent hydroxylation of the indole alkaloid desacetoxvindoline has been demonstrated to be the second to last step in the biosynthesis of vindoline, which is a direct biosynthetic precursor of the antineoplastic dimeric indole alkaloids vinblastine and vincristine. cDNA clones for the enzyme catalyzing this reaction have revealed extensive amino acid sequence homologies with other 2-oxoglutarate dependent dioxygenases, such as ethylene forming enzyme from tomato and hyoscyamine 6-hydroxylase from henbane suggesting a common evolutionary origin of this class of dioxygenase. Southern blot analysis revealed that this hydroxylase is a single copy gene, whereas Northern blot analysis showed that the regulation of this gene is under tissue-, environment- and development-specific controls. Details of these results will be presented.

Oral Paper 15* - Sunday, 17:00

THE MOLECULAR CONFORMATIONS AND DYNAMICS OF HELENALIN
T.J. Schmidt¹, D. Vargas² and N.H. Fischer¹, ¹Department of Chemistry,
and ²College of Basic Sciences, Louisiana State University, Baton Rouge, LA
70803, U.S.A.

The sesquiterpene lactone (STL) helenalin, found in several species of the Asteraceae, has been shown to be one of the most active STL in a wide variety of biological testing systems. It has been speculated that besides the presence of reactive sites susceptible to Michael additions with biological nucleophiles, the steric orientation of these centres, i.e., the molecular conformation, might be of importance with respect to bioactivity [1].

Molecular Mechanics calculations of helenalin indicated that the activation barriers between three possible stable conformations (2 twist chair and 1 twist boat conformation) of the cycloheptane ring should be very small (∞ 5 kcal/mol), indicating that at ambient temperature a mixture of conformations should be present in solution. Careful analysis of the ¹H-NMR- and 2D NOESY spectra as well as variable temperature NMR-experiments showed that at least two of the three possible conformations are indeed present in solution. A quantitative analysis of the equilibrium conditions as well as results of investigations on further related STL and possible implications on structure activity relationships within this group of compounds will be given.

[1] Willuhn, G.:Dtsch. Apotheker Ztg. 127, 2511 (1987).

Oral Paper 16* - Sunday, 17:15

CHORISMATE UTILIZING ENZYMES AND TERPENOID INDOLE ALKALOID BIOSYNTHESIS.

R.J.M. Bongaerts¹, M.S. Scheffers¹, J.H.C. Hoge², R. Verpoorte¹
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Leiden University, Gorlaeus Laboratories, P.O. Box 9502, 2300 RA Leiden,
The Netherlands ²Institute of Molecular Plant Sciences, Leiden University,
Clusius Laboratory

Availability of L-tryptophan is important for the biosynthesis of terpenoid indole alkaloids in *Catbaranthus roseus*. Anthranilate synthase (AS; EC 4.1.3.27) and chorismate mutase (CM; 5.4.99.5) respectively catalyze the first reactions leading from chorismate to L-tryptophan, and L-phenylalanine/L-tyrosine biosynthesis. Regulation at the chorismate branchpoint has our interest. After purification and characterization of AS (1), we started the isolation of AS genes. Complementation of an *Escherichia coli* deletion mutant defective for AS led to the isolation of a positive cDNA clone. Sequence analysis showed low homology with AS from *Arabidopsis thaliana*. Further analysis is in progress. Two chorismate mutase isoforms have been purified from plant cell cultures of *C. roseus*. CM-1 activity is inhibited by L-phenylalanine and L-tyrosine, and dominantly stimulated by L-tryptophan, while CM-2 is not influenced by these aromatic amino acids. The apparent molecular mass of the purified CM-1 is 44 kDa, as determined by gel filtration.

1 Poulsen *et al.*, Eur. J. Biochem. 212 (1993) 431-440.

Oral Paper 17 - Monday, 10:30

VARIATION AND GENETIC CONTROL OF VOLATILE TERPENES
IN UPLAND COTTON (*GOSSYPIUM HIRSUTUM* L.)

A.A. Bell and R.D. Stipanovic, USDA, ARS, Southern Crops Research
Laboratory, 2765 F&B Road, College Station, TX 77845;
and H.J. Williams, Department of Entomology, Texas A&M University,
College Station, TX 77843.

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Volatile terpenes of *Gossypium* species are localized in the lysigenous pigment glands that distinguish the tribe Gossypieae. Concentrations of the terpenes are greatest in very young leaves and bolls (ovaries). Texas race stocks of *G. hirsutum* L. that show resistance to insects or are used in folk medicine were surveyed for volatile terpenes. Only β -ocimene occurred in all race stocks. The survey and genetic studies indicated that separate single genes (and probably terpene cyclases) control the synthesis of 1) myrcene; 2) α - and β -pinene and limonene; 3) α - and γ -terpinene and 2 unknowns; 4) caryophyllene, caryophyllene oxide, and humulene; 5) γ -bisabolene and β -bisabolol; 6) α - and β -selinene, 7) aromadendrene and spathulenol and 8) 2 unknown sesquiterpenes. Manipulation of these genes may be useful to control pests and diseases of cotton.

Oral Paper 18 - Monday, 10:45

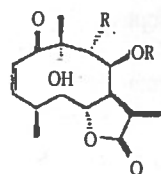
GERMACRANOLIDES FROM *NEUROLAENA COBANENSIS* AND THEIR ACTIVITIES AGAINST *SPODOPTERA LITTORALIS*

C.M. Passreiter¹, B. Schwarz², P. Proksch², P. Moreno³, B. Medinilla⁴ and R. Velasquez⁴

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³Facultad de Agronomia, ⁴Escuela Farmacia, Facultad de CCQQ y Farmacia, Universidad de San Carlos de Guatemala, Ciudad Guatemala



	R ¹	R ²
1	H	ival
2	Oac	ival
3	Oival	H
4	H	ival
5	Oac	5-OH-tig

Recently we reported on the sesquiterpene lactones of *Neurolaena lobata* [1], commonly used as a medicinal plant in Central America.

We now report on the isolation and spectroscopic identification (GC-MS, ¹H-NMR) of the germacranolides 1-5 as constituents of the leaves of *N. cobanensis*.

For neurolenin B (2) and a mixture of neurolenin C (3) and D (4) we could show an antifeedant activity against neonates of *Spodoptera littoralis*, Lepidoptera, Noctuidae (ED₅₀: 0.53 and 0.21 μ mol/g diet, respectively, LD₅₀: 1.49 and 1.95 μ mol/g diet, respectively).

[1] C.M. Passreiter, D. Wendisch and Condol (1995) *Phytochemistry*, in press.

Oral Paper 19 - Monday, 11:00

TISSUE CULTURE PRODUCTION OF CUCURBITACINS

Dr. F. T. Halaweish, Dept of Pharmacognosy, Faculty of Pharmacy, Univ. of Mansoura, Mansoura, Egypt,

D. W. Tallamy, Dept. of Entomology and Applied Ecology, University of Delaware, Newark, DE 19717 - 1303 USA

Cucurbitacins have been used recently as a semiochemical bait for diabroticite control [cornroot worm adults]. They have also shown a unique pattern of cytotoxicity to renal tumors and melanoma cell line. A principal constraint hindering large-scale application of bait and anticancer activities is the lack of economically attractive cucurbitacin sources. Trials have been made to produce cucurbitacins by tissue culture to overcome low-yield and costly extraction from cucurbits. Suspension culture of *Cucurbita andreana* as well as other species of cucurbits (Family Cucurbitaceae) have been established on Murashige & Skoog media with a variable levels of phytohormones and carbon sources. Several growth promoting as well as media manipulation have been studied. Cucurbitacins were estimated in the liquid medium as well as in the tissues.

Oral Paper 20 - Monday, 11:15

INTERACTION OF VISUAL AND CHEMICAL CUES IN HOST EXTRACT RESPONSES OF A DIURNALLY OVIPOSITING MOTH, *CHORISTONEURA FUMIFERANA* (LEPIDOPTERA: TORTRICIDAE).

G.G. Grant and D. Langevin, Canadian Forest Service, P.O. Box 490, Sault Ste. Marie, Ontario, Canada P6A 5M7.

In dual-choice bioassays, oviposition by the spruce budworm, *C. fumiferana*, was stimulated by a nonpolar fraction and deterred by a polar fraction of homogenated, coniferous host extracts applied to white filter paper substrate. The interpretation of these responses was confounded by the colors and visual contrast imparted by these fractions to the substrate. Bioassays comparing colored paper substrates of different hue and intensity (without host extract) showed that females preferred light-colored substrates over dark-colored substrates. However, responses to both stimulating and deterring extract fractions were unchanged when control substrates were dyed to match extract colors, suggesting that chemical stimuli rather than visual cues were responsible for female responses. But when extract fractions were applied to black filter paper, or when ovipositing females were maintained in continuous dark, responses to some fractions were altered, suggesting some involvement of visual cues.

Oral Paper 21 - Monday, 11:30

PROTECTION OF COTTON LEAF TISSUE FROM SUNLIGHT-ACTIVATED TOXICITY OF ITS OWN PHYTOALEXIN BY RED EPIDERMAL CELLS

M. Essenberg, W. Edwards, A. R. Rowlan, K. Willis, T. Barfield-Schneider, and J. A. Hall, Dept. of Biochemistry & Molecular Biology, Oklahoma Agricultural Experiment Station, Oklahoma State University, Stillwater, Oklahoma 74078-0454, USA.

The sesquiterpene phytoalexin 2, 7-dihydroxycadalene (DHC) has photoactivated toxicity toward both bacteria and cotton leaf tissue. During the hypersensitive resistance response, a ring of red epidermal

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cells appears surrounding infection sites. In leaves of a cultivar in which some epidermal cells of healthy leaves are red, infiltration with DHC and exposure to sunlight resulted in fewer dead palisade cells per overlying red epidermal cell than dead palisade cells per colorless epidermal cell. Red epidermal cells exhibited several fold higher UV-visible absorbance at wavelengths responsible for DHC photoactivation than did colorless epidermal cells (R.G. Fulcher, Univ. of Minnesota). The principal red pigment has been isolated and identified by UV-visible absorbance, 1D and 2D and ^{13}C NMR spectroscopy, and carbohydrate analysis as the anthocyanin cyanidin-3- β -glucoside. We suggest that the red epidermal cells surrounding infection sites protect underlying leaf cells from phytoalexin toxicity by acting as light filters.

Oral Paper 22 - Monday, 11:45

PHYTOCHEMICAL REDUNDANCY IS EXPLAINED BY THE JONES-FIRM MODEL OF SECONDARY CHEMICAL DIVERSITY

R.D. Firm and C.G. Jones, Department of Biology, University of York, UK and IES, Millbrook, N.Y.

Any chemical structure has a very low probability of possessing high biological activity. This statement is verified every time an attempt is made to find a new drug, pesticide or biocide. Thus any organism (microbe, plant or animal) seeking to make and exploit the biological properties of a molecule must possess a means of generating chemical diversity repeatedly (as in the case of the immune system in higher animals) or generating and retaining chemical diversity (as postulated by Jones and Firm (1991) for microbes and plants). If most chemical structures are biologically inactive, the generation of massive chemical diversity in compensation necessarily results in massive "redundancy". In the immune system, the redundant chemicals (antibodies that do not recognise the antigen) are not retained because by using the infinite structural variety so easily and rapidly produced by polypeptide synthesis, new chemical diversity is always readily available. In microbes and plants, it is proposed (Jones & Firm, 1991) that redundant chemicals are retained in order to maintain the chemical diversity which is necessary in order to generate new chemical structures.

Jones C.G. and Firm R.D. (1991) Phil Trans Roy Soc. Lond. B333, 273-280.

Oral Paper 23 - Monday, 15:50

HYDROXAMIC ACID CONTENT AND PLANT DEVELOPMENT OF MAIZE IN RELATION TO DAMAGE CAUSED BY THE WESTERN CORN ROOTWORM

R. A. Assabgui,¹ R.I. Hamilton² and J.T. Arnason¹. ¹Ottawa-Carleton Institute of Biology, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5; ²Plant Research Centre, Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada K1A 0C6.

Biweekly variation in root hydroxamic acid content, as determined by high-pressure liquid chromatography, was compared with field resistance

of 4- to 16-week-old maize plants. The phytochemical analysis showed that the highest concentrations of DIMBOA equivalents, HMBOA and total hydroxamic acids were found in 6- and 10- week old maize root extracts for the inbred with low and high susceptibility, respectively. In field trials, the inbred with low susceptibility suffered maximal root damage 8 weeks post infestation, followed by a rapid and pronounced recovery. Damage to the root system of the inbred with high susceptibility rose rapidly throughout the growing season, reaching a maximum 12 weeks post infestation, followed by minimal recovery. Plant morphological factors were unaffected. The concentration of hydroxamic acids in the root systems of maize plants plays a role in resistance to western corn rootworm larvae under field conditions.

Oral Paper 24 - Monday, 16:05

CYANOGENESIS IN *TURNERA ULMIFOLIA* L. (TURNERACEAE): MEDIATING INTERACTIONS ON MULTIPLE LEVELS.

P.I. Schappert and J.S. Shore, Dept. of Biology, York University, 4700 Keele St., North York, Ontario, Canada, M3J 1P3.

Turnera ulmifolia, a Neotropical shrub, exhibits quantitative genetic variation for cyanogenesis as a result of differences in the quantity of cyanogenic glycosides possessed by plants. Seedlings have significantly higher levels of cyanogenesis than mature plants in largely acyanogenic populations on Jamaica, but this age-specific variation is absent in predominately cyanogenic populations. Developmental loss of cyanogenesis is correlated with earlier maturation (indicated by the onset of flower production) of acyanogenic morphs. *Euptoieta begesia* (Lepidoptera, Nymphalidae), a specialist herbivore, exhibits elevated levels of cyanogenesis, and indications are that it is partially protected from Anolis predators, when reared on cyanogenic morphs.

Oral Paper 25 - Tuesday, 14:30

cDNA CLONING OF A PARTIALLY METHYLATED FLAVONOL O-METHYLTRANSFERASE

A. Gauthier, P. Gulick & R. Ibrahim, Plant Biochemistry Lab, Department of Biology, Concordia University, Montréal, Canada H3G 1M8.

In order to investigate the molecular basis of position-specificity of the O-methyltransferases (OMTs) involved in the stepwise O-methylation of quercetin in *Chrysosplenium americanum* (Phytochemistry 26:1237, 1987), we have obtained six categories of cDNA clones with high similarity to other plant OMTs. These clones have > 90% similarity at the amino acid level. A representative cDNA clone of one of the categories was expressed in *E. coli*, using the pTRC-His vector, and exhibited strict specificity for positions 3' and 4' of tri- and tetra-O-methyl derivatives of quercetin, respectively. The characterization of this OMT cDNA clone as well as the ORF product will be presented and discussed. Other clones are currently being investigated.

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Oral Paper 26 - Tuesday, 14:45

PRENYLATION OF ISOFLAVONES IS CATALYZED BY DISTINCT PRENYLTRANSFERASES, AND IS STIMULATED BY METHYL JASMONATE IN LUPIN ROOT CELL CULTURES

R. Ibrahim, E. Bleichert, P. Laflamme, J. Seguin, H. Gagnon, J. Saleeba & P. Gulick, Plant Biochemistry Laboratory, Department of Biology, Concordia University, Montreal, Canada H3G 1M8

Isoflavone prenyltransferases (PTs) are integral membrane proteins that are stabilized by their endogenous substrates. Their solubilization by detergents and the removal of contiguous membrane lipids contribute to their instability and, therefore, they are difficult to purify. Attempts made towards their partial purification will be discussed, with regard to the characterization of two distinct PT activities with specificity for positions 6 & 3' of isoflavones. In addition, the stimulating effect of methyl jasmonate treatment on isoflavonoid prenylation will be described in relation to further purification of PTs.

Oral Paper 27 - Tuesday, 15:30

(+)-PINORESINOL SYNTHASE: THE FIRST STEREOSELECTIVE PHENOL COUPLING ENZYME.

L. B. Davin, D. L. Bedgar, H. Wang and N.G. Lewis.

Institute of Biological Chemistry, Washington State University, Pullman WA 99164-6340, USA.

Lignans are a widespread group of plant metabolites with important roles in nutrition, health, ecological interactions and plant physiology. Of these diverse metabolites, the most abundant are the 8,8'-linked representatives. The enzyme catalysing entry into this diverse group of metabolites, trivially called (+)-pinoresinol synthase, has been purified to apparent homogeneity. It is an oxidase of M.W. 80 kD, and catalyses the first known example of stereoselective coupling in phenolic metabolism. Its properties, including mode of catalysis, are described.

Oral Paper 28 - Tuesday, 15:45

THIS CONIFER DOES HAVE A FAMILY OF PAL GENES

S. Butland, M. Lam and B. Ellis, Department of Plant Science, University of British Columbia, Vancouver, B.C., Canada, V6T 1Z4.

In angiosperms, phenylalanine ammonia-lyase (*pal*) is encoded by families of 2 to 50 genes, depending on the species, but in *Pinus taeda*, (the only gymnosperm for which *pal* sequence has been published), *pal* has been reported to exist as a single gene. This implies that *pal* may be regulated differently in gymnosperm and angiosperm species. We have isolated four different *pal* sequences from *Pinus banksiana* megagametophyte genomic DNA, using degenerate PCR primers designed to recognize sequences conserved among all known plant *pal* genes. All four *P. banksiana* loci

lack the intron that has been universally found in *pal* genes in angiosperms. Three of the nucleotide sequences are 99% identical to the corresponding sequences obtained from *P. banksiana* DNA isolated from cell suspension culture which had been maintained for over five years. We are investigating the expression pattern of all four loci in different tissues and developmental stages. The existence of a family of at least four *pal* genes in *P. banksiana* suggests that the organization of *pal* genes in gymnosperms may not be radically different from that in angiosperms.

Oral Paper 29 - Tuesday, 16:00

RECEPTORS FOR FUNGAL β -GLUCAN ELICITORS IN CELL MEMBRANES OF SPECIES OF THE PLANT FAMILY FABACEAE

E. G. Cosio, L. Antelo, M. Feger, C. Miller and J. Ebel

Centro Nacional de Biotecnología, C.S.I.C., E-28049 Madrid, Spain and Botanisches Institut der Universität München, Munich, Germany

(1-3, 1-6)- β -Glucans are characteristic structural components of the mycelial walls of most fungi. The interaction of phytopathogenic fungi such as *Phytophthora* spp. with plant tissues results in the release of significant quantities of these compounds as part of the growth process of the fungus and the action of plant hydrolytic enzymes. This makes them useful markers for a potential pathogen in plant defense responses. The identification of a putative receptor for a hepta- β -glucoside elicitor in soybean served as an incentive for a search for similar proteins in other species of the Fabaceae. Of the species screened, we found high-affinity binding in membranes of peas, lupins and french beans. All displayed high affinity ($K_d > 30$ nM) for fungal- β -glucan. The presence of putative receptor correlated well with isoflavonoid phytoalexin accumulation in response to β -glucan in tissues of these plants. The characterization of these proteins and the strategies for their purification and cloning are described.

Oral Paper 30 - Tuesday, 16:15

ISOLATION AND CHARACTERIZATION OF NEW ANTIFUNGAL PROTEINS IN TUBERS OF PARTIALLY DOMESTICATED ANDEAN PLANT SPECIES.

P. Alfonso and E. Cosio. Centro Nacional de Biotecnología, C.S.I.C. 28049, Madrid, Spain

Plants are equipped with an array of constitutive antifungal and antimicrobial compounds. These types of defenses are especially important for underground storage or propagation organs such as tubers or bulbs. These are highly exposed to infection by pathogens due to their high water content and slow metabolism during their latency period. We have investigated the occurrence of antifungal proteins in tubers of subsistence Andean crop species. The main objective is to attempt to identify potential candidates for use against human pathogens. Activity against *Candida albicans* has been found in a low molecular weight fraction ($6000 > M_r > 3000$) extracted from tuber cell walls using 1.5M $(NH_4)_2SO_4$

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and partially purified by hydrophobic interaction chromatography. Medium term aims are to sequence these proteins and initiate mode of action studies.

Oral Paper 31 - Wednesday, 11:10

OVIPOSITION STIMULANTS FOR THE MONARCH BUTTERFLY:
FLAVONOL GLYCOSIDES FROM *ASCLEPIAS CURASSAVICA*

M. Haribal and J. Alan A. Renwick, Boyce Thompson Institute
at Cornell University, Tower Road, Ithaca, New York 14853 USA

The monarch butterfly *Danaus plexippus* oviposits on milkweed plants, primarily within the family Asclepiadaceae. Oviposition stimulants responsible for host plant recognition were isolated from *Asclepias curassavica*. Six flavonoid glycosides - quercetin 3-O-(2',6'- α -L-dirhamnopyranosyl)- β -D-galactopyranoside (1a), quercetin 3-O- β -D-glucopyranosyl-(1->6)- β -D-galactopyranoside (2), quercetin 3-O-(2'-O- α -L-rhamnopyranosyl)- β -D-galactopyranoside (3), quercetin 3-O- α -L-rhamnopyranosyl-(1->6)- β -D-glucopyranoside (6), quercetin 3-O- β -D-galactopyranoside (7), quercetin 3-O- β -D-glucopyranoside (8), and an unidentified flavonoid mixture (4 and 5) were isolated and characterized from this plant. An additional glycoside, possibly quercetin 3-O-(2',6'- α -L-dirhamnopyranosyl)- β -D-glucopyranoside (1b), which could not be separated from compound 1a, was also found in some batches of plant extract. Compounds 1 (mixture of 1a + 1b), 1a, 2 and 6 were found to be active as oviposition stimulants at 0.5 gram leaf equivalents.

Oral Paper 32 - Wednesday, 11:25

BIOLOGICAL ACTIVITY OF FLAVONOIDS
FROM *CHROMOLAENA ODORATA*

Q. Crescente¹; W. Henríquez¹; D. Hidalgo²; A. R. Romero³;
J.C. Herrera, ³; R. Compagnone⁴.

¹Dept. Química, Universidad de Oriente Cumaná.

²Dept. Química, Universidad de Los Andes, Mérida.

³Dept. Química, Universidad Simón Bolívar, Caracas,

⁴Dept. de Química, Universidad Central de Venezuela, Caracas, Venezuela.

Chromolaena odorata is a plant with a wide ethnobotanical use in Venezuela. A dichloromethane extract of its leaves was evaporated, and the resulting gum was chromatographed over a silica column monitoring the biological activity of each fraction with antibiosis and *Artemia salina* bioassays. Further separation of each fraction afforded 5, 7-dihydroxy-4'-methoxy, 6-hydroxy-5, 7,4'-trimethoxy, and 5, 7,4'-trihydroxy-6-methoxy flavanones. The elucidation of their structure was done using spectroscopic techniques and GC/MS.

Oral Paper 33 - Wednesday, 11:40

INFLUENCE OF CYCLOHEXIMIDE ON PHENOLIC COMPOUNDS
IN COLUMELLA OF GERMINATING CANOLA SEEDS

M. Stefanowska-Wronka¹, M. Kuras¹, T. Tykarska¹, A. Zobej²

1) Instytut Eksperymentalnej Biologii Roslin UW. 00-927 Banacha;
Warszawa, Poland.

2) Department of Chemistry, Trent University, Peterborough, Ontario
K9J 7B8

The re-appearance of phenolic compounds during inhibition is connected with biosynthesis of DNA, RNA, proteins, and starch, restoration of endoplasmic reticulum. Using phenolic compound inhibitor and protein biosynthesis inhibitor we showed that the production of phenolic compounds proceeded independently of the biosynthesis of proteins. In the second stage of germination (20 h to 48 h), no production of phenolic compounds was observed, suggesting the existence of 2 phases of phenolic compound biosynthesis during breakage of seed dormancy in *Brassica*: primary phase when phenolic compounds are synthesized from pre-existing precursors and second phase (after 20 h) when new matrices of RNA were used.

Oral Paper 34 - Wednesday, 11:55

MONOPHENOL EXUDATION BY *NUPHAR LUTEA* SEEDLINGS,
PROVOKED BY LOW NITROGEN SUPPLY

R. Suetfeld, Max-Planck-Institut f. Limnologie,
Postfach 165, D-24302 Ploen, Germany

In comparison to terrestrial plant research, investigations into aquatic macrophytes yielded unsatisfactory results only with regard to the excretion (exudation) of secondary natural products. A recent kinetic study, however, gave evidence for the exudation of, supposedly, (poly)phenolic compounds from *Nuphar lutea* seedlings (Suetfeld, 1993). Axenically grown seedlings were cultivated in nutrient solutions resembling natural lake water and also in nitrate-enriched solutions. With this, a dramatic change of the pattern of exuded compounds was observed. One of the compounds, a major monophenolic derivative, exhibited unusual HPL-chromatographic properties. Its isolation and analysis will be demonstrated and the role of *Nuphar* exudation products will be discussed.

Suetfeld, R., Exudation of UV-Light Absorbing Natural products by Seedlings of *Nuphar lutea*. Chemoecology 4, 108-114 (1993).

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Oral Paper 35 - Wednesday, 13:00

STERYL FERULATE AND *p*-COUMARATE ESTERS
FROM CORN, RICE AND OTHER CEREALS

R. A. Norton: USD-ARS, NCAUR, Mycotoxin Research, Peoria, IL 61604.

Esters of sterols and ferulic or *p*-coumaric acids are found, among others, in seeds of corn, wheat, rye, triticale and rice. Because the cinnamic acid derivative (CAD) moiety can occur as both *cis* and *trans* isomers, and can be esterified to a range of plant sterols and at least two CADs, HPLC separation of this group is challenging. Separation of the *trans* forms of more than 16 of these compounds by HPLC has been accomplished using acetonitrile:*n*-butanol:acetic acid:water (94:3:2:1) with a reverse phase C₁₈ column. And retention times, relative to ergosterol and cholesteryl cinnamate, have been derived. Sitosteryl, sitostanyl, stigmasteryl, campesteryl, campestanil and Δ^7 -sitosteryl and Δ^7 -campesteryl ferulates have been identified in corn bran. The ferulates of cycloartenol, 24-methylene-cycloartenol, cyclobranol, sitosterol, sitostanol, campesterol and campestanol have been identified in rice bran and *r*-oryzanol. Use of a diol column allows fast screening of crude hexane extracts for this group of compounds and has allowed the identification of these compounds in *Tripsacum dactyloides*, *Andropogon gerardi*, *Bothriochloa bladhii*, and *B. ischaemum*; indicating a wider distribution for this group of lipids than previously reported.

Oral Paper 36 - Wednesday, 13:15

ANTIBACTERIAL AND PHOTOTOXIC ACTIVITIES OF
AN EXTRACT OF *CHROMOLAENA MORITZIANA* (ASTERACEAE)

*D.Hidalgo, *C. de los Rios, **O. Crescente and **A.Caserta.

*Universidad de Los Andes. Facultad de Ciencias Depto. de Quimica, Mérida Venezuela. **Universidad de Oriente. Facultad de Ciencias. Escuela de Quimica. Cumapá, Venezuela.

Chromolaena moritziana was selected for this study because some botanical species related to it have been screened for their antimicrobial activity, such as *C. odorata*, which is being used in folk medicine against skin diseases; its antibacterial activity has been reported. Ground and dried leaves of *C. moritziana* were extracted with 80% aq. MeOH. The extract was evaporated under reduced pressure until only H₂O remained. The aqueous layer was extracted successively with *n*-hexane, CH₂Cl₂ and EtOAc. The aqueous residual extract was evaluated for its chemical components and antibacterial and phototoxic activities. After it was chromatographic over LH-20 column using MeOH as solvent, this extract yielded two flavonoid glycosides, rutin and quercetin-3-di-glucoside. The antibacterial and phototoxic activities were determined by agar diffusion method using a disk as reservoir and Arnason's method respectively. The aqueous extract of *C. moritziana* was tested against *E. coli*, *P. aeruginosa*, *S. typhi*, *S. aureus* and *B. cereus*. The extract shows antibacterial activity against

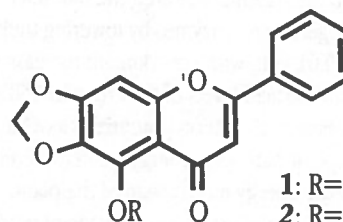
S. aureus and phototoxic activity against *B. cereus* after being exposed 6 h under UV irradiation. The results suggest that the aqueous extract of *C. moritziana* can be used as anti-infectious agent.

Oral Paper 37 - Wednesday, 13:30

SIMPLE FLAVONES POSSESSING COMPLICATED BIOLOGICAL ACTIVITIES

Satoshi Tahara, Hiroyuki Katsuta, Hiroto Kikuchi and Junya Mizutani,
Department of Applied Bioscience, Faculty of Agriculture, Hokkaido University, Kita-ku, Sapporo 060, Japan

Cochliophilin A (**1**) has been isolated from the host plant roots as a potent attractant for the zoospores of *Aphanomyces cochliformis*, a causal fungus of root rot disease of spinach. The chromosorb W A W particles (80-100 mesh) coated with 0.1-1 nM solution of **1** showed a clear attracting activity toward the zoospores suspended in water. Another simple flavone 5-methoxy-6,7-methylenedioxyflavone (**2**) structurally closely related to **1** has been identified in Polygonaceae as an antidote to benzimidazole fungicides, which are believed to suppress the development of numerous fungi by inhibiting cell division when they bind to beta-tubulin. The structure-activity relationships of these flavones and mode of action will be briefly discussed.



Oral Paper 38 - Wednesday, 13:45

CLAISEN REARRANGEMENTS IN THE ORGANIC
SYNTHESIS OF PRENYL FLAVONOIDS

D. Barron, A. Desfougères, D. Nougoué-Tchamo and H. Ragueneau,
Plant Biochemistry Laboratory, Claude Bernard University, Lyon, France and
Pharmacognosy Laboratory, Joseph Fourier University, Grenoble, France.

Reports on the natural occurrence of prenyl flavonoids in the plant kingdom are appearing with increasing frequency. Those compounds display a number of biological activities, among which are significant antifungal properties. Another attractive access to prenyl flavonoids is represented by their chemical synthesis. Among the methods for the introduction of C-prenyl aromatic substituents Claisen rearrangements usually give rise to the best yields. Selected applications of *ortho* and *para* Claisen rearrangements in the synthesis of prenyl flavones, flavonols, isoflavones and chalcones will be presented. Some aspects of their NMR identification will be discussed.

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Oral Paper 39 - Wednesday, 14:00

NOVEL HIV-INHIBITORY PLANT PEPTIDES AND PROTEINS

K. R. Gustafson, J. H. Cardellina II, M. R. Boyd,

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National Cancer Institute, NCI-FCRDC, Bldg. 1052, Rm 121, Frederick,
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Anti-HIV natural products screening and drug development efforts at the U.S. National Cancer Institute have led to the isolation and identification of several new classes of HIV-inhibitory proteins and peptides. Bioassay-guided isolation, purification, structural characterization, and anti-HIV properties of selected amino acid based plant metabolites will be described.

Oral Paper 40 - Wednesday, 14:15

PHYTOCHEMICAL DEFENSE AS MEDIATED BY THE BINOMIAL ISOENZYMES OF NADH-GLUTAMATE DEHYDROGENASE

G.O. Osuji, R.G. Cuero, and W.C. Madu, CARC, Prairie View

A&M University, P.O. Box 4079, Prairie View, Texas 77446, USA.

When inversion by pathogen was mimicked by treatment of yam tuber and maize with chitosan solution, the treatment altered the binomial distribution of glutamate dehydrogenase isoenzymes by lowering their reductive amination potential by 0.01 Volt, with concomitant increase of the free L-glu, and the total free amino acid levels of the crops by 150%, and 200% respectively. The decrease in amination potential is a defensive strategy because it increased the plant-pathogen energy barrier, thereby delaying pathogen intrusion into the energy metabolism of the plant. These results are important for improving post-harvest storage of crops.

Oral Paper 41 - Wednesday, 14:30

ETHNOBOTANICAL PROSPECTING FOR BIOACTIVE PHYTOCHEMICALS FROM BOREAL FOREST PLANTS

R. J. Marles, N. Spence, T. Clavelle, D. Burns, and L. Monteleone.

Botany Department, Brandon University, Brandon, MB Canada R7A 6A9

Traditional uses of plants have often been used to guide the selection of promising sources of bioactive phytochemicals. Sources for this information have included interviews with indigenous elders, which if done by researchers foreign to the host culture risks misunderstandings and misinterpretations. We are attempting to avoid these problems by having ethnobotanically trained community members interview their elders, supported by voucher specimen and ecological plant collections done by botanists. We believe the result is a more accurate and culturally sensitive description of the dynamic interrelationship between plants and people. This approach will be illustrated with some of the past season's fieldwork results from communities within the boreal forest region of the Canadian prairie provinces.

Oral Paper 42 - Wednesday, 14:45

BLACK SPRUCE GROWTH INHIBITION BY *KALMIA ANGUSTIFOLIA*: RESOURCE TOXIN HYPOTHESIS

A.U. Mallik and Inderjit. Department of Biology,
Lakehead University, Thunder Bay ON P7B 5E1

Regeneration failure of black spruce as a result of widespread proliferation of the *Kalmia angustifolia* following clearcutting and forest fire has been reported from eastern Canada. Rapid vegetative regeneration strategies of *Kalmia* and its allelopathic effects have been argued as potential causes of black spruce regeneration failure. In this paper we present a hypothesis that water soluble phenolic compounds interfere with the nutrient availability of the site following *Kalmia* dominance and bring about long term soil change. Involvement of resource toxin interference was studied in the laboratory by amending *Kalmia* free organic and mineral soil with leaf litter and leaf leachate of *Kalmia*. The soils were analyzed for pH, organic matter, PO₄, N, Ba, Ca, Zn, Fe, Mn, Ca, Na, K, Mg, Al and total phenolics. Black spruce seedling growth response was tested in the amended and control soils. Water soluble phenolic content was significantly higher in *Kalmia* amended organic soil than the unamended organic soil. All the amended mineral soils had significantly higher total phenolics than the unamended control soil. Linear decrease in content was obtained in amended organic and mineral soils with increasing quantity of *Kalmia* leaf litter amendment. Amended mineral soils had higher concentrations of Fe, Mn, Al and PO₄ than control. We relate higher accumulation of PO₄, Fe, Mn, and Al, in *Kalmia* amended mineral soils to higher phenolic content. Both the amended, organic and mineral soils significantly reduced the root and shoot growth of black spruce. We conclude that in addition to allelopathy, phenolics contributed by *Kalmia* create long term nutrient imbalances that have growth inhibiting effects on black spruce.

Abstracts of Posters

(Posters marked with an asterisk are part of the Best Poster Competition)

POSTER 1* - MONDAY 19:00-20:00

CARDIAC STIMULATORY, CYTOLYTIC AND HEMOLYTIC ACTIVITY OF UPI A NOVEL PROTEIN FROM THE SEA ANEMONE, *URTICINA PISCIVORA*

Edith I. Cline, *Michael W. Wolowyk and Leonard I. Wiebe, Faculty of Pharmacy and Pharmaceutical Sciences, University of Alberta, Edmonton AB Canada T6G 2N8

The sea has always been a potential source of novel therapeutic agents with diverse pharmacological activities. From some tropical and sub-tropical species of sea anemones, peptide and protein toxins have been characterized with molecular masses ranging from 5-30 kDa.

Screening of 12 species of sea anemones collected from the west coast of Canada showed varying degrees of all three activities. From *Urticina piscivora*, we have characterized a protein UPI (~28 kDa) with the partial amino acid sequence DENENLYGPNENKAKAKDLTAGASYLTKEAGCTKLQAGCTMYQAYN. It is a potent positive inotrope (ED₅₀ 8.1 x 10⁻⁹ M) a potent hemolysin on erythrocytes of five mammals, and is cytotoxic on three cell lines (KB, L1210 and HEL 299 cancer cell lines). The results obtained from the pharmacological evaluation will be presented.

POSTER 2* - MONDAY 19:00-20:00

SECONDARY METABOLITES FROM THE STEM BARK OF *MALMEA DEPRESSA* WITH PHYTOGROWTH AND HILL'S REACTION INHIBITORY PROPERTIES.

Adeline Jiménez¹, Rachel Mata¹, A. Luisa Anaya² and Blas Lotina-Hennsen. ¹Facultad de Química, ²Instituto de Fisiología Celular, Universidad Nacional Autónoma de México, Coyoacán 04510, México D.F.

From the CHCl₃ extract of the stem bark of *Malmea depressa*, four known phenyl-propanoids were isolated and identified as: 1,2,3,4-tetramethoxy-5-(1-propenyl)benzene (1), *trans* isomyristicin (2), tetramethoxycinnamaldehyde (3) and tetramethoxycinnamyl alcohol (4). In addition, a new benzaldehyde derivative, which was characterized as 1,2,3,4-tetramethoxybenzaldehyde by spectral means, was obtained. Compound 1, the major phytotoxic component showed significant phytogrowth inhibitory activity on seedlings of *Amaranthus hypochondriacus* and *Echinochloa crus-galli*. The effect of compound 1 on several photosynthetic processes was also investigated on freshly lysed spinach chloroplasts. Compound 1 behaves as a Hill's reaction inhibitor. ATP synthesis and proton uptake were also affected by compound 1. To determine the site of inhibition, the effect of compound 1 on

partial photosynthetic reactions (photosystem I and photosystem II) was measured using artificial electron donors and acceptors. The site of inhibition was located in the span from P680 to QA.

POSTER 3* - MONDAY 19:00-20:00

ENHANCED PEROXIDASE ACTIVITY IN HOP CELL CULTURES ELICITED WITH *VERTICILLIUM ALBO-ATRUM* PREPARATIONS

MTS Trevisan*, JJC Scheffer and R. Verpoorte, Division of Pharmacognosy, LACDR, Gorlaeus Laboratories, P.O. Box 9502, 2300 RA Leiden, The Netherlands.

In diseases caused by facultative parasites, peroxidase activity is generally higher in affected tissues than in healthy tissues, especially in resistant reactions (1).

It is also generally assumed that the peroxidase activity in infected tissues is a reflection of a metabolic demand for hydroxylation reactions in the synthesis of aromatic compounds, and the increased levels of phenolic compounds might then serve to inhibit pathogen development. The purpose of this study was to determine the effect of elicitation on peroxidase activity in cell cultures of *Humulus lupulus* L. (hop).

The peroxidase activity was measured using guaiacol as substrate. Elicitation of cell suspension cultures of five hop cultivars by *Verticillium albo-atrum* (filtrate and homogenate) resulted in some cases in an increase of the peroxidase activity. The enhanced enzyme activity correlated with the disease resistance of the cultivars

¹. Seevers, PM and Daly, JM *Phytopathology* **60**: 1642-1647 (1970)

*CNPq, Brazil.

POSTER 4* - MONDAY 19:00-20:00

IMMUNOLOGICAL RELATIONSHIP BETWEEN PHENYLALANINE AMMONIA-LYASE AND HISTIDINE AMMONIA-LYASE

Seong Hwan Kim, James W. Kronstad, and Brian E. Ellis, Biotechnology Laboratory, Department of Plant Science, University of British Columbia, Vancouver, B.C., Canada V6T 1Z4.

Phenylalanine ammonia-lyase (PAL; E.C. 4.3.1.5) occurs in plants, fungi and streptomycetes, but has not been found in animals and bacteria. Histidine ammonia-lyase (HAL; E.C. 4.3.1.3) occurs in animals and bacteria, and has been detected in a few plant species. While PAL and HAL proteins are likely to have evolved from a common progenitor ammonia-lyase protein, the catalytic and structural properties of that progenitor can only be inferred. We have begun a structure-function analysis of PAL and HAL to gain insight into the origin of the ammonia lyases, and have undertaken an immunological comparison of various PAL and HAL

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proteins. Antibodies have been produced against PAL purified from *Ustilago maydis*, and against recombinant poplar PAL expressed from a Baculovirus vector. These, together with anti-alfalfa PAL antibodies (provided by R.A. Dixon) have been used in Western Blots to examine the cross-reactivity of PAL from *U. maydis*, poplar, potato and yeast, and HAL from *Pseudomonas* and rat. Antibodies raised against *Pseudomonas* HAL have been used in a reciprocal set of analyses. The results of comparisons, and the relationships they reveal between the two ammonia-lyases from different organisms, will be presented.

POSTER 5* - MONDAY 19:00-20:00

NEW DITERPENES FROM *EUTHAMIA LEPTOCEPHELA* (ASTERACEAE)

Steven L. Robbs, Guido F. Pauli, & Nikolaus H. Fischer, Dept. of Chemistry, Louisiana State University, Baton Rouge, LA 70803, USA.

The genus *Euthamia* was previously classified as a subgenus of *Solidago*, which has been intensively investigated for its therapeutic properties. Investigations of the dichloromethane extracts of flowers of *Euthamia leptocephala* Torr. and Gray has afforded four new labdane diterpenes, all possessing a unique conjugated dilactone. The structures were elucidated by spectroscopic methods and one has been confirmed by X-ray crystallography. Data leading to the structures of the new compounds will be presented.

POSTER 6* - MONDAY 19:00-20:00

ENHANCED EXTRUSION OF PHENOLIC COMPOUNDS IN *BRASSICA* AFTER ULTRAVIOLET RADIATION

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²Botany Institute, Warsaw University. 00-927 Warszawa, Poland

UV-absorbing phenolic compounds play several important roles in the ecology of the plant. Our aim was to investigate the barrier against UV located on the surface of red cabbage leaves and so absorption was measured at a wavelength of 325 nm. Red cabbage plants were irradiated with monochromatic 254 nm and 366 nm radiation. After 7 days of treatment there was an increased concentration of compounds absorbing radiation of 325 nm in comparison to the control. The extrusion was increased by up to 100% after 366 nm radiation and by up to 200% after 254 nm radiation. Younger leaves showed more drastic responses by

enhanced extrusion and in some cases the interior concentration was higher in the old leaves. The results suggested that the biosynthesis and extrusion of UV absorbing phenolic compounds is stress-induced (UV) and is a non-specific defensive response.

POSTER 7* - MONDAY 19:00-20:00

PHYTOCHEMICAL ANALYSIS OF CERAMBYCID HOST PLANTS IN A NEOTROPICAL LOWLAND RAIN FOREST IN FRENCH GUIANA: LECYTHIDACEAE

A. Berkov, B. Meurer-Grimes, S. Mori#, and G. Tavakilian*

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A multiyear project (1991-1993), which took place in the Sinnamary River Basin of French Guiana, revealed hundreds of previously unknown host-plant associations for wood-boring beetles in the family Cerambycidae. Over 600 trees were felled, identified, and investigated for their cerambycid fauna. Twenty-one wood samples of Lecythidaceae, representing 15 species in the five genera commonly encountered in French Guiana, were extracted, then fractionated into water, methanol and dichloromethane phases. Each fraction was analyzed by TLC and HPLC/UV. The predominant compounds are terpenoids, mostly saponins, and simple phenolics. Preliminary data suggest that some beetle species only require chemical cues allowing them to distinguish Lecythidaceae from non-Lecythidaceae, while others utilize additional compounds to distinguish among the various tree taxa.

POSTER 8* - MONDAY 19:00-20:00

PHYTOCHEMICAL ANALYSIS OF CERAMBYCID HOST PLANTS IN A NEOTROPICAL LOWLAND RAINFOREST IN FRENCH GUIANA: LEGUMINOSAE

B. Meurer-Grimes, B. Hallihan, and G. Tavakilian*

Department of Biological Sciences, Lehman College and The Graduate School, The City University of New York, 250 Bedford Park Boulevard West, Bronx NY 10468 USA

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Over a three year period, from 1991-1993, over 600 wood samples belonging to the Leguminosae (3 Swartzieae, 13 Caesalpiniaaceae, 17 Mimosaceae, and 15 Fabaceae, most represented by more than one replicate) were extracted and fractionated into water, methanol, and dichloromethane phases. Each of these fractions was analyzed by TLC and HPLC/UV. Although each species or genus was found to specialize in a single class of secondary metabolites (quinones, flavonoids, simple phenolics, or alkaloids), there was little correlation between patterns of secondary metabolites and higher taxonomic categories in the Leguminosae. Therefore, the correlations between chemical patterns in host plants and Cerambycid taxonomy were investigated and yielded informative results. These studies focus on a rarely investigated plant/insect relationship that involves the recycling of senescent plant material, and will therefore make a major contribution to the ongoing discussions on biodiversity and conservation of tropical rainforests.

POSTER 9* - MONDAY 19:00-20:00

EFFECT OF GENETIC AND PHENOLOGICAL VARIATION IN ASPEN CHEMISTRY ON GYPSY MOTH AND TIGER SWALLOWTAIL PERFORMANCE

S.Y. Hwang and R.L. Lindroth, Department of Entomology, University of Wisconsin, Madison, WI 53706 USA

This research evaluated the roles of genetic and phenological variation in foliar secondary chemistry on suitability of aspen to gypsy moth (spring-feeding) and tiger swallowtail (summer-feeding) larvae. Insect bioassays were conducted with propagated aspen clones, in mid-May (gypsy moth) and July-August (swallowtails). Leaf foliage was collected periodically and analyzed for nitrogen, phenolic glycosides and condensed tannins. Results revealed substantial among-clone variation in performance of both insect species, and that the clones supporting especially good or poor performance varied between insect species. Chemical analyses showed marked among-clone variation in phenolic glycosides and condensed tannins; correlation analyses indicated that phenolic glycosides were responsible for among-clone variation in insect performance. Seasonal trends in foliar concentrations of phenolic glycosides varied among clones, explaining the shift in "resistant" and "non-resistant" clones between gypsy moth and swallowtail feeding studies.

POSTER 10* - MONDAY 19:00-20:00

CHEMICAL BASIS OF PHYLOGENETIC TRENDS WITHIN LAMIIFLORAE

Fábio S. Menezes and Maria Auxiliadora C. Kaplan, Núcleo de Pesquisas de Produtos Naturais, Universidade Federal do Rio de Janeiro, Ilha do Fundão, Rio de Janeiro, Brazil

The super order Lamiiflorae, formerly esteemed by Dahlgren (1980) to consist of Lamiales, Scrophulariales, Hippuridales and Hydrostachyales, has been recently rearranged into just three orders: Lamiales (enclosing Lamiales and Scrophulariales), Hippuridales and Hydrostachyales (Dahlgren, 1989). The iridoidal chemistry of Lamiiflorae does not clearly confirm the first proposal. On the other hand, the analysis of its diterpenoids favors the separation of Lamiales into two orders, Scrophulariales accumulating mainly iridoids and Lamiales accumulating diterpenoids. Quantitative evolutionary advancement parameters calculated for Lamiiflorae on its diterpenes and its flavonoids suggest a clear differentiation between these two orders. Furthermore, the results obtained with correlations of the evolutionary advancement parameters show an evolutionary gradient from Scrophulariales to Lamiales, allowing us to understand the position of some families within Lamiiflorae.

POSTER 11* - MONDAY 19:00-20:00

FUNGITOXICITY OF PHENOLS IN DATE PALM ROOTS. RELATION WITH THE RESISTANCE TO BAYOUD DISEASE

E. El Boustani¹, A. Ziouti¹, A. El Mandili¹, C. El Modalar¹, and J.J. Macheix², ¹ Université Cadi Ayyad, Faculté des Sciences, Département de Biologie, Laboratoire de Biochimie, B.P. S/15, Marrakech, Maroc, ² Université Montpellier II, Laboratoire de Physiologie et Biotechnologie Végétale Appliquée, Montpellier, France.

Fusarium oxysporum f. sp. *albedinis* (Foa), the causal agent of bayoud disease, constitutes a real threat to date palm (*Phoenix dactylifera* L.) culture in Morocco. Only 6 of 223 existing date palm cultivars show a resistance to the disease. Up to now, palm tree resistance could only be assessed by field observations but mechanisms of such resistance are not yet well known. Phenolic compounds in date palm roots were identified as 5-caffeoylshikimic acid (dactylifric acid) and its positional isomers, 3 and 4-caffeoylshikimic acids. Significant differences between susceptible and resistant cultivars were observed in levels of these phenolic compounds. *In vitro* studies also showed that the amount of caffeoylshikimic acids accumulated in resistant cultivars was fungitoxic. They affected conidia germination and mycelial growth of Foa while accumulated quantity in susceptible cultivars had no effect on this pathogen. These results show that phenolic compounds could be used as a marker of date palm resistance to bayoud disease.

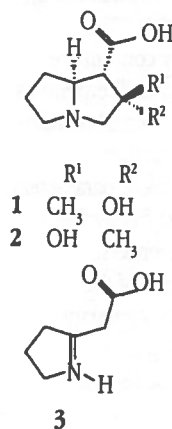
POSTER 12 - MONDAY 19:00-20:00

PYRROLIZIDINE ALKALOIDS IN ROOTS AND HAIRY ROOT CULTURES OF *ARNICA MONTANA*

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Recently we have found the unusual pyrrolizidines tussilaginic acid **1** and disotussilaginic acid **2** as well as their 1-epimers together with 2 pyrrolidin acetic acid **3** in flowers of several *Arnica* species [1], which leads to the assumption that the biosynthesis of **1** and **2** is probably different from other pyrrolizidine alkaloids, none of them bearing a methyl group at C 2. To study the possible biosynthetic pathway of these unusual substituted pyrrolizidines, we now have analysed roots and hairy root cultures of *A. montana*. In both we could identify these three compounds in form of their methyl esters by TLC, GLC, GLC/MS analysis in direct comparison with the authentic samples.

[1] C.M. Passreiter (1992) *Phytochemistry* 31, 4135.

POSTER 13 - MONDAY 19:00-20:00

ANTHOCYANOPLASTS IN THE BRASSICACEAE:
DOES THEIR PRESENCE SERVE AS A CHEMOTAXONOMIC
MARKER WITHIN THE FAMILY?

Constance Nozzolillo and Jeff Anderson, Department of Biology,
University of Ottawa, Ottawa, Ontario, Canada K1N 6N5, and
Suzanne Warwick, Centre for Land and Biological Resources,
Agriculture and Agri-food Canada, Ottawa, Ontario, Canada
K1A 0C6.

Seedlings and mature plants of 127 accessions growing in the CEF
greenhouses and representing 93 species of Brassicaceae were
examined for the presence of deeply pigmented bodies called
anthocyanoplasts (ACP) in red-pigmented tissues. Together with
other reports from the literature, a total of 103 species,
representing 47 genera and 8 tribes have been surveyed.
ACP were noted in at least one species of 21 genera and in at least
one species of 6 tribes. This result leads to the conclusion that
the trait of ACP formation is widespread in family Brassicaceae
but does not answer the question posed in the title.

POSTER 14 - MONDAY - 19:00-20:00

MICROPROPAGATION OF *CAMPTOTHECA ACCUMINATA*

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Shoot cultures of *Camptotheca accuminata* Decne (Nyssaceae),
source of the anti-cancer drug camptothecin (CPT), were
established on WPM medium supplemented with 10 μM zeatin.
CPT content of *in vitro* leaves was similar to that of whole
plants. CPT content in the newest fully expanded leaves of
micropropagated greenhouse plants averaged 0.033% dry weight.
When conventional propagation was examined, it was found that
small, young cuttings rooted faster and with a higher frequency
than older cuttings. However, frequency of rooting was variable
and many plants failed to grow even after successful rooting and
acclimation. An initial bulk *ex vitro* rooting of micropropagated
shoots yielded an 83% rooting frequency and the development
of new growth at a faster rate than that of conventional cuttings.
These results suggest that micropropagation is a viable method
of rapid clonal propagation of elite genotypes.

POSTER 15 - MONDAY 19:00-20:00

EFFECTS OF THE L-PHENYLALANINE AMMONIA LYASE
INHIBITOR AIP (2-AMINOINDAN-2-PHOSPHONIC ACID)
ON RED CABBAGE SEEDLINGS

Dennis C. Gitz III and Jerry W. McClure. Botany Department,
Miami University, Oxford, OH 45056 USA

AIP was synthesized by a procedure modified from Zons and
Amrhein (*Liebigs Ann Chem* 1992:925). Red cabbage (cv Red
Acre) seedlings were grown on a 23^o/19^o day/night (16-h-
photoperiod, 200 $\mu\text{E m}^{-2} \text{s}^{-1}$ PAR from CW fluorescent lamps)
regime with 0.0 to 50 μM AIP. Anthocyanins, chlorophylls,
carotenoids, steady state chlorophyll fluorescence, and leaf
area were determined. The I50 for anthocyanin was ca. 0.1 μM ,
0.5 μM AIP blocked all anthocyanin synthesis. At 50 μM of AIP
lignification [determined histochemically] was blocked without
measurable effects on seedling growth. We have extended our
work with this model red cabbage system to a study of UV-B
effects on soybeans grown with AIP- modulated levels of
secondary phenolics. Supported by USDA/NRI grant
93-37100-8836.

POSTER 16 - MONDAY 19:00-20:00

FLAVONOID PATTERNS IN LEAVES
AND FLOWERS OF TRILLIUM SPECIES

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Faculty of Science, Kumamoto University,
Kumamoto 860 Japan and C. Nozzolillo, Department of Biology,
University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

Four flavonol glycosides were identified in the leaves of
Trillium tschonoskii: monoacetylated kaempferol 3-O-
arabinosylgalactoside (TAK), kaempferol 3-O-

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arabinosylgalactoside (TK), monoacetylated quercetin 3-O-arabindosylgalactoside (TAQ) and quercetin 3-O-arabinosylgalactoside (TQ). TAQ and TQ were widely distributed as main components in the leaves of the other five species found in Japan: *T. apetalon*, *T. kamtschaticum*, *T. smallii*, *T. xbagae*, and *T. xmiyabeanum*. TAQ was one of the main flavonols in the leaves of *T. grandiflorum* and *T. erectum* collected in Canada. In addition to TAQ and TQ, leaves of *T. apetalon* contain isorhamnetin glycosides. The main anthocyanin in the red sepals of *T. apetalon* was cyanidin 3-O-rhamnosylglucoside (keracyanin). It was also the main anthocyanin in the petals of *T. smallii* and *T. erectum*. The chemosystematic significance of these findings will be discussed.

POSTER 17 - MONDAY 19:00-20:00

ANTIMUTAGENIC ACTIVITY OF *NIGELLA SATIVA* IN THE METABOLIC ACTIVATION OF ARYLAMINES

Medhat Abu-Zeid, Ibrahim Abdel-Salam, Faried Abou-Bedair and Nagy Iskandar*, Department of Cancer Biology, National Cancer Institute, Cairo University and *Radiation Technology Centre, Cairo, Egypt.

The effect of *Nigella sativa* extract on the metabolic activation of arylamines pyrolysates was examined *in vitro*. In *Salmonella typhimurium* mutagenesis assay (TA98), the addition of *Nigella sativa* at a dose of 10 mg per 250 mg microsomal protein inhibited the mutagenic activation of 2-amino-6-methylidipyrrodo [1,2-a:3',2'-d]imidazole, Glu-P-1; 2-amino-3-methylimidazo [4,5-f] quinoline, IQ; 2-amino-3,8-dimethylimidazo[4,5-f] quinoxaline, MeIQ; 3-amino-1-methyl-5H-pyrrodo[4,3-b]indole, Trp-P-2; 2-aminofluorene, 2-AF and 2-acetyl-aminofluorene, 2-AAF by 87.6%, 60.4%, 81.2%, 39.9%, 63.6% and 76.3% relative to the control. *Nigella sativa* inhibited the formation of N-hydroxy-Glu-P-1 by 40.6% of the control, whereas no significant inhibition was found on the formation of N-hydroxy-2-AF (12%). Using uninduced rat hepatic cytosols, the effect on the acetyltransferase- and sulfotransferase-mediated activation was examined by the DNA binding technique. We introduce *Nigella sativa* as a new inhibitor of both arylamine activating cytochrome P-450 and O-acetyltransferase, and an antimutagenic natural product with a promising role in limiting and controlling food carcinogenesis.

POSTER 18 - MONDAY 19:00-20:00

RADIOPROTECTIVE ROLE OF *NIGELLA SATIVA* OIL AGAINST GAMMA IRRADIATION IN MICE

Ibrahim Abdel Salam, Medhat Abu-Zeid, Soumaya El-Hosseiny, Mohamed Refaie, Hassan Abdel Moneim and Nadia Mokhtar. Department of Cancer Biology, National Cancer Institute, Cairo University, Cairo, Egypt.

The effect of *Nigella sativa* oil has been studied against gamma irradiation in the liver of swiss albino mice. The radioprotective effect of *Nigella sativa* oil was indicated by nucleic acids (DNA and RNA), glutathione and superoxide dismutase in the liver tissue homogenate of the control group, irradiated group, *Nigella sativa* treated group and *Nigella sativa* irradiated group. The liver superoxide dismutase and glutathione were significantly decreased in the irradiated group. For nucleic acids, irradiation reduced the DNA content/g tissue of the liver while RNA was increased. The possible radioprotective effect of *Nigella sativa* oil was also evaluated by cytomorphologic studies, DNA cytophotometric analysis and silver nucleolar organizer regions on liver, kidney and intestine of the previous groups. The use of *Nigella sativa* oil with irradiation was shown to antagonise the harmful effect of radiation on the hepatic and renal cells, which was proved both biochemically and histopathologically. The intestine showed less evident radioprotective effect.

POSTER 19 - MONDAY 19:00-20:00

ESTIMATION OF NATURAL AND SEMISYNTHETIC AMINOGLYCOSIDE ANTIBIOTIC LEVELS IN FEBRILE PEDIATRIC ONCOLOGY PATIENTS AT THE NATIONAL CANCER INSTITUTE, EGYPT

Salah ABDELHADI*, Medhat ABU-ZEID and Emad EBEID*, Departments of Pediatric Oncology* & Cancer Biology, National Cancer Institute, Cairo University, Cairo, Egypt.

The aminoglycoside antibiotics gentamycin and amikacin contain aminosugars linked to an aminocyclitol ring by glycosidic bonds. None is adequately absorbed after oral administration and all are excreted rapidly by the normal kidney. The aminoglycosides are used primarily to treat infections caused by aerobic gram negative bacteria. Gentamycin is a natural broad spectrum aminoglycoside antibiotic derived from species of Actinomycete Micro-monospora whereas amikacin is a semi synthetic aminoglycoside antibiotic derived from kanamycin. Gentamycin, 5mg/kg/day i.v. for 7 days was utilized in the management of 10 pediatric oncology patients who developed fever +/-neutropenia during their antineoplastic treatment. Gentamycin blood levels were analyzed by radio immuno assay. A similar group of 10 pediatric oncology patients with fever +/-neutropenia received amikacin, 15 mg/kg/day i.v. for 7 days and had their amikacin blood levels analyzed by High Pressure Liquid Chromatography. The results of administering a natural versus a semisynthetic aminoglycoside antibiotic for the empiric treatment of fever +/-neutropenia in pediatric cancer patients will be analyzed with respect to antibiotic blood level as a measure of efficacy/toxicity of treatment in an attempt to offer optimized therapy, reduce toxicity and avoid semisynthetic products.

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POSTER 20 - MONDAY 19:00-20:00

REGULATION OF A DIHYDROBENZOPHENANTHRIDINE OXIDASE FROM ELICITED *SANGUINARIA CANADENSIS* CELL CULTURES.

Atanas V. Ignatov¹, W. Gregg Clark¹, Robert J. Krueger^{2*}, Carmine J. Coscola¹ and E.A. Doley Dept. of Biochemistry¹ and Molecular Biology, St. Louis University School of Medicine, St. Louis, MO 63104, Dept. of Pharmacognosy², Ferris State University, Big Rapids, MI 49307.

Addition of carbohydrate-rich fungal cell wall preparations or putative plant defense signal molecules (methyl jasmonate, acetylsalicylic acid) to *S. canadensis* cultures enhanced the activity of dihydrobenzophenanthridine (DHBP) oxidase. Both methyl jasmonate and acetylsalicylic acid induced oxidase activity to a greater extent than fungal elicitors. In dose and time dependency studies at least a 2-fold induction of specific activity was observed with either treatment. No change in total enzyme activity in the cultured cells was observed. The results suggest that DHBP oxidase, jasmonate and salicylate may play roles in *S. canadensis* defense against pathogens.

POSTER 21 - MONDAY 19:00-20:00

CROCETIN GLYCOSYLATION BY *CROCUS SATIVUS* L. CALLUS CELL-FREE EXTRACT

Christiane Dufresne, François Cormier and Sonia Dorion, Food R&D Centre, Agriculture & Agri-Food Canada, St-Hyacinthe (PQ), Canada J2S 8E3

Developing an enzymatic process for the glycosylation of carotenoids represents a great challenge because their water solubilisation can open the door to a wide range of new uses by the food colour industry. Cell-free extract of *Crocus sativus* callus exhibited the ability to transform crocetin into its related glycosides in the presence of UDP-glucose. The reaction was conducted in aqueous medium. Crocetin was solubilized by encapsulation in maltosyl- β -cyclodextrin, thereby circumventing the detrimental effect of DMSO. The glycosylation products identified were, in order of occurrence, all-*trans*-crocetin mono (β -D-glucosyl) ester, all-*trans*-crocetin mono (β -D-gentiobiosyl) ester, all-*trans*-crocetin di (β -D-glucosyl) ester, all-*trans*-crocetin β -D-gentiobiosyl- β -D-glucosyl ester and all-*trans*-crocetin di (β -D-gentiobiosyl) ester or crocin, the major pigment of saffron stigmas. The kinetics of synthesis for each glycoside seem to indicate that there are probably two glucosyl transferases involved in the synthesis of crocin.

POSTER 22 - MONDAY 19:00-20:00

CHARACTERIZATION OF UDP-GLUCOSE:CYANIDIN

3-O-GLUCOSYLTRANSFERASE (CGT) AND SAM:CYANIDIN 3-GLUCOSIDE 3'-O-METHYLTRANSFERASE (CGMT) FROM *VITIS VINIFERA* CELL CULTURE.

Chi Bao Do, François Cormier, Christophe Bailly, & Yves Nicolas, Food R&D Centre, Agriculture Agri-Food Canada, St-Hyacinthe (PQ) Canada J2S 8E3

Two enzymes involved in the early steps of anthocyanin synthesis (i.e., CGT and CGMT), have been isolated from a *Vitis vinifera* cell suspension culture, purified 75- and 35-fold respectively (with 3.8% and 3.4% recovery respectively), and characterized. Molecular weight, *pH*-activity optimum, kinetic parameters and influence of divalent ions were determined. CGT could glucosylate cyanidin and delphinidin indiscriminately and was affected by substitution patterns in positions 3' and 5' in the B ring. CGMT was highly specific to cyanidin 3-glucoside and could not accommodate cyanidin 3-*p*-coumaroylglucoside nor cyanidin. The activity of CGMT was substantially higher in cell suspension cultures grown under anthocyanin-promoting conditions, which increase the proportion of 3'-methylated anthocyanins.

POSTER 23 - MONDAY 19:00-20:00

SPECTROSCOPIC CHARACTERIZATION OF CROCETIN DERIVATIVES FROM *CROCUS SATIVUS* AND *GARDENIA JASMINOIDES*

Marie-Rose Van Calsteren¹, Martine C. Bissonnette¹, François Cormier¹, Christiane Dufresne¹, Takahito Ichi², J.C. Yves LeBlanc³, Daniel Perreault¹ and Ingeborg Roewer¹

¹Food Research and Development Centre, Agriculture and Agri-Food Canada, Saint-Hyacinthe, Quebec, Canada J2S 8E3

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Crocetin derivatives were extracted and purified from saffron stigmas and gardenia fruits. They were characterized by NMR, UV-visible and IR spectroscopies and mass spectrometry. The following compounds were found in saffron: all-*trans*-crocetin di-(β -D-gentiobiosyl) 1, β -D-gentiobiosyl- β -D-glucosyl 2, di-(β -D-glucosyl) 3 and mono-(β -D-gentiobiosyl) 4 esters, as well as 13-*cis*-crocetin de-(β -D-gentiobiosyl) 5 and β -D-gentiobiosyl- β -D-glucosyl 6 esters. Compounds 1, 2 and 4 were also present in gardenia, in addition to all-*trans*-crocetin mono-(β -D-glucosyl) 7 ester.

POSTER 24 - MONDAY 19:00-20:00

DIVERSITY OF SESQUITERPENES IN FORTY-SIX POTATO CULTIVARS AND BREEDING SELECTIONS

Abstracts of Posters

Susan McCormick and Anne Desjardins, Mycotoxin Research Unit, USDA, ARS, NCAUR, Peoria IL 61604 USA, and Dennis L. Corsini, USDA-ARS, University of Idaho Research and Extension Center, Aberdeen, Idaho, 83210 USA.

Rishitin, lubinun and solavetivone were the major sesquiterpenes found in 46 cultivars and breeding selections of potato (*Solanum tuberosum* L.). Concentrations of total sesquiterpenes were low or undetectable in untreated tuber slices, but ranged from 5 to 101 µg/g fresh weight four days after treatment with the elicitor arachidonic acid. Seven genotypes produced significantly higher sesquiterpene concentrations than Russet Burbank (17µg/g), a widely grown commercial cultivar. More than half of the genotypes tested were significantly different from Russet Burbank in sesquiterpene composition due to higher ratios of lubimin or solavetivone, both of which are reported to be biosynthetic precursors of rishitin. The highest ratios of solavetivone to total sesquiterpenes were strongly correlated with derivation from *S. tuberosum* ssp. *andigena* CPC 1673 which confers the H1 gene for resistance to the golden nematode (*Globodera rostochiensis*).

POSTER 25 - MONDAY 19:00-20:00

HIV INHIBITORY GALLOTANNINS FROM
LEPIDOBOTRYS STAUDTII

Heidi R. Bokesh*, Tawnya C. McKee, Michael J. Currens, Robert J. Gulakowski, John H. Cardellina II, James, B. McMahon and Michael R. Boyd Laboratory of Drug Discovery Research and Development, DTP, DCT, NCI-FCRDC, and *SAIC-Frederick, NCI-FCRDC

Two galloylquinic acids, 1,3, 4,5-tetra-O-galloylquinic acid (1) and 3,4,5-tri-O-galloylquinic acid (2), were isolated from the stem bark of the monotypic plant, *Lepidobotrys staudtii*. Compound 1 protected target cells (EC₅₀=0.5µM) from the cytopathic effects of HIV-1 and HIV-2 and also exhibited potent inhibition (IC₅₀=0.4µM) of HIV-1 and HIV-2 RT in enzyme assays. A growing number of compounds are recognized to have anti-HIV-1 activity; however, many of these are ineffective against HIV-2. Compound 1 represents an unusual class of HIV-2 inhibitory plant metabolite.

POSTER 26 - MONDAY 20:00-21:00

POTASSIUM DEFICIENCY INCREASES THE PRODUCTION
OF THIOPHENES IN *TAGETES ERECTA*

Julia J. Martin and Jeffrey Weidenhamer,
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The roles of plant secondary compounds include protection from environmental stresses and defense against pathogens, predators

and competing plants. Naturally occurring thiophenes accumulate in the roots of *Tagetes erecta*, a species of marigold. Thiophenes have been reported to have various toxic effects. Nematocidal activity has been most extensively described, but toxicity to fungi, insects, bacteria and viruses has also been shown. This study examined the effect of nutrient stress on the production of three thiophene products from *T. erecta*.

The levels of alpha-terthienyl, 5-(3-buten-1-ynyl)-2,2'-bithienyl, and 5-(4-acetoxy-1-butyryl)-2,2'-butenyl (BBTOAc) were analyzed by HPLC. Nutrient solutions were circulated through open-bottomed pots containing four plants per pot and root exudates were collected using C18 solid-phase extraction tubes. The results of a preliminary study examining the effects of reduced nitrogen, phosphorus, potassium and sulfur indicate that thiophene production is modified by nutrient deficiency. The most striking effect was a 520% increase in the production of BBTOAc per unit biomass in plants receiving 90% less potassium than the control plants. This finding is currently being investigated in greater detail over a wider range of potassium levels.

POSTER 27 - MONDAY 20:00-21:00

POLYURETHANE FOAM: AN ADSORBENT
FOR ALLELOCHEMICALS IN SOIL

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Plants produce many phytotoxic chemicals with the potential to inhibit growth of nearby plants. Measured static concentrations of these allelochemicals in soil are low, and do not assess flux rates, which may be a key factor in toxicity. Adsorbents, which trap allelochemicals from soil, could help address these concerns. Polyurethane foam (PUF) plugs were tested as adsorbents for juglone, a naphthoquinone from *Juglans nigra*, and α-terthienyl, a thiophene from *Tagetes erecta*. Experiments were conducted with aqueous juglone solutions and the PUF plugs to characterize the adsorption equilibrium. Approximately 30 minutes were required for equilibration. The maximum amount of juglone extracted from solution by the plugs was 65.68%. Recovery of juglone from the plugs with acetone over a concentration range of 1-28.5 mg/L ranged from 73% to 83%. Recovery of juglone from plugs stored for up to two weeks decreased to 39%, indicating that juglone degrades or is irreversibly bound over time. A field study with plugs placed in the root zone of a mature black walnut tree is in progress. Preliminary studies show PUF plugs placed in pots of marigolds grown in sand trapped an average of 0.72 µg terthienyl over 3 weeks. These data show that PUF plugs may be useful for trapping soil allelochemicals.

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POSTER 28 - MONDAY 20:00-21:00

AN *IN VITRO* CELL ASSAY FOR HYDROPHOBIC LEAF COMPOUNDS

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In vitro bioassays of secondary leaf metabolites against cells in liquid suspension are frequently hampered by the hydrophobic nature of many of these compounds. This paper describes an application of the "lawn assay" with agarose-suspended cells that allows direct testing of leaf extracts and purified compounds in organic solvents while avoiding solvent toxicity to the cells. Over 20 compounds - phenolics, flavonoids and whole-leaf extracts - have been tested in assays against CF-1 cells and their potencies compared. The assay is presently being used to investigate the potential interaction of secondary leaf metabolites with the insecticidal activity of *Bacillus thuringiensis* toxins.

POSTER 29 - MONDAY 20:00-21:00

PHENOLIC CONTENT AMONG COMMERCIAL HERBAL PREPARATIONS OF HAWTHORN (*CRATAEGUS* SP., ROSACEAE)

W. Dennis Clark, Department of Botany, Arizona State University, Tempe, AZ 85287-1601, USA

Methanolic extracts of six commercial preparations of hawthorn berry powder showed a 13-fold range in total phenolic content among samples as measured by HPLC peak integration. The sample containing the highest amount had 4.5-fold times the phenolic content of its nearest competitor. In addition, Hawthorn tinctures varied about 4-fold in total phenolic content between two brands. The wide quantitative variation of these low-molecular weight phenolics underscores the absence of quality control among commercial hawthorn products and suggests that certain brands may have little or no medicinal value.

POSTER 30 - MONDAY 20:00-21:00

BIOLOGICAL ACTIVITY OF EXTRACTS FROM *TRICHILIA HIRTA* AND *T. GLABRA*. ISOLATION OF NATURAL PRODUCTS FROM AN ACTIVE FRACTION OF *T. HIRTA*

Denise C. Chauret,¹ Deborah D. Wheeler,² J. Thor Arnason,¹ Tony Durst,¹ Murray B. Isman,² Pablo Sanchez-Vindas,³ L. San Roman,³ and L. Poveda.³

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Hexane, methylene chloride, butanol-ethyl acetate, and water fractions of ethanol extracts from the wood and bark of *Trichilia hirta* and *T. glabra* were bioassayed using the asian armyworm, *Spodoptera litura*. The methylene chloride and butanol-ethyl acetate fractions were found to be the most active. Through preliminary column chromatography, followed by preparatory HPLC, several compounds from the methylene chloride fraction of *T. hirta* have been isolated, purified, and identified.

POSTER 31 - MONDAY 20:00-21:00

A PROFILE OF FREE AND BOUND (AS VALEPOTRIATE ESTERS) SHORT-CHAIN ORGANIC ACIDS IN VALERIANA PLANTS. BIOLOGICAL ACTIVITY OF ISOVALERIC ACID.

Linda Arel, Gabriel Guillet, Denise C. Chauret, and J. Thor Arnason, Department of Biology, University of Ottawa, Ottawa ON K1N 5N6 Canada

Plants of the Valerianaceae family, well known for their medicinal uses since the Greek and Roman times, are identifiable by their strong odour due to constituent volatile free organic acids. Such acids are also present in bound forms, known as valepotriates, to which the plants' medicinal qualities are generally attributed. Through solvent extraction, followed by separation of the free acids, fresh and dried roots of *Valeriana* L. were examined for acetic, isovaleric, and 4-methyl-n-aleric acids, both free and bound, by gas chromatography. In addition, isovaleric acid was bioassayed using granary weevil adults, *Sitophilus granarius*, and was found to be very active.

POSTER 32 - MONDAY 20:00-21:00

METABOLISM OF [¹⁴C]-PHENYLALANINE IN TOBACCO NECROTIC VIRUS (TNV)-INFECTED LEAVES OF SOME MONOCOT SPECIES

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The objective of this study was to determine if tobacco necrotic virus (TNV) infection affected metabolism of phenylalanine in leaves of rice (*Oryza sativa*), corn (*Zea mays*) and barley (*Hordeum vulgare*). The ethyl acetate soluble fractions from TNV-infected rice, corn and barley leaves had 5-20% higher radioactivity than control. After 24 hours of [¹⁴C]-phenylalanine administration, *p*-coumaric and ferulic acids were identified as the major metabolites in both control and TNV-infected leaves of 2-week-old seedlings of rice and corn. The metabolism of

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[¹⁴C]-phenylalanine to phenolic acids in leaves of these species will be discussed in relation to TNV-infection.

POSTER 33 - MONDAY 20:00-21:00

METHYL 3-(3-METHYL-2-BUTENYL)-4-HYDROXY BENZOATE AS THE MAJOR INSECTICIDAL PRINCIPLE FROM *PIPER GUANACASTENSIS*

R. Pereda-Miranda^{1,2}, C.B. Bernard¹, T. Durst¹, J.T. Arnason^{1*}, P. Sanchez³, L. Poveda³ and L. San Roman³ / ¹Institutes of Biology and Chemistry, University of Ottawa, Ottawa, ON, Canada K1N 6N5 / ²Departamento de Farmacia, Facultad de Quimica, Universidad Nacional Autonoma de Mexico / ³Universidad Nacional, Costa Rica

As part of a program aimed at the development of potentially useful phytochemicals as insect control agents (green insecticides) and together with our interest in the chemical ecology of the American neotropical Piperaceae, we now report the isolation and identification of a novel prenylated phenolic from *P. guanacastensis*. The insecticidal and growth reducing properties of this species were established previously using the European corn borer as model insect. The CHC13-soluble extract of this plant material was found to have a noteworthy insecticidal activity to mosquito larvae (LC₅₀ = 80.5 µg/ml) and by activity guided fractionation afforded methyl 3-(3-methyl-2-butenyl)-4-hydroxy benzoate as the major bioactive constituent (LC₅₀ = 22.8 µg/ml).

POSTER 34 - MONDAY 20:00-21:00

IS GUARANA PRESENT IN GUARANA PRODUCTS? CONTENT OF THEOBROMINE, THEOPHYLLINE, AND CAFFEINE IN 43 GUARANA SAMPLES AND PRODUCTS

Amy Berkov, Hans Beck^{*}, Phytochemistry Class U745.02, and Barbara Meurer-Grimes[#], Department of Biological Sciences, Lehman College and The Graduate School, The City University of New York, 250 Bedford Park Boulevard West, Bronx, NY 10468, USA ^{*}Institute of Economic Botany, The New York Botanical Garden, 200th Street and S. Blvd., Bronx, NY 10458 USA, [#]corresponding authors.

Guaraná is a caffeine containing natural product derived from the seeds of *Paullinia cupana* Hbk. (Sapindaceae). In addition to a caffeine content of more than 5% of the dry weight, traces of theobromine and theophylline are typically present in guaraná. In recent years, guaraná has become an increasingly popular ingredient of many commercially available products such as powders, tinctures, gel caps, syrups, and especially sodas. As a

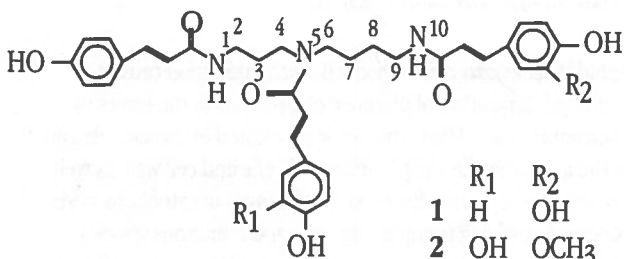
result, the demand for guaraná far exceeds the production from the plant source, which is primarily carried out in Brazil. We investigated the purine alkaloid content of 43 commercially available guaraná products using HPLC/UV. Most of the guaraná products did contain caffeine as the major purine alkaloid, along with traces of theophylline and theobromine, but numerous syrups and sodas contained up to ten times more theobromine than caffeine.

POSTER 35 - MONDAY 20:00-21:00

MINOR HYDROXYCINNAMOYL SPERMIDINES FROM POLLEN OF *QUERCUS DENTATA* THUNB.

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We recently reported the structures of four major trisubstituted hydroxycinnamoyl spermidines from pollen of *Quercus dentata*, and present here the structures of two additional minor compounds from the same plant. Compound 1 was identified as N1, N5-di-*p*-coumaroyl-N10 caffeoyl spermidine (MW = 599). Compound 2 was identified as N1-*p*-coumaroyl-N5-caffeoyl-N10-feruloyl spermidine (MW = 629). This compound is the first hydroxycinnamoyl amide reported to contain three different cinnamoyl moieties.



POSTER 36 - MONDAY 20:00-21:00

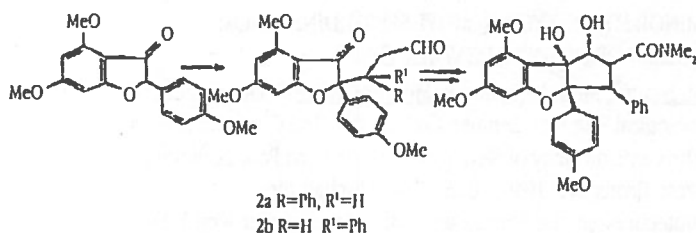
ASYMMETRIC INDUCTION IN THE SYNTHESIS OF A PRECURSOR OF ROCAGLAMIDE

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The antileukemic natural product, rocaglamide (**3**) can be efficiently prepared from keto aldehyde (**2a**). Here we report an asymmetric synthesis of compound (**2a**) by addition of cinnamaldehyde to benzofuranone (**1**). This asymmetric Michael reaction proceeds stereospecifically to afford mixtures of **2a** and **2b** adducts. In summary, we have demonstrated a highly effective chiral catalytic process for the synthesis of an optically active precursor of rocaglamide.



POSTER 37 - MONDAY 20:00-21:00

CYTOCHEMICAL CHANGES IN PELARGONIUM LEAVES DUE TO APHID INFESTATION

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Aphid (*Neomyzus circumflexus* Buckt.) infestation caused increased deposition of phenolic compounds in the leaves of *Pelargonium* sp. Most deposits were located in the vacuole and in the area between the plasma membrane and cell wall, as well as some in the intercellular spaces. Changes in cytoplasm were observed involving tonoplast damage and numerous vesicles deposited in the vicinity of the plasma membrane. Endoplasmic reticulum and myelin structures increased in number as well as mitochondria in which cristae were longer and larger. Thus, we observed both the increase in activity of organelles in such cells and segregation of damaged areas in the form of membrane degradation.

POSTER 38 - MONDAY 20:00-21:00

EFFECTS OF MODIFIER AND MOLECULAR STRUCTURE OF SOME COUMARINS, ANTHOCYANINS AND OTHER FLAVONOIDS ON RETENTION IN NORMAL AND REVERSED PHASE HIGH PERFORMANCE THIN-LAYER CHROMATOGRAPHY

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Coumarins, anthocyanins and other flavonoids (23 compounds) were investigated in silanized (HPTLC-RP-18) and silica (HPTLC-Si 60) systems containing a polar modifier (methanol, acetonitrile, dioxane, tetrahydrofuran, diisopropyl ether, ethyl methyl ketone, ethyl acetate, 2-propanol) or a polar (buffer solution) or non-polar diluent (n-heptane, hexane). Results under isocratic conditions in binary solvent systems showed a linear relationship ($R_M = f\gamma$) between the R_M values and the percentage concentration of the polar modifier. Retention data were analyzed as a function of mobile phase composition and solute molecular structure. There was an effect of individual substituents (as ΔR_M values) on retention relative to solvent type, and type of plate.

POSTER 39 - MONDAY 20:00-21:00

THE BIOCHEMICAL CHANGES IN PLANT CELLS DUE TO TOXIC CONCENTRATIONS OF SILVER

Teresa Switzer and Alicja Zobel, Department of Chemistry, Trent University, Peterborough ON K9J 7B8

Very high concentrations of silver have been found in soil and rock samples from Peru; often as high as 300 grams per tonne. As well, in particular areas of Lake Ontario it was found that the concentration of silver was so high that it was possible to develop photographic films in it. This high concentration of silver must affect plants. We found that both 300 and 3000 ppm silver nitrate ($AgNO_3$) affects *Tradescantia* plants, which are native to warm climates. The silver was absorbed by the plants and was transported to the top of the shoot in various proportions.

The silver caused shrinkage and blackening of tissues in the plant shoots, with a very distinctive barrier being formed between the black tissue and the green tissue on the stems. Such barriers contained drastic changes in concentrations of accumulated silver ions.

POSTER 40 - MONDAY 20:00-21:00

PHENOLIC INDUCTION UPON ULTRAVIOLET TREATMENT IN AUSTRIAN PINE

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Abstracts of Posters

Separated branches of Austrian Pine were removed and used to study the induction of phenolic metabolites upon treatment with two wavelengths of UV radiation. Many plant species can avert or reduce the damaging effect of UV-B radiation by the formation of UV-protecting pigments, as one of their defense systems.

Compounds absorbing ultraviolet radiation of 330 nm were extracted from both the internal and external parts of the pine needle after irradiation. Approximately 10% of all UV absorbing compounds were found embedded in the external wax layer.

POSTER 41 - MONDAY 20:00-21:00

EXPRESSION OF REPORTER GENES BY ELECTROPORATION OF INTACT MAIZE TISSUES

¹James A. Saunders, ²Nombasa Tsengwa, ¹R. Patel, ¹Mei Zhang, and ²M.S. McIntosh/ ¹USDA/ARS/CSL Bldg. 9, Rm 5, Beltsville, MD 10750 USA / ²U. of Maryland, Agronomy Dept. College Park, MD 20742 USA

Several useful reporter genes have been used to investigate successful gene transfer in plants by electroporation. These include chloramphenicol acetyl transferase (CAT), β -glucuronidase (GUS) and most recently the green fluorescent protein (GFP). Typically these plasmids are electroporated into protoplasts and the protoplasts are encouraged to regenerate into intact tissues. Recently, we have explored the possibility of electroporating plant tissue in which the cell wall has not been removed. Using maize, we have been successful in electroporating several reporter genes into germinating pollen as well as into excised embryo tissue. Both square wave and exponential pulse generators are capable of electroporating DNA through the intact cell wall. Expression is seen within 24 hours of the electroporation treatment. Permeabilization of intact tissues transforms individual cells, which then must be selected in an antibiotic or biochemical selection screen to yield stably transformed plants. The introduction of DNA by electroporation directly into maize embryos offers a tool for genetic transformation of economically important crops.

POSTER 42 - MONDAY 20:00-21:00

CONGEA TOMENTOSA ROXB.: LEAF MORPHOLOGY AND CHEMICAL COMPOSITION

Suzana G. Leitão, Débora O. Futuro (Departamento de Farmacognosia, Faculdade de Farmácia, UFRJ, Rio de Janeiro, Brazil) and Franco Delle Monache (Centro Chimica Recettori, Università Cattolica S. Cuore, Rome, Italy)

The genus *Congea* (Verbenaceae) comprises a number of species (c. 10) occurring from the Northeast of India (the name *Congea* derives from an East Indian vernacular name) to the Malayan peninsula. Its chemistry is completely unknown. *Congea tomentosa* is a climbing shrub with opposite entire leaves, ovate-

acute, hairy on both epidermis. The flowers are combined in large terminal panicles conspicuous for the pink and changing tints of the elliptic persistent bracts. Preliminary analysis of the ethyl acetate extract led to the isolation of: epicatechin, apigenin, 7-O-glucosyl-[4", 6"-di-O-*p*-coumaroyl]-apigenin, **1**, 7-O-glucosyl-[4" -O-*p*-coumaroyl]-apigenin, **2**, 7-O-glucosyl-[6" -O-*p*-coumaroyl]-apigenin, **3**, and verbascoside. As far as we know, **1-3** were isolated for the first time in Verbenaceae. Previously, it had been reported only from *Anisomeles ovata* (Lamiaceae), **2**, from *Sideritis* sp (Lamiaceae) and *Echinops echinatus* (Asteraceae) and **3** from *Pogostemon cablin* (Lamiaceae). FUJB, CNPq.

POSTER 43 - MONDAY 20:00-21:00

STUDIES ON TANNIN CONTENT OF PLANTS EATEN BY A GROUP OF HOWLING MONKEYS, *ALOUATTA FUSCA* (PRIMATES : CEBIDAE)

Luciene Ferreira, Gilda G. Leitão (Núcleo de Pesquisas de Produtos Naturais, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil), Suzana G. Leitão (Dept^o Farmacognosia, Faculdade Farmacia, UFJ, Rio de Janeiro, Brazil), Vania Limeira e Luiz Flamarion (Dept^o Mastozologia, Museu Nacional, UFRJ, Brazil)

A recent study on the diet of a group of *A. fusca*, which inhabits a fragment of secondary Atlantic Forest (semi-deciduous forest) shows that two plant species - *Apuleia leiocarpa* (= *A. praecox*, Leguminosae) and *Brosimum guianense* (Moraceae) are the major components (65%) of the diet of these animals.

The relative composition of this percentage varies seasonally. Another species - *Platypodium elegans* (Leguminosae) - stands out as the third preferred plant of the monkey during the dry season, whereas in the wet season this preference drops to 0.38%. Thus, this study examines the possible relationship between variation of leaf condensed tannins and total phenolics with seasonality and foliage consumption by *A. fusca*. *P. elegans* showed the lowest content of condensed tannins in both dry and wet season. The total phenolic contents were highest for *B. guianense* and *P. elegans*, varying smoothly along the year. For *A. leiocarpa*, however, this variation is abrupt with low levels in April-June, and a sudden increase from August onwards. CNPq.

POSTER 44 - MONDAY 20:00-21:00

INFLUENCE OF GROWTH CONDITIONS ON DEVELOPMENT
OF CALLUS OF *TAXUS BACCATA* L. AND ON TAXOL CONTENT
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Taxus baccata L. growing in Poland contains taxol and cephalomannine in the needles. These compounds were also determined in callus and suspension cultures of the species. HPLC method was used for taxane determination. The taxol content ranged from 0.42 µg/g to 26.32µg/g and cephalomannine from 6.55 µg/g to 64.80 µg/g of lyophilized callus or suspension culture. The highest content of taxol and cephalomannine was found in lyophilized cells of *T. baccata* suspension culture growing in WR medium with methyl jasmonate. Callus growing in light contains more cephalomannine than callus cultured in darkness. Light stimulates growth rate of callus.

POSTER 45 - MONDAY 20:00-21:00

HEBIVORY, OZONE AND UVB EFFECTS ON CUCURBITS

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Comparison of damage from herbivores and global change (ozone and UVB) in cucurbits revealed similar responses in cucurbitacins. Studies included two species of squash (garden squash, *Cucurbita pepo*; and an endangered native species, *C. okeechobeensis*) and three types of watermelons (domestic American, *Citrullus lanatus vulgaris*; naturalized Australian, *C. lanatus*; and native African, *C. colocynthis*). Total cucurbitacins increased (induction) for most species in most treatments. Induction of cucurbitacin D is associated with decreases in cucurbitacins I. Insects prefer these leaves. Production of cucurbitacin glycosides (E and I) are associated with the highest damage (MUVB and ozone) in both squash and watermelons. Phenolic production increased in most treatments. Australian watermelons had 4 times more cucurbitacins than their American ancestors.

POSTER 46 - MONDAY 20:00-21:00

INTERFERENCE POTENTIAL OF BIG BULRUSH WITH NORTHERN WILD RICE

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Big bulrush (*Scirpus acuta* L.), a common weed of wild rice (*Zizania aquatica* L.) in northern Ontario is suspected to cause growth inhibition of wild rice by chemical interference. Aqueous extracts of root, rhizome and shoot of big bulrush were tested to determine their phytotoxicity using a lettuce seedling bioassay. The primary root growth of lettuce seedlings was significantly inhibited (47.3 percent compared to control) by the rhizome

extract. The root and shoot extracts caused 2.3 and 16.3 percent inhibition compared to control. The aqueous extracts of the rhizome were further analyzed for the phytotoxic compounds using ethyl acetate extraction and GC - Mass spectroscopy. The organic fraction of ethyl acetate extracts contained lactic acid, succinic acid, fumaric acid, salicyl alcohol, 2-hydroxy succinic acid, *p*-hydroxy phenyl ethanol, 2-phenyl lactic acid, *m*-benzoic acid, *p*-hydroxy benzoic acid, protochatechuic acid, ferulic acid and catechin. Significance of these compounds to growth inhibition potential of wild rice associated with big bulrush is discussed.

POSTER 47 - MONDAY 20:00-21:00

"HYDROXYCINNAMIC ACID DERIVATIVES FROM *ASIMINA TRILOBA* AS OVIPOSITION STIMULANTS FOR ZEBRA SWALLOWTAIL BUTTERFLY"

Meena Haribal and Paul Feeny Section of Ecology and Systematics Cornell University, Ithaca NY 14853

Females of the zebra swallowtail butterfly, *Eurytides marcellus* (Fam: Papilionidae), oviposit only on *Asimina* species (Fam: Annonaceae) in North America. Bioassays guided our investigation of the role played by secondary plant chemistry in stimulating oviposition on *Asimina triloba*. We found that volatiles in a hexane extract of the plant enhance landing by female butterflies while egg laying is stimulated by polar hydroxycinnamic acid derivatives that are perceived on contact with the leaf surface. The compounds were identified on the basis of their spectral properties and by comparison with authentic samples.

POSTER 48 - MONDAY 20:00-21:00

THE EFFECT OF QUERCETIN AND RUTIN ON THE MIDGUT OF LEPIDOPTERAN LARVAE

Danica Baines, Ray Wilson and Mamdouh Abou-Zaid, Canadian Forest Service - Sault Ste. Marie, 1219 Queen St. E., Sault Ste. Marie, Ontario, Canada P6A 5M7

Spruce budworm and gypsy moth larvae are important pests in Canadian forests. Spruce budworm preferentially consume softwood foliage, while gypsy moth can consume both softwood and hardwood foliage. Two distinct flavanols, quercetin and rutin, are dominant in hardwood and softwood foliage, respectively. We examined the impact of these compounds on the first target tissues in the midgut of spruce budworm and gypsy moth larvae, epithelial cells and visceral muscle. A summary of the results will be presented.

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POSTER 49 - MONDAY 20:00-21:00

A ROLE OF NICOTINAMIDE, TRIGONELLINE AND POLY(ADP-RIBOSE)POLYMERASE IN STRESS SIGNALLING IN PLANTS?

A.B. Ohlsson, G. Kalbin*, A. Strid*, and T. Berglund, Dept. of Biochemistry and Biotechnology, Royal Inst. of Technology, S-100 44 Stockholm, Sweden, * Dept. of Biochemistry and Biophysics, University of Goteborg, S-413 90 Goteborg, Sweden

It has been suggested that poly(ADP-ribose)polymerase (PADPRP) mediated nicotinamide (NIC) release from NAD functions as a stress signal in plants and other eukaryotes (1). We show that treatment of plant tissue cultures with free radical generating substances or intact plants with UV-B exposure leads to increased tissue levels of NIC and its metabolite trigonelline (TRIG). It is known that NIC can induce defensive and secondary metabolism in plant tissue cultures (2,3). Here it is also demonstrated that NIC may protect the activity of oxidative-stress sensitive enzymes within the primary metabolism, e.g., aconitase. Results regarding differential effects of NIC and TRIG will be presented and discussed. The results support a role of PADPRP and NIC in defense signalling.

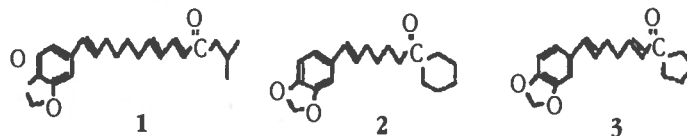
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POSTER 50 - MONDAY 20:00-21:00

EXPEDIENT SYNTHESSES OF UNSATURATED AMIDE ALKALOIDS FROM *PIPER* SPP. AND ACTIVITY OF THESE COMPOUNDS AGAINST SOME IMPORTANT INSECT PESTS

George M. Strunz and Heather Finlay, Natural Resources Canada, Canadian Forest Service - Maritimes, and Blair Helson, Natural Resources Canada, Canadian Forest Service - Sault Ste. Marie

Piper spp., including *Piper nigrum* (black pepper) produce an array of unsaturated amide alkaloids, many of which exhibit pronounced bioactivity, e.g., insecticidal properties. We have devised new expedient synthetic approaches to these compounds, based on recently developed chemical methodology. The efficiency and brevity of the new strategy has allowed ready and rapid access to a dozen of these alkaloids, including piperidine **1**, piperolein A, **2**, and sarmentosine **3**.



Results of preliminary assays to the insecticidal activity of some of these compounds against important insect pest spp. are reported.

Research Report

Kazimierz Glowniak

Department of Pharmacognosy, The Medical Academy

Lublin, Poland

Our main research interests concern phytochemical investigations of the coumarins from medicinal plants of the family Umbelliferae. Linear furanocoumarins (psoralens) exhibit significant biological activity, having been implicated in induction of photophyto dermatitis, as antimicrobial agents, insect antifeedants, mutagens, cytotoxins and plant growth regulators.

One of the strategies used by plants to protect against attack by microbial pathogens is production of phytoalexins, of which linear psoralens are only one example. But biosynthesis of these psoralens is induced in response to various forms of stress: microbial infection, insect-linked wounding, or environmental stress due to temperature variations, higher doses of UV, and air pollution. Infection of celery by *Sclerotinia sclerotiorum*, for example, leads to the production of such elevated levels of psoralens that they can induce photophyto dermatitis in celery handlers and processors when they are exposed to light.

The different psoralens have varying activities in inducing the photosensitizing reaction. Our earlier studies on roots of *Angelica archangelica* showed that in response to infection by five fungal strains the level of synthesis of four different psoralens after 4-5 days of incubation increased two- to threefold. I believe that quantitative determination of specific furanocoumarins instead of merely their total amount is of greater value in assessing risks to human health.

We have investigated the localization of psoralens in pathogen-infected plant tissues and their concentrations. As a result we suggest that stimulation of plant resistance to disease is connected with the creation of optimal proportions of psoralens and their localization on the surface (epidermis) of the plant.

In addition to psoralens we have been interested in taxol, a diterpenoid compound of *Taxus* species which exhibits activity against various leukemias, Sarcoma 180 and Lewis lung tumour. Its extraction and isola-

tion from plant material present many difficulties because it and other taxane derivatives generally occur in very low concentrations in *Taxus*. We are employing HPLC and SPE for quantitative determination of the content of taxol and related compounds, as well as coumarins.

The process of regeneration in vitro of some medicinal plants (*Carum carvi*, *Apium graveolens*, *Pastinaca sativa* and *Archangelica officinalis*) is currently being studied. We are also interested in the initiation of callus cultures, and are attempting to establish parameters of media composition and culture conditions for the development of plant tissue cultures of various species in vitro. The object is to optimize the production of callus and to maximize the yields of chemical compounds which are important from the physiological and biological points of view. ■