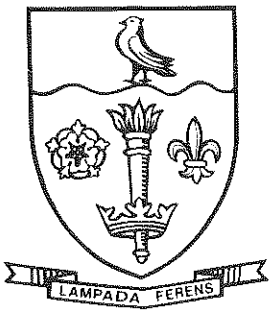
Fourth Annual Meeting

International Society of Chemical Ecology



University of Hull, England
The Lawns Halls
13th - 17th July, 1987

Fourth Annual Meeting of ISCE

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List of Participants and Guests	49

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Daily Schedule of Events

All activities, including meals, will be in the Lawns Centre unless otherwise stated.

Day and Date	Time	Event	Location
Sunday 12th July	afternoon	Executive Officers and Council Meeting	Party Room
Monday 13th July	morning	Executive Officers and Council Meeting	Party Room
	1400 onwards	Registration Preparation of Posters	Entrance Hall Main Concourse
	1800-1900	Wine Reception (Mixer)	Main Concourse and Courtyard (if fine)
	1915	Dinner	Hexagon Room
	After Dinner - 2230	Preparation of Posters and Bar	Main Concourse
Tuesday 14th July	7.45-8.50	Breakfast	Verandah
	9.00-9.15	Welcome by the Vice Chancellor of the University of Hull, Professor William Taylor, CBE	
	9.15-1035	Invited Papers	Main Concourse
	1035-1105	Break (coffee)	Verandah
	1105-1225	Invited Papers	Main Concourse
	1225-1315	Discussion + free time	
	1315-	Lunch	Hexagon Room
	1430-1530	Contributed Paper Session A Session B	Main Concourse Party Room
	1530-1600	Break (tea)	Verandah
	1600-1700	Contributed Paper Session A Session B	Main Concourse Party Room
	1700-1815	Posters	Main Concourse
	1825 for 1830	Assemble outside main entrance to Lawn's Centre	
	1830-1900	Travel by bus to Guildhall	

	1900-1945	Reception at Guildhall by the Deputy Lord Mayor of Kingston upon Hull Councillor (Mrs.) M. Smelt and Mr. W. Smelt	
	1945-2015	Return to the Lawns	
	2015	Dinner	
	After Dinner to Midnight	Posters and Bar in Main Concourse	
Wednesday 15th July	7.45-8.50	Breakfast	Verandah
	9.00-1020	Invited papers	Main Concourse
	1020-1050	Break (coffee)	Verandah
	1050-1210	Invited papers	Main Concourse
	1210-1300	Society Business	Main Concourse
	1300-1400	Lunch	Hexagon Room
	1400-1830	Excursions a) Spurn Peninsula b) Wharram Quarry and Wharram Percy	
	1830-1915	Free - the Bar will be open	
	1915	Dinner	
	After Dinner to Midnight	Free time. Bar in Main Concourse ? Executive and Council Meeting	
Thursday 16th July	7.45-8.50	Breakfast	Verandah
	9.00-1020	Invited papers	Main Concourse
	1020-1050	Break (coffee)	Verandah
	1050-1250	Invited papers	Main Concourse
	1300-1415	Lunch	Hexagon Room
	1415-1515	Contributed papers Session A Session B	Main Concourse Party Room
	1515-1545	Break (Tea)	Verandah
	1545-1645	Contributed papers Session A Session B	Main Concourse Party Room
	1645-1900	Posters	Main Concourse

	1900-1930	Host's Reception	Verandah
	1930	Conference Dinner (Banquet) Main Speaker: Professor Jeffrey B. Harborne	Hexagon Room
	After Dinner to Midnight	Bar in Main Concourse	
Friday 17th July	7.45-8.50	Breakfast	Verandah
	9.00-1020	Invited papers	Main Concourse
	1020-1050	Break (Coffee)	Verandah
	1050-1250	Invited papers	Main Concourse
	1250-1305	Meeting adjourns	
	1310	Lunch	
	Afternoon	? Meeting of Executive Committee	

Tuesday 14th July

Symposium 1 - The Veracity of Bioassays in Chemical Ecology
Convenor - D. A. Jones

9.15 - 9.55

BIOASSAYS: JUST WHAT ARE WE TRYING TO TEST?
Dr. Jane L. Wolfson
Department of Entomology, Purdue University, West Lafayette, Indiana 47907, U.S.A.

9.55 - 10.35

THE BIOASSAY OF NATURALLY OCCURRING COMPOUNDS FOR PHYTOTOXICITY
Dr. Gerald R. Leather
Foreign Disease-Weed Science Research, USDA-ARS, Fort Detrick, Building 1301, Frederick, Maryland 21701, U.S.A.

10.35 - 11.05

BREAK

11.05 - 11.45

BIOASSAYS OF SEGREGATING PLANTS: A STRATEGY FOR STUDYING CHEMICAL DEFENSES
Dr. Stephen Sinden
USDA/ARS, Vegetable Laboratory, Beltsville, MD 20705, U.S.A.

11.45 - 13.00

DISCUSSION

Session A - Concourse
Session Leader - R. M. Silverstein

14.30 - 14.42

CHEMICAL AND BEHAVIORAL ECOLOGY OF PHEROMONE RELEASE BY MALE CARIBBEAN FRUIT FLIES
James L. Nation
Department of Entomology and Nematology, 202 Newell Hall, University of Florida, Gainesville, Florida, 32611 U.S.A.

14.42 - 14.54

THE SEX PHEROMONE OF THE HOUSEFLY: SYNTHESIS OF COMPONENTS AND THEIR BIOLOGICAL ACTIVITY
Dalia LaFrance and Arnon Shani
Department of Chemistry, Ben-Gurion University of the Negev, Be'er Sheva 84105, Israel

14.54 - 15.06

THE FORMATION OF THE SEX PHEROMONE IN SPODOPTERA LITTORALIS
E. Dunkelblum and M. Kehat
Institute of Plant Protection, Volcani Center, Bet Dagan 50 250, Israel

15.06 - 15.18

A MODEL OF PHEROMONE MOLECULE RECEPTOR REGION, AND ITS APPLICATION IN THE DEVELOPMENT OF SEX ATTRACTANT INHIBITORS
H. J. Bestmann
Institut für Organische Chemie der Universität Erlangen-Nürnberg, D-8520 Erlangen, F.R.G.

15.18 - 15.30

SEMIOCHEMICALS PRODUCED BY THE FEMALE TERGAL GLANDS OF THE PRIMITIVE COCKROACH CRYPTOCERCUS PUNCTULATUS
R. Brossut, +C. Nalepa, *J. L. Lequerré, O. Bonnard
Lab. Zoologie, CNRS UA 674, Universite Dijon, France
+Department of Entomology, North Carolina State University, Raleigh, U.S.A.
*Lab. de Recherches sur les Aromes, INRA, Dijon, France

Session B - Party Room
Session Leader - J. L. Wolfson

14.30 - 14.42

TACTICS OF MONARCH BUTTERFLY SPRING MIGRATION
Stephen B. Malcolm, Barbara J. Cockrell and Lincoln P. Brower
Department of Zoology, University of Florida, 223 Bartram Hall, Gainesville, FL 32611, U.S.A.

14.42 - 14.54

ISOLATION AND BIOASSAYING OF YELLOW SQUASH (CUCURBITA PEPO) LEAF COMPONENTS FOR STIMULATION OF OVIPOSITION BY THE PICKLEWORM MOTH (DAPHNIA NITIDALIS, STOLL.)
Joseph K. Peterson and Kent D. Elsey
U.S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29407, U.S.A.

14.54 - 15.06

BIOASSAYS FOR THE MULTIPLE EFFECTS OF SWEET POTATO PERIDERM CHEMICALS
Howard F. Harrison, Joseph K. Peterson and Philip D. Dukes
U.S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29407, U.S.A.

15.06 - 15.18

TO EAT OR NOT TO EAT. HOST SELECTION BEHAVIOUR OF THREE CREOSOTE-BUSH-FEEDING GRASSHOPPERS IN SOUTHERN CALIFORNIA
R. F. Chapman, E. A. Bernays and *T. D. Wyatt
Department of Entomology and Division of Biological Control, University of California, Berkeley, California 94720, U.S.A.
*Cleppa Park Field Research Station, University College, Cardiff CF1 1XL, U.K.

15.18 - 15.30

TOXICITY AND FATE OF ACETYLCHROMENES IN THE MIGRATORY GRASSHOPPER
+Murray B. Isman and *Peter Proksch
+Department of Plant Science, University of British Columbia, Vancouver, Canada
*Technische Universität, Braunschweig, West Germany

Session A - Concourse
Session Leader - F. A. Einhellig

16.00 - 16.12

RAPIDLY INDUCED CHEMICAL CHANGES IN BIRCH FOLIAGE
S. E. Hartley
University of York, Heslington, York YO1 5DD U.K.

16.12 - 16.24

THE BIOGEOLOGY AND ECOTOXICOLOGY OF MERCURY IN PLANTS
B. Z. Siegel and S. M. Siegel
School of Public Health and Department of Botany, University of Hawaii at Manoa, Honolulu, HI 96822, U.S.A.

16.24 - 16.36

DENSITY-DEPENDENT PHYTOTOXICITY: A PROMISING METHOD FOR ALLELOPATHIC INVESTIGATIONS
Jeffrey D. Weidenhamer, *David C. Hartnett and John T. Romeo
Department of Biology, University S. Fla., Tampa, FL 33620, U.S.A.
*Division of Biology, Kansas State University, Manhattan, KS 66506, U.S.A.

16.36 - 16.48

ALLELOPATHIC EFFECTS OF TOMATO PLANTS ON SOME SELECTED SPECIES
+Kim, Young Sik and *Bong-seop Kil
+Department of Physical Therapy, Wonkwang Public Health Junior College
*Department of Biology Education, Wonkwang University, Iri, Republic of Korea

16.48 - 17.00

COMPARATIVE STUDY OF ALLELOPATHY AS EXHIBITED BY PROSOPIS JULIFLORA AND PROSOPIS CINERARIA
Usha Goel
School of Environmental Sciences, Jawaharlal Nehru University, New Delhi - 110 067 India

Session B - Party Room
Session Leader - John H. Sudd (Hull)

16.00 - 16.12

SLAVES AND SLAVE-MAKERS AMONG ANTS: A COMPARISON OF DUFOUR GLAND SUBSTANCES
E. D. Morgan
Department of Chemistry, University of Keele, Keele, Staffs, England

16.12 - 16.24

DEFENSIVE ALLOMONES FROM THE METAPLEURAL GLAND OF THE ANT, CREMATOGASTER DIFFORMIS (HYMENOPTERA: MYRMICINAE)
+A. B. Attygalle, +B. Siegel, +O. Vostrowsky, +H. J. Bestmann and *U. Maschwitz
+Institut für Organische Chemie der Universität Erlangen-Nürnberg, D-8520 Erlangen, F.R.G.
*Zoologisches Institut der Universität, D-6000, Frankfurt, F.R.G.

16.24 - 16.36

A COMPARISON OF THE VOLATILES FROM A PARASITOID WASP (ORASEMA sp., EUCHARITIDAE) AND ITS ANT HOST (SOLENOPSIS INVICTA, FORMICIDAE)
+Lloyd R. Davis, Jr., *Robert K. Vander Meer, *Donald P. Jouvenaz and Daniel P. Wojcik
*U.S. Department of Agriculture, Agricultural Research Service, P.O. Box 14565, Gainesville, Florida 32604, U.S.A.
+Department of Entomology and Nematology, Gainesville, Florida 32611, U.S.A.

16.36 - 16.48

THE ROLE OF ENVIRONMENT-DERIVED CUES IN NESTMATE RECOGNITION IN RED CARPENTER ANT WORKERS
Laurence Morel and Robert K. Vander Meer
U.S. Department of Agriculture, Agricultural Research Service, Insects Affecting Man and Animals Research Laboratory, P.O. Box 14565, Gainesville, Florida 32604, U.S.A.

16.48 - 17.00

THE USE OF CHEMICAL CHARACTERS IN DEFINING POPULATIONS OF FIRE ANTS IN THE UNITED STATES AND SOUTH AMERICA
Robert K. Vander Meer and Clifford S. Lofgren
U.S. Department of Agriculture, Agricultural Research Service, Insects Affecting Man and Animals Research Laboratory, P.O. Box 14565, Gainesville, Florida 32604, U.S.A.

POSTERS

MALE SEX PHEROMONE IN THE GENUS XYLOTRECHUS AND ITS RELATED GENERA

Tsutomu Sakai and Kikuo Iwabuchi
Suntory Institute for Bioorganic Research, Shimamoto-cho, Mishima-gun, Osaka-fu 618, Japan

EVIDENCE FOR ALLELOPATHIC EFFECTS OF POLYGONELLA MYRIOPHYLLA

Jeffrey D. Weidenhamer and John T. Romeo
Department of Biology, University of South Florida, Tampa, FL 33620, U.S.A.

CHEMICAL ECOLOGY OF OREINA CACALIAE: VARIATION AT THE SUBSPECIES AND POPULATION LEVEL

M. Rowell-Rahier and +J. M. Pasteels
Zoology Institut, Rheinsprung 9, 4057 Basel, Switzerland
+Lab. Biologie anim. & cel., Fac. Sciences, ULB, Avenue F.D. Roosevelt 50, 1050 Bruxelles, Belgium

FEMALE LUTZOMYIA LONGIPALPIS (DIPTERA: PSYCHODIDAE) RESPONSE TO HOSTS IN THE PRESENCE OF A PHEROMONE

R. D. Ward, V. Lancaster and P. Smith
Department of Medical Entomology, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA U.K.

PHEROMONE DISC CONTACT BIOASSAY OF THE SANDFLY LUTZOMYIA LONGIPALPIS (DIPTERA: PSYCHODIDAE)

I. Morton and R. D. Ward
Department of Medical Entomology, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA U.K.

EFFECTS OF MICROALGAL METABOLITES ON PARTICLE SELECTION AND FILTRATION RATES OF MUSSELS

J. Evan Ward and Nancy M. Targett
University of Delaware, College of Marine Studies, Lewes, Delaware 19958 U.S.A.

THE CHEMICAL RELATIONS BETWEEN ALLIUM, THE LEEK-MOTH AND ITS ENTOMOPHAGE

E. Thibout, C. Lecomte and J. Auger
Institut de Biocénotique Expérimentale des Agrosystèmes, Faculté des Sciences, Parc Grandmont, 37200 Tours, France

DETERRENCY, TOXICITY AND MODE OF ACTION OF AZADIRACHTIN IN SCHISTOCERCA GREGARIA AND LOCUSTA MIGRATORIA

A. J. Mordue (Luntz) and F. Plane
Department of Zoology, University of Aberdeen, Aberdeen AB9 1AS U.K.

SEX PHEROMONE OF THE WHITE RICE STEMBORER MALIARPHA SEPARATELLA

+Alan Cork and *Martin Agyen-Sampong
+Tropical Development and Research Institute, 56-62 Gray's Inn Road, London WC1X 8LU U.K.
*West African Rice Development Association, PMB 678, Freetown, Sierra Leone

THE PHEROMONE OF THE COCOA POD BORER MOTH CONOPOMORPHA CRAMERELLA AND ITS USE IN AN INTEGRATED PEST MANAGEMENT STRATEGY

P. S. Beevor, +J. D. Mumford, *S. Shah, -S. H. Ho and R. Liew
Tropical Development and Research Institute, 56-62 Grays Inn Road, Holborn, London WC1X 8LU U.K.
+ Silwood Centre for Pest Management Studies, Imperial College at Silwood Park, Ascot, Berks. SL5 7PY U.K.
* BAL Estates, P.O. Box 135, Tawau, Sabah, E. Malaysia
- Sabah Softwoods SB, P.O. Box 137, Tawau, Sabah, E. Malaysia

SEASONAL FLUCTUATIONS OF PLANT PHENOLIC ACIDS IN SOILS OF A BOTTOMLAND DECIDUOUS FOREST IN THE SOUTHEASTERN UNITED STATES

Barry R. Dalton and Jodi R. Shann
Savannah River Ecology Laboratory of the University of Georgia, Drawer E, Aiken, SC 29801, U.S.A.

CATERPILLAR/HOST PLANT INTERACTIONS: ENZYME INDUCTION AND INSECTICIDE TOLERANCE

Andrew J. Walker
Department of Pure and Applied Zoology, University of Reading, Whiteknights, Reading, Berks. RG6 2AJ U.K.

EFFECTS OF WEED AND CROP ALLELOCHEMICALS

J. V. Lovett, D. L. Liu and M. Y. Ryuntyu
Department of Agronomy and Soil Science, University of New England, Armidale, NSW 2351, Australia

THE ROLE OF 4-CRESOL AND 3-n-PROPYLPHENOL IN THE TSETSE ATTRACTION OF BUFFALO URINE AND THEIR ORIGIN

A. Hassanali, M. L. Owaga and P. G. McDowell
The International Centre of Insect Physiology and Ecology (ICIPE), P.O. Box 30772, Nairobi, Kenya

AN AGGREGATION PHEROMONE OF THE PEA AND BEAN WEEVIL, SITONA LINEATUS

+Margaret M. Blight, +J. A. Pickett, *O. R. W. Sutherland and +L. J. Wadhams
+Department of Insecticides and Fungicides, AFRC Institute of Arable Crops Research, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ U.K.
*Entomology Division, Department of Scientific and Industrial Research, Auckland, New Zealand

AN APHID SEX PHEROMONE

G. W. Dawson, D. C. Griffiths, N. F. Janes, L. A. Merritt, A. Mudd, J. A. Pickett, L. J. Wadhams and Christine M. Woodcock
Department of Insecticides and Fungicides, AFRC Institute of Arable Crops Research, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ U.K.

VOLATILES OF SORGHUM BICOLOR (L.) MOENCH - ELECTROANTENNOGRAM RECORDINGS ON CHILO PARTELLUS (SWINHOE) MOTHS

+W. Lwande, *M. D. Bentley and +S. M. Wallade
+The International Centre of Insect Physiology and Ecology (ICIPE), P.O. Box 30772, Nairobi, Kenya
*Department of Chemistry, University of Maine, Orono, Maine 04469, U.S.A.

CONSTITUENTS OF THE VOLATILE OIL OF THE DECIDUOUS SHRUB, COMMIPHORA ROSTRATA: POSSIBLE ROLE IN PLANT DEFENCE

+Phillip G. McDowell, +Wilber Lwande and *Peter G. Waterman
+International Centre of Insect Physiology and Ecology, P.O. Box 30772, Nairobi, Kenya
*Phytochemistry Research Laboratories, Department of Pharmacy, University of Strathclyde, 204 George Street, Glasgow G1 1XW U.K.

SUNFLOWER POLLEN: ITS IMPORTANCE IN THE REPRODUCTIVE BIOLOGY OF HOMOEOSOMA ELECTELLUM (LEPIDOPTERA: PYRALIDAE)

Jeremy N. McNeil and Johanne Delisle
Département de Biologie, Université Laval, Québec, P.Q., G1K 7P4 Canada

APHID RESPONSE TO NON-PROTEIN AMINO ACIDS OF CALLINDRA

Monique J. Simmonds, +Wally M. Blaney and *John T. Romeo
Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3DS U.K.
+Department of Biology, Birkbeck College, London WC1E 7HX U.K.
*Department of Biology, University of South Florida, Tampa, FL 33620 U.S.A.

Wednesday 15th July

Symposium 2 - Chemical Ecology and Plant Protection
Convenor - J. B. Harborne

9.00 - 9.40

DEVELOPMENT OF PLANT DERIVED ANTIFEEDANTS FOR ARABLE AGRICULTURE
Dr. John A. Pickett
Department of Insecticides and Fungicides, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ U.K.

9.40 - 10.20

BULLFINCHES AND ASH TREES - DO PLANT CHEMICALS CONTROL HERBIVORE DAMAGE IN A LONG-LIVED SPECIES?
Dr. Peter W. Greig-Smith
Ministry of Agriculture, Fisheries and Food, Tolworth Laboratory, Surbiton, Surrey, KT6 7NF U.K.

10.20 - 10.50

BREAK

10.50 - 11.30

PLANT POLYPHENOLS - FACT AND FICTION
Professor Edwin Haslam
Department of Chemistry, University of Sheffield, Sheffield S3 7HF U.K.

11.30 - 12.10

ALKALOIDAL AND TERPENOID ACTION AGAINST INSECTS: SOME OF THEIR TARGETS
Dr. Jean-Luc Clement
Cytophysiologie des Arthropodes, Université Pierre et Marie Curie, 105 Boulevard Raspail, 75006 Paris, France

12.10 - 13.00

SOCIETY BUSINESS

Thursday 16th July

Symposium 3 - The Applications of Chemical Ecology
Convenor - J. H. Langenheim

9.00 - 9.40

THE APPLICATION OF SEX-ATTRACTANTS FOR MONITORING THE PEA MOTH, CYDIA NIGRICANA (F.) (LEPIDOPTERA: TORTRICIDAE)
Dr. Clive Wall
Entomology Department, Institute of Arable Crops Research, Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ U.K.

9.40 - 10.20

POTENTIALS FOR EXPLOITING ALLELOPATHY TO ENHANCE CROP PRODUCTION
Dr. Frank A. Einhellig
Department of Biology, University of South Dakota, Vermillion, SD 57069, U.S.A.

10.20 - 10.50

BREAK

10.50 - 11.30

CHEMICAL ECOLOGY AND THE SEARCH FOR MARINE ANTI-FOULANTS: STUDIES OF A PREDATOR-PREY SYMBIOSIS
Dr. Donald J. Gerhart
Marine Laboratory, Duke University, Pivers Island, Beaufort, North Carolina 28516 U.S.A.

11.30 - 12.10

MATING DISRUPTION IN EUROPEAN ORCHARDS AND VINEYARDS: PRESENT AND FUTURE
Dr. Heinrich Arn
Swiss Federal Research Station for Fruit Growing, CH-8820 Wädenswil, Switzerland

12.10 -12.50

DISCUSSION

Session A - Concourse
Session Leader - G. Bergstrom

14.15 - 14.27

LIMONENE: ITS ROLE IN DEFENSE OF SPRUCE AND TAMARACK FROM ATTACK BY BARK BEETLES
Richard H. Werner
Institute of Northern Forestry, USDA Forest Service, University of Alaska, Fairbanks, AK 99775-5500 U.S.A.

14.27 - 14.39

MONOTERPENE VARIATIONS IN DEFENSIVE SECRETIONS OF SOME NEW GUINEAN NASUTITERMES
+C. Everaerts, *J. M. Pasteels, +O. Bonnart and *Y. Roisin
+Université de Bourgogne, Dijon, France
*Université Libre de Bruxelles, Belgique

14.39 - 14.51

PHEROMONES OF BUMBLE BEE AND ANT SPECIES: STUDIES OF DOUBLE BOND POSITIONS OF STRAING CHAIN VOLATILE COMPOUNDS
Boel S. Lanne and Gunnar Bergström
Department of Chemical Ecology, University of Göteborg, Box 33 031, S-400 33 Göteborg, Sweden

14.51 - 15.03

QUASISYNERGISMS AND SELF PROTECTION - EVOLUTIONARY PRINCIPLES IN STAPHYLINID BEETLE DEFENSIVE SECRETIONS
Konrad Dettner
Institute of Animal Ecology, Universität Bayreuth, D-8580 Bayreuth, F.R.G.

15.03 - 15.15

SYNERGISM AND RELATIVE EFFICIENCY OF SEMIOCHEMICALS FOR JAPANESE BEETLE ATTRACTION IN THE AZORES
+A. Martins, *M. R. Paiva, and +N. Simões
+Departmento de Biologia, Universidade dos Açores, 9502 Ponta Delgada, Portugal
*D.C.E.A., Universidade Nova de Lisboa, 2825 Monte de Caparica, Portugal

Session B - Party Room
Session Leader - S. G. Compton

14.15 - 14.27

DISRUPTION OF SPIDER WEB STRUCTURE BY THE PLANT-DERIVED CHEMICAL DEFENCE OF AN APHID
Stephen B. Malcolm
Department of Zoology, University of Florida, 223 Bartram Hall, Gainesville, FL 32611, U.S.A.

14.27 - 14.39

HERBIVORES ON FIG TREES MINIMISE THEIR EXPOSURE TO LATEX
S. G. Compton
Department of Zoology and Entomology, Rhodes University, Grahamstown, South Africa

14.39 - 14.51

DEFENSIVE STRATEGIES AND ECOLOGY IN THE SAWFLY LARVAE CROESUS VARUS AND C. SEPTENTRIONALIS
Jean-Luc Boevé and Jacques M. Pasteels
Lab. Biol. animale et cellulaire C.P. 160, U.L.B., Brussels, Belgium

14.51 - 15.03

BUZZ POLLINATION AND FLORAL ODOR CHEMISTRY OF CLETHRA ALNIFOLIA L. (CLETHRACEAE)
J. C. Hemingson
University of Connecticut, Storrs, CT, 06268 U.S.A.

15.03 - 15.15

IS EXTRAFLORAL NECTAR PRODUCTION AN INDUCIBLE ANTIHERBIVORE DEFENSE?
Suzanne Koptur
Department of Biological Sciences, Florida International University, Miami, FL 33199 U.S.A.

Session A - Concourse
Session Leader - J. G. Roddick

15.45 - 15.57

DIETARY TANNINS AND THEIR ACTION IN MAMMALS
Simon Mole, Larry G. Butler, *John C. Rogler and Carlos J. Morell
*Department of Biochemistry and Department of Animal Science, Purdue University, West Lafayette, IN 47907, U.S.A.

15.57 - 16.09

SYNERGISTIC INTERACTION BETWEEN BIOLOGICALLY-ACTIVE SOLANUM GLYCOALKALOIDS
J. G. Roddick
Department of Biological Sciences, Washington Singer Laboratories, University of Exeter, Exeter EX4 4QQ U.K.

16.09 - 16.21

ABSTINON IN THE TSETSE FLY, GLOSSINA MORSITANS: ISOLATION AND IDENTIFICATION OF A LONG-CHAIN ALKENE
+D. A. Carlson and *J. C. Schlein
+United States Department of Agriculture, Agriculture Research Service, Insects Affecting Man and Animals Research Laboratory, P.O. Box 14565, Gainesville, Florida, 32604, U.S.A.
*Department of Parasitology, Hadassah Medical School, The Hebrew University of Jerusalem, Jerusalem, Israel

16.21 - 16.33

SOME INSECT-ACTIVE MATERIALS FROM PLANTS
K. L. Mikolajczak
Northern Regional Research Center, Agricultural Research Service, U.S. Department of Agriculture, Peoria, IL 61604 U.S.A.

16.33 - 16.45

ELECTROPHYSIOLOGY OF TASTE RECEPTORS: A BIOASSAY TOOL
Monique J. Simmonds and +W. M. Blaney
Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3DS U.K.
+Department of Biology, Birkbeck College, London WC1E 7HX U.K.

Session B - Party Room
Session Leader - L. P. Brower

15.45 - 15.57

PERCEPTION OF PHEROMONES IN MARINE BROWN ALGAE
Wilhelm Boland
Institut für Biochemie, An der Bottmühle 2, D-5000 Köln 1, FRG

15.57 - 16.09

SNAIL HERBIVORY ON ENDOLITHIC LICHENS: THE WEATHERING OF A DESERT AND OTHER CHEMICAL PHENOMENA
+Clive G. Jones, *Moshe Shachak and *Yigal Granot
+Institute of Ecosystem Studies, Millbrook, New York 12545, U.S.A.
*Mitrani Centre for Desert Ecology, Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev, Sede Boger Campus, Israel 84990

16.09 - 16.21

HOST AND NONHOST PLANT DISCRIMINATION IN TWO PHYTOPHAGOUS FLIES: THE ROLE OF CABBAGE PLANT COMPOUNDS
Reto Schöni and Erich Städler
Edig. Forschungsanstalt, CH-8820 Wädenswil, Switzerland

16.21 - 16.33

CARDENOLIDES IN ERYSIMUM CHEIRANTHOIDES DETERRING OVIPOSITION BY THE CABBAGE BUTTERFLY, PIERIS RAPAE
J. A. A. Renwick, C. D. Radke and K. Sachdev
Boyce Thompson Institute, Ithaca, NY 14853, U.S.A.

16.33 - 16.45

CARDENOLIDE COEVOLUTION: FACT OR FICTION?
Lincoln P. Brower
Department of Zoology, University of Florida, 223 Bartram Hall, Gainesville, FL 32611, U.S.A.

Friday 17th July

Symposium 4 - Biochemical mechanisms and defence compounds
Convenor - M. F. Ryan

9.00 - 9.40

ENZYME ADAPTATIONS IN FOLIAGE-FEEDING INSECTS TO HOST PLANTS
Dr. Lena B. Brattsten
Department of Entomology, Rutgers University, P.O. Box 231, New Brunswick, New Jersey 08903 U.S.A.

9.40 - 10.20

INSECT PERCEPTION OF PHYTOCHEMICAL NAPHTHOQUINONES AS ALLELOCHEMICALS
Dr. Dale M. Norris
Department of Entomology, University of Wisconsin, Madison, WI 53706 U.S.A.

10.20 - 10.50

BREAK

10.50 - 11.30

PLANT DEFENCE COMPOUNDS AS INHIBITORS OF ACETYLCHOLINESTERASE
Dr. Michael F. Ryan
Department of Zoology, University College, Dublin, Eire

11.30 - 12.10

ADAPTIVE RELATIONSHIPS OF EPOXIDE HYDROLASE IN HERBIVOROUS INSECTS
Dr. Christopher A. Mullin
Department of Entomology, Pennsylvania State University, University Park, PA 16802 U.S.A.

12.10 - 12.50

OLIGOSACCHARIDE SIGNALLING OF PROTEINASE INHIBITOR GENES
Dr. Roxanne M. Broadway
Institute of Biological Chemistry, Washington State University, Pullman, WA 99164-6340 U.S.A.

12.50 - 13.05

MEETING ADJOURNS

BIOASSAYS: JUST WHAT ARE WE TRYING TO TEST?

Jane L. Wolfson
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A great many hypotheses have been generated which touch upon the relationships of insect herbivores to their host plants. It has, however, proven easier to generate hypotheses than to test them. The dynamic nature of plant-insect interactions and the exacting requirements of hypothesis testing are often difficult to reconcile. How does one test the importance of a single component within a complex system without seriously compromising the integrity of the system? Can artificial diets be used to solve some of these problems or do they just create new ones?

Although no perfect solutions will be offered, some common problems and successful methods will be discussed.

THE BIOASSAY OF NATURALLY OCCURRING COMPOUNDS FOR PHYTOTOXICITY

Gerald R. Leather and Frank A. Einhellig
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The bioassay has been one of the most widely used tests to demonstrate allelopathic activity. Often, claims that a particular plant species inhibits the growth of another are based entirely on the seed germination response to solvent extracts of the suspected allelopathic plant; few of these tests are of value in relating the results to the demonstration of allelopathy under natural conditions. In tests that compared known allelochemicals in several bioassay systems, we found that seed germination was the least sensitive bioassay with limited parameters as the measure of activity. Because allelochemicals have different mechanisms of phytotoxic activity, bioassays should allow detection of activities other than germination. The bioassay should also be sensitive to the relatively small amounts of allelochemical available to perform the first tests. The Lemna sp. bioassay meets the requirements for a test of several mechanisms of phytotoxic activity that can be determined with extremely small amounts of chemical. Depending upon the species of Lemna selected, inhibitors of growth, reproduction, photosynthesis, respiration, chlorophyll and anthocyanin synthesis/degradation, and other processes can be detected. This bioassay can be employed at every step in the procedure of isolating and identifying allelochemicals. However, the definitive bioassays for the allelopathic potential of a plant species should be performed using the target species. There is no perfect assay that will meet all the requirements for detecting the phytotoxicity of naturally occurring compounds, and it would be prudent to use several for each case of suspected allelopathic interaction.

BIOASSAYS OF SEGREGATING PLANTS: A STRATEGY FOR STUDYING CHEMICAL DEFENSES

S. L. Sinden, L. L. Sanford, W. W. Cantelo and K. L. Deahl
USDA, Agriculture Research Service, Beltsville, MD 20705 U.S.A.

Most genotypes of Solanum chacoense synthesize the glycoalkaloids, solanine (sol) and chaconine (chac), and are hosts of Leptinotarsa decemlineata. A few rare segregates in S. chacoense have a gene for acetylation of carbon

23 of the steroid aglycone of sol and chac. Laboratory bioassays and replicated field tests of sib-clones segregating for presence/absence of the acetyl moiety showed that acetylation of sol and chac markedly affects the response of both adults and larvae to the foliage. Measurements of adult feeding-deterrency conferred by acetylated forms of sol and chac (leptines) in leaf-disk preference tests were consistent with the degree of antixenosis measured in the field. Development of larvae on foliage from segregates with leptines was also inhibited. The studies support the validity of using laboratory bioassays of plants segregating for levels of a suspected defense compound to determine the role the compound has in defending the plant from attack by an insect predator.

DEVELOPMENT OF PLANT-DERIVED ANTIFEEDANTS FOR ARABLE AGRICULTURE

Y. Asakawa (1), G. W. Dawson (2), D. C. Griffiths (2), S. V. Ley (3), K. Mori (4), A. Mudd (2), J. A. Pickett (2), L. J. Wadhams (2), H. Watanabe (4), C. M. Woodcock (2) and Z-n Zhang
(1) Institute of Pharmacognosy, Tokushima Bunri University, Yamashiro-cho, Tokushima 770, Japan
(2) Department of Insecticides and Fungicides, Rothamsted Experimental Station, AFRC Institute of Arable Crops Research, Harpenden, Herts. AL5 2JQ U.K.
(3) Department of Chemistry, Imperial College of Science and Technology, Prince Consort Road, London SW7 2AY
(4) Department of Agricultural Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113, Japan

Sesquiterpenoids in the drimane group, particularly dialdehydes such as the natural product (-)-polygodial, are potent inhibitors of insect feeding. The activity of a series of drimane sesquiterpenoids and related compounds against aphid colonization of plants is discussed. Polygodial was highly active, even against insecticide-resistant aphids. This compound can be synthesised relatively easily as the (±)-mixture and the separate enantiomers showed similar activity in a number of tests. For large scale production, (-)-polygodial was extracted from commercially-grown water-pepper, Polygonum hydropiper, using liquid CO_2. In field trials, this material decreased transmission of barley yellow dwarf virus by the bird-cherry aphid, Rhopalosiphum padi.

BULLFINCHES AND ASH TREES - DO PLANT CHEMICALS CONTROL HERBIVORE DAMAGE IN A LONG-LIVED SPECIES?

P. W. Greig-Smith
Ministry of Agriculture, Fisheries and Food, Tolworth Laboratory, Surbiton, Surrey KT6 7NF U.K.

Wild bullfinches Pyrrhula pyrrhula feed heavily on the seeds of ash trees, Fraxinus excelsior. Field and laboratory studies show that individual trees with high levels of fat and low levels of phenolic chemicals in their seeds are particularly vulnerable. This paper examines the consequences of seed predation for successful dispersal of fruits, contrasting trees that have strongly or weakly attractive combinations of nutrients and secondary chemicals.

In certain conditions, bullfinches can be responsible for almost total loss of dispersal potential within a season. However, this pressure

changes as trees grow, and varies from year to year, in relation to fluctuations in the quality and quantity of seed produced. Environmental conditions may also constrain the activities of predators; for example, high winds prevent bullfinches feeding in ash trees, and also promote efficient fruit dispersal. As a result, most trees are free of predation at some times, and the selective advantages of protective chemicals are not likely to be as great as the competitive ability of seedlings.

Overall, the results illustrate the importance, in long-lived species, of identifying whether anti-herbivore chemicals afford protection at times that are crucial for the plant's reproductive success. If not, even highly aversive plant constituents may provide little more protection than that conferred by a range of other ecological factors.

PLANT POLYPHENOLS - FACT AND FICTION

Edwin Haslam
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The question of the function of secondary metabolism in plants and micro-organisms is one which continues to excite considerable interest. Hypotheses abound; evidence in support does not. Theories which have been principally canvassed fall into four broad categories and the putative role of plant polyphenols (vegetable tannins) in the secondary metabolism of higher plants will be discussed in the light of these various proposals.

THE APPLICATION OF SEX-ATTRACTANTS FOR MONITORING THE PEA MOTH CYDIA NIGRICANA (F.) (LEPIDOPTERA: TORTRICIDAE)

C. Wall
Entomology Department, Institute of Arable Crops Research,
Rothamsted Experimental Station, Harpenden, Herts. AL5 2JQ U.K.

The pea moth, Cydia nigricana, is a troublesome pest of commercial peas in England and much of Europe. Since 1978 growers of combining peas, which are harvested dry, have been able to monitor this pest with sex-attractant traps and accurately time insecticide sprays with the help of the advisory services. In 1987 a new type of trap became available for use as a risk assessment tool in vining peas, which are harvested green. This paper will discuss the strengths and weaknesses of the two types of trapping system and the problems encountered during the R & D and implementation phases.

POTENTIALS FOR EXPLOITING ALLELOPATHY TO ENHANCE CROP PRODUCTION

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+University of South Dakota, Vermillion, SD 57069
*USDA-ARS, Foreign Disease-Weed Science Research, Frederick, MD 21701

Protocols for utilizing allelopathy as an aid in crop production include both avoidance and application strategies. There are immediate opportunities for management of crop sequences, crop residues and tillage scenarios for allelopathic weed control. Varieties of grain and forage sorghums (Sorghum), sunflower (Helianthus annuus L.), oats (Avena sativa

L.), wheat (Triticum aestivum L.), rye (Secale cereale L.) and others may provide weed control and in some instances crop stimulation from cover-crop residues and/or with reduced tillage. Strip cropping that included sorghum showed that in the subsequent year weed density and biomass were significantly lower in the previous year sorghum strips. Our four-year field study with cultivated sunflower resulted in no differences in weed biomass between plots with and without herbicide (EPTC) applications. Under greenhouse conditions, joint application of low levels of atrazine, trifluralin, alachlor, or cinmethylin with a phenolic allelochemical showed that these two categories of inhibitors acted in concert. Data show that interactions of allelochemicals with environmental conditions must be a consideration in efforts to benefit from allelopathy. Allelochemicals may also be adapted as environmentally sound herbicides, such as cinmethylin, and possibly as yield stimulants. The future portends possibilities for modification of biochemical pathways of crops and microorganisms to control both production and residence time of allelopathic chemicals.

CHEMICAL ECOLOGY AND THE SEARCH FOR MARINE ANTI-FOULANTS: STUDIES OF A PREDATOR - PREY SYMBIOSIS

Donald J. Gerhart, Sara Mayo and Daniel Rittschof
Duke University Marine Laboratory, Pivers Island, Beaufort, North Carolina 28516 U.S.A.

The gorgonian octocoral Leptogorgia virgulata (Coelenterata: Anthozoa) is avoided by most predators and is rarely overgrown by fouling organisms. Several cembranoid diterpenes appear to contribute to the defense of L. virgulata against predators. These cembranoids also effectively inhibit the settlement of barnacle larvae, and recently have been patented as anti-foulants. In spite of the presence of these compounds in L. virgulata, the ovulid gastropod Neosimnia uniplicata lives symbiotically with this gorgonian, consuming the coenenchyme of the octocoral and laying its egg masses on the colony. The color of N. uniplicata invariably matches that of the gorgonian on which the snail feeds. The resulting camouflage appears to be important in the survival of N. uniplicata, which is readily eaten when presented to fish in the laboratory. Chemical analyses demonstrate that N. uniplicata contains a number of pigments and other chemical constituents. These compounds are not, however, found in L. virgulata. Two of the compounds from N. uniplicata inhibit the settlement of barnacle larvae more potently, and via a different mechanism, than the patented anti-fouling agents found in L. virgulata. Further research on the structures of these compounds, their origin, their role in the evolutionary ecology of the symbiosis, and their potential use as anti-fouling agents will be discussed. This research demonstrates how chemical ecology not only can shed new light on marine predator-prey interactions, but also can provide new solutions to applied problems in marine technology.

MATING DISRUPTION IN EUROEAN ORCHARDS AND VINEYARDS: PRESENT AND FUTURE

Heinrich Arn
Swiss Federal Research Station, CH-8820 Wadenswil, Switzerland

Control of the grape moth, Eupoecilia ambiguella, in vineyards by mating disruption with sex pheromone has been registered for use in the German Federal Republic and Switzerland; registrations for other tortricid pests,

e.g. the codling moth, are expected soon. General acceptance by the growers will depend on an number of rational and emotional factors. To improve reliability and reduce cost, considerable research effort will be needed, mainly in the areas of measurement of pheromone displacement in the field and optimization of the disruptant blend. A particular problem is the grapevine moth, Lobesia botrana, a vineyard pest of warm climates, whose control with pheromone is presently too expensive.

DEFENSIVE ALLOMONES FROM THE METAPLEURAL GLAND OF THE ANT, CREMATOGASTER DIFFORMIS (HYMENOPTERA: MYRMICINAE)

+A. B. Attygalle, +B. Siegel, +O. Vostrowsky, +H. J. Bestmann and *U. Maschwitz
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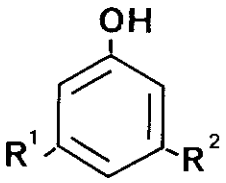
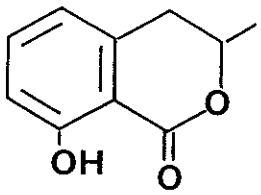
The ant Crematogaster difformis is known to use the secretions of its metapleural gland as a repellent against enemies. Small quantities of the glandular discharge is also used as an antiseptic to protect the colony against micro-organisms. The secretion contains five volatile components. The major component 3-propyl phenol (1) is accompanied by 3-pentyl phenol (2), 5-propyl resorcinol (3), 5-pentyl resorcinol (olivetol, 4) and 3,4-dihydro-8-hydroxy-3-methylisocoumarin (mellein, 5). Such phenolic compounds, except mellein, have not been isolated previously from insect sources. The isolation, structure determination and biological activity of these compounds will be discussed.





(1) R^1 = H, R^2 = propyl
(2) R^1 = H, R^2 = pentyl
(3) R^1 = OH, R^2 = propyl
(4) R^1 = OH, R^2 = pentyl

A MODEL OF PHEROMONE MOLECULE RECEPTOR REGION, AND ITS APPLICATION IN THE DEVELOPMENT OF SEX ATTRACTANT INHIBITORS

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Studies on structure-activity relationships of pheromones led to the postulation of a model of flexible interactions between signal molecules and receptor regions. The application of this model, in order to develop sex attractant inhibitors, allows chemical engineering of pheromone molecules more or less directly.

DEFENSIVE STRATEGIES AND ECOLOGY IN THE SAWFLY LARVAE CROESUS VARUS AND C. SEPTENTRIONALIS

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The larvae of the sawflies Croesus varus and C. septentrionalis are respectively cryptic and conspiciously colored. The two defensive strategies were studied in the field, on sympatric larval populations.

Field distribution varies in the two species. C. septentrionalis has gregarious larvae, and females lay their eggs preferentially on shrubs characterized by a medium size. The larvae are also more punctually present in time, compared to C. varus. The full-grown larvae of the latter species have always solitary habits and they are more evenly distributed between shrubs.

Well-developed defensive ventral glands are present in the two species and dolichodial is emitted by both. In the laboratory, this secretion is highly efficient against ants; much less so towards birds.

In the field, various invertebrate predators were observed preying upon Croesus larvae. Apparently each Croesus species is commonly parasitized by a specific Ichneumonid with a highly adapted egg laying behaviour.

PERCEPTION OF PHEROMONES IN MARINE BROWN ALGAE

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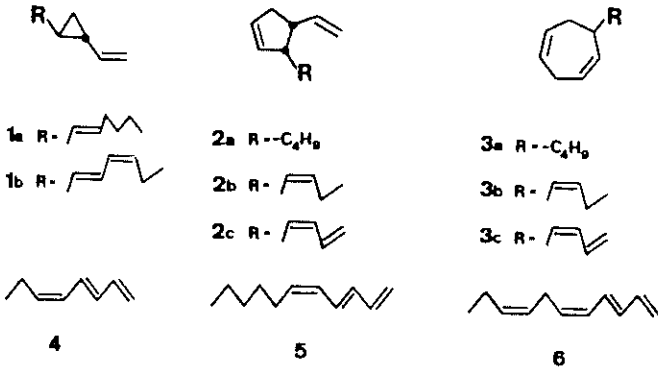
Mating of male and female gametes of marine brown algae is supported by a communication system based on olefinic hydrocarbons.



The initial encounter of the pheromones is effectively accomplished by simple distribution of the unpolar messenger molecules between the membrane and the polar carrier medium water. Spatial complementarity between the signal and the 'receptor'-unit is the second selecting criterion. Mutual polarization of signal and receptor effects binding; conformational changes are probably responsible for further processing of the signal. Aspects of the coevolution of signal- and receptor systems are discussed.

SEMIOCHEMICALS PRODUCED BY THE FEMALE TERGAL GLANDS OF THE PRIMITIVE COCKROACH CRYPTOCERCUS PUNCTULATUS

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*Lab. de Recherches sur les Aromes, INRA, Dijon, France

In many species of cockroaches, the tergal glands produce chemical signals during precopulatory behavior. Though little is known of the sexual behavior of C. punctulatus, such a role must be considered. The tergal glands of the female are characterized by an unusual association of several types of glandular cells and by the secretion of an alcohol (MW-210), the structure of which is reported here: a branched undecadienol with three methyl groups and one E double bound: 4,6,8-trimethyl-7,9-undecadien-5-ol.

C. punctulatus is a wingless wood-eating cockroach which remains a relatively unknown species. It is considered the most primitive extant member of the Blattaria and is believed to be related to the ancestral stock that gave rise to the termites. The morphology of the glands and the chemistry of their secretion are discussed in this phylogenetic context.

CARDENOLIDE COEVOLUTION: FACT OR FICTION?

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My paper will show how the partial break-down of the cardenolide chemical defense of monarch butterflies against bird predators in the Mexican overwintering areas is more likely the fortuituous result of predator preadaptation (= exaptation, S. Gould and E. Vrba, 1982) than a stepwise coevolutionary process.

ABSTINON IN THE TSETSE FLY, GLOSSINA MORSITANS: ISOLATION AND IDENTIFICATION OF A LONG-CHAIN ALKENE

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The major alkene of the male tsetse fly, Glossina morsitans morsitans was isolated and identified by thin-layer and gas chromatography (GC). The mass spectra of a DMDS derivative indicates one isomer, 11,15-dimethyltritriacontene. The material is present at 1 to 2 µg per male fly, and is partially transferred to the female preparatory to or during mating. A dose-dependent anti-aphrodisiac effect was seen with exposed male flies using the isolated natural product, with 2 and 4 µg causing 80% loss of copultory attempts, and 10 ug extinguishing the attempts. This effect was synergised by addition of male alkene, increasing the activity of male alkene by an order of magnitude. Similar quantities of alkenes that are species-specific appear in all tsetse males.

TO EAT OR NOT TO EAT. HOST SELECTION BEHAVIOUR OF THREE CREOSOTE BUSH-FEEDING GRASSHOPPERS IN SOUTHERN CALIFORNIA

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*Cleppa Park Field Research Station, University College, Cardiff CF1 1XL U.K.

The three species show different specificities of host selection. All three feed on the creosote bush, Larrea tridentata, but whereas Bootettix argentatus is monophagous, Ligurotettix coquilletti is oligophagous, and Cibolacris parviceps, polyphagous. The monophagous species is stimulated to bite by a compound, nordihydroguaiaretic acid (NDGA) which is characteristic of its host plant, Larrea, and which may form up to 10% of the dry weight of the leaf. Host specificity of B. argentatus is enhanced by deterrent responses to compounds found in the surface waxes of non-host plants. Both the oligophagous and polyphagous species are deterred by NDGA at naturally occurring concentrations. Their looser association with Larrea is probably based on tolerance of the Larrea compounds rather than requirement.

HERBIVORES ON FIG TREES MINIMISE THEIR EXPOSURE TO LATEX

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Department of Zoology and Entomology, Rhodes University, Grahamstown, South Africa

Latex production is a feature of several major plant families, including the Asclepiadaceae, Euphorbiaceae, Moraceae and some Compositae. The release of latex from sites of tissue damage poses both physical and chemical problems for the herbivores that feed on these plants. An examination of the insect fauna of fig trees (Ficus spp., Moraceae) in South Africa has revealed that various means are employed to reduce their exposure to latex. Larvae of the moths Aganais speciosa and Pseudoclanis postica physically sabotage the latex system by chewing through lactifers that are proximal to feeding sites. The larvae of a third moth, Phycodes punctata cause premature senescence of the leaves they are feeding on, perhaps by manipulating the hormone system of the plant. This not only reduces their exposure to latex, but also creates a cluster of dead leaves which may help protect the larvae from predation.

A COMPARISON OF THE VOLATILES FROM A PARASITOID WASP (ORASEMA SP, EUCHARITIDAE) AND ITS ANT HOST (SOLENOPSIS INVICTA, FORMICIDAE)

+Lloyd R. Davis Jr., *Robert K. Vander Meer, *Donald P. Jouvenaz and *Daniel P. Wojcik
*U.S. Department of Agriculture, Agricultural Research Service, P.O. Box 14565, Gainesville, Florida 32604, U.S.A.
+Department of Entomology and Nematology, Gainesville, Florida 32611, U.S.A.

The fire ant, S. invicta, is a medical and agricultural pest accidently imported to the United States. Several parasitoids and myrmecophiles have been discovered in S. invicta's native habitat in South America. This paper discusses the relationship of the cuticular chemistry of an Orasema parasitoid and its S. invicta host. Adult female Orasema lay eggs in plant tissue. The first instar larvae, planidia, hitch a ride on foraging ants and are brought back to the colony by workers. Once inside the nest, Orasema larvae feed on late instar larvae and pupae. Worker ants treat Orasema larvae as if they were ant larvae and help in the eclosion of adult Orasema. The adult Orasema leave the ant nest, mate in swarms, and the females begin the cycle again. Gas chromatograph (GC) studies of cuticular washes of S. invicta and Orasema larvae, pupae and adults showed that the host and parasitoid were indistinguishable. Unlike a previously reported myrmecophile-host relationship where the myrmecophile had both host acquired and endogenous components, the Orasema parasitoid only had GC peaks associated with its host. It is not known whether these chemicals are acquired from the host or biosynthesized by the parasitoid. However, adult Orasema caught outside the nest had GC patterns that reflected the host and several additional components of unknown origin.

QUASISYNERGISMS AND SELF PROTECTION - EVOLUTIONARY PRINCIPLES IN STAPHYLINID BEETLE DEFENSIVE SECRETIONS

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During evolution of Oxytelinae rove beetle species (Coleoptera: Staphylinidae) the toxic quinoic principle of the abdominal defensive glands was retained in both primitive and derived beetle species.

On the other hand it appears that the solvents for this toxic principle were changed drastically in order to improve the repellency of the defensive secretion. Finally phylogenetically derived species of Oxytelinae have been found to manufacture definite ratios of different solvent types for their quinone. At a certain ratio of solvents the formulation shows a maximal repellency which has actually been found both in naturally occurring beetle secretions and in synthetic mixtures. This phenomenon was identified as quasisynergism since the found ratios of different solvents correlate with a maximal penetration rate of the toxic p-toluquinone of the secretions through the integumment of an aggressing arthropod.

Derived Oxytelinae beetles always have shifted their gland reservoir openings from soft intersegmental abdominal membranes toward the center of the adjacent sclerite. When beetles were treated with their own secretions, topical application on sclerites did not harm the beetles whereas membraneous treatments resulted in high mortality rates. It is assumed that derived Oxytelinae species evolved such highly efficient defensive secretions that they must inevitably protect themselves by shifting their reservoir openings on sclerits in order to prevent autointoxication.

THE FORMATION OF THE SEX PHEROMONE IN SPODOPTERA LITTORALIS

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Institute of Plant Protection, Volcani Center, Bet Dagan 50 250, Israel

The pheromone content in Spodoptera littoralis, as a function of age and of time into scotophase, was determined. Largest amounts of pheromone were found in 1-3 day-old females, 1-2 hour into scotophase: maximum of 6-8 ng of (Z,E)-9,11-tetradecadienyl acetate per female. Very low amounts of pheromone were detected 1 hour before and at the end of scotophase. The sharp increase in pheromone content at the beginning of scotophase suggests enhanced biosynthesis triggered by onset of darkness. Analysis of fatty acids in the pheromone gland revealed the presence of a series of specific acids which are probably the direct precursors to the corresponding pheromone components. A mechanism for the formation of these acids is proposed. The amount of the fatty acid precursors is very large as compared to the pheromone content. These findings indicate that S. littoralis females store large quantities of fatty acids and convert them to the pheromone according to the dark/light cycle.

MONOTERPENES VARIATIONS IN DEFENSIVE SECRETIONS OF SOME NEW-GUINEAN NASUTITERMES

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+Université de Bourgogne, Dijon, France
*Université Libre de Bruxelles, Belgique

The monoterpenic fraction of defensive secretions of papuan Nasutitermes soldiers was analysed by capillary GC and GCMS. The major components of this fraction for the different studied species were: alpha-pinene, myrcene, limonene, terpinolene. Alpha-phellandrene, alpha-terpinene, alpha-thujene and sabinene were also present but at lower concentrations.

These analyses were achieved with 36 nests of 6 species of Nasutitermes: N. novarumhebridarum, N. princeps, N. polygynus, N. gracillirostris and two undescribed species.

We observed some differences of the proportions of monoterpenes occurring between allopatric populations of one peculiar species but these variations seemed less important than those observed between the different species.

COMPARATIVE STUDY OF ALLELOPATHY AS EXHIBITED BY PROSOPIS JULIFLORA AND PROSOPIS CINERARIA

Usha Goel
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Both field and laboratory studies have been made on the allelopathic effects of two species of Prosopis, the native slow growing P. cineraria and the introduced fast growing P. juliflora (native of Mexico).

In the field P. cineraria does not appear to have any toxic effect on other plants, but under the canopy, J. juliflora is highly allelopathic and does not allow the growth of any other species.

In laboratory experiments, aqueous extracts of P. cineraria leaves were slightly inhibitory for the germination and early seedling growth of radish seeds. Extracts of leaves from P. juliflora were observed to be highly allelopathic. Pods and leaf leachates were also inhibitory at 10% concentrations. Decaying leaves of P. juliflora were highly inhibitory for the germination of Cassia occidentalis seeds at early stages of decomposition. Chemical investigation of the extracts showed the allelopathic compounds to be phenolic in nature in both the species. Further observations in litter production and decomposition show that litter below P. cineraria decomposes more rapidly while slow decomposition in P. juliflora may possibly result in accumulation of toxic substances in soil layers inhibiting growth of other species.

BIOASSAYS FOR THE MULTIPLE EFFECTS OF SWEET POTATO PERIDERM CHEMICALS

Howard F. Harrison, Joseph K. Peterson and Philip D. Dukes
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The sweet potato (Ipomoea batatas) clone 'Regal' is resistant to insects, fungal diseases and root knot nematodes and is allelopathic to other plants. Several bioassays have indicated that these characteristics are at least partially due to chemicals present in periderm tissue. Most of the phytotoxic activity of periderm tissue serially extracted with hexane, ethyl acetate and aqueous methanol was in the methanol fraction. Yellow nutsedge (Cyperus esculentus) root growth and seed germination of ten weed species were inhibited by the methanol extract. There was a fifty-fold difference in sensitivity to the extract between species in the seed germination bioassays. Root knot nematode (Meloidogyne incognita) egg hatching and growth were inhibited by the hexane and methanol extracts. The aqueous methanol extract contains over sixty phenolic compounds, and a number of these have exhibited activity in various bioassays.

RAPIDLY INDUCED CHEMICAL CHANGES IN BIRCH FOLIAGE

S. E. Hartley
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Recent theory suggests that rapidly induced chemical changes in plant foliage in response to insect attack are defensive and reduce further herbivory. In Betula pendula damage causes an increase in phenolic levels, but the mechanism and significance of this change are not well understood.

In this study changes in phenolic levels were measured with several techniques, following both caterpillar and artificial damage to foliage. The plants' response to the two sorts of damage differs markedly, both quantitatively and qualitatively.

The mechanism underlying this difference was investigated using an intact cell assay for phenylalanine ammonia-lysase (PAL). Enzyme activity increased following both insect attack and artificial damage, but the magnitudes and patterns of induction were very different.

The role of this mechanism as a defense against natural birch herbivores is discussed.

BUZZ POLLINATION AND FLORAL-ODOR CHEMISTRY OF CLETHRA ALNIFOLIA L. (CLETHRACEAE).

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Clethra alnifolia attracts a variety of insects, especially Hymenoptera and one species of Cantharis (Coleoptera), for pollen and/or nectar. Field studies showed Bombus spp. to be the most effective pollinators. A suite of floral characters, such as porate dehiscence, pollen in monads, small, light-colored pollen with a psilate exine, and an extended blooming season suggest similarities to other buzz pollinated plants.

A solvent extract of the flowers was analyzed by gas chromatography (GC) and GC-mass spectrometry. Thirty-three compounds were identified by their mass spectra and Kovats retention indices on Carbowax 20M and OV-101 capillary columns. The compounds were primarily ketones, alcohols, aldehydes or esters of straight chain hydrocarbons, and monoterpenes. Most of the compounds have been reported from flowers previously. The odor profile of C. alnifolia is similar to other flowers which attract bees, in that it contains anethole, phenylethyl alcohol, benzyl alcohol, linalool, eugenol and geraniol.

TOXICITY AND FATE OF ACETYLCHROMENES IN THE MIGRATORY GRASSHOPPER

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Acetylchromenes (benzopyrans) are major natural constitutents of the desert sunflower Encelia, which have insecticidal action against several types of insect. Encecalin, and its unsubstituted analogue, desmethoxyencecalin, are toxic to the migratory grasshopper Melanoplus sanguinipes via residue contact, whereas the demethyl derivative (possessing a free hydroxyl group) is less toxic. Excretion of acetylchromenes and their metabolites in the feces by the adult grasshopper was investigated following topical administration of the compounds. The total quantities of chromenes and their metabolites excreted, and the proportion of unchanged parent chromene in the excreta, is inversely proportional to contact toxicity. Although absorption of the relatively non-toxic demethylencecalin and that of encecalin are similar, grasshoppers excrete significantly more unchanged demethylencecalin than encecalin. Each of the three acetylchromenes applied was subject to oxidative metabolism, primarily via aliphatic hydroxylation of one of the geminal methyl groups. Other metabolites were similarly characterized by the presence of one or more free hydroxyl groups. Bioassays confirm that these transformation products, which presumably are more amenable to excretion because they are more polar, are significantly less toxic than their parent compounds.

SNAIL HERBIVORY ON ENDOLITHIC LICHENS: THE WEATHERING OF A DESERT AND OTHER CHEMICAL PHENOMENA

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Two species of snail, Euchondrus albulus and E. desertorum, eat endolithic lichens growing under the surface of limestone rocks in the Negev Desert, Israel. This unusual type of herbivory has the unexpected and major impact of weathering this rocky desert at a rate of 0.7-1.1 metric tons/hectare/year, because the snails must consume limestone rock in order to eat the lichens. This biotic weathering is 2 to 3 times greater than the contribution of wind-borne dust deposition to the process of soil formation. These findings demonstrate that herbivores can have a significant regulatory impact on ecosystem processes, even in cases where the total amount of primary production consumed is small. Current studies are also examining the effects of these herbivores on lichen productivity, secondary chemistry and inorganic chemistry.

ALLELOPATHIC EFFECTS OF TOMATO PLANTS ON SOME SELECTED SPECIES

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A number of laboratory experiments on allelopathic effects of tomato plants have been carried out. Aqueous extracts and leachates of tomato plants were significantly inhibitory to seed germination and seedling growth of the tested species. Both lettuce and grapevine grown near the tomato plants in a vinyl house showed reduced growth both in elongation and in dry weight.

Tests were made to determine whether this effect was due to volatile substances produced by the tomato plants. PC and HPLC were used to identify phytotoxic substances from the tomato plants. Tannic acid, hydroquinone, p-hydroxybenzoic acid, vanillic acid and ferulic acid were isolated from leaf extracts. Bioassays were performed using these substances.

The results of bioassays with different concentrations of phenolic solution showed inhibition effects similar to those mentioned above for extracts and leachates. Therefore these five phenolics may be responsible for the apparent allelopathic effects upon the tested species in this study.

IS EXTRAFLORAL NECTAR PRODUCTION AN INDUCIBLE ANTIHERBIVORE DEFENSE?

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A number of chemical defenses of plants have been found to increase in response to the presence of and/or damage by herbivores. Extrafloral nectaries on plants attract ants and other beneficial insects that can provide biotic protection for plants against a wide variety of herbivores. The hypothesis that plants pre-disposed to this type of defense will respond to damage by secreting more extrafloral nectar has been tested in various species. In Vicia sativa, a temperate annual herb, moderate levels of defoliation increased nectar production over controls during the day following defoliation. The woody tropical emergent, Ipomea carnea, showed no inducible increase in nectar production with experimental defoliations. Increased amounts of nectar can serve to attract greater numbers of ants or parasitoids and thereby increase biotic protection subsequent to incidents of damage. Both plant life-form and phylogenetic constraints may influence whether extrafloral nectar production can be induced.

THE SEX PHEROMONE OF THE HOUSEFLY: SYNTHESIS OF COMPONENTS AND THEIR BIOLOGICAL ACTIVITY

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Synthetic components of the sex pheromone of the housefly have been studied for their biological activity. The chemicals represent the three main groups of hydrocarbons found in the female cuticula (1), namely, long chain alkenes, alkanes and methylalkanes. The chemicals showed moderate activity, in general, as compared with the main active component (Z)-9-tricosene (Muscalure). The synthesis of the chemicals will be described, and the biological activity will be discussed.

Reference

(1) D. R. Nelson, J. W. Dillwith and G. J. Blomquist, Insect Biochem. 11, 187-197 (1981)

PHEROMONES OF BUMBLE BEE AND ANT SPECIES; STUDIES OF DOUBLE BOND POSITIONS OF STRAIGHT-CHAIN VOLATILE COMPOUNDS

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The pheromones of several Hymenopteran species contain straight-chain compounds with double bonds. These compounds include primary alcohols, esters, aldehydes, and hydrocarbons. The chain lengths range from between eleven and twentyfive carbons.

The biosynthesis of long straight-chain monounsaturated pheromone components of Lepidopteran species has lately attracted a great deal of interest, while the corresponding compounds of Hymenopteran species have not been studied in any great detail. We here report the determination of double bond positions of pheromone components of several bumble bee (Bombus and Psithyrus) and ant (Formicine) species. We also discuss possible biosynthetic pathways of these compounds and make comparisons with what is known about biosynthesis of Lepidopteran pheromones.

DISRUPTION OF SPIDER WEB STRUCTURE BY THE PLANT-DERIVED CHEMICAL DEFENCE OF AN APHID

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Two toxic and bitter-tasting cardenolides are sequestered by the brightly coloured aphid Aphis nerii from the neotropical host plant Asclepias curassavica. After feeding on milkweed-reared aphids the orb web spider Zygiella x-notata built severely disrupted webs, whereas the webs of spiders fed non toxic aphids remained intact. The regularity and size of the prey trapping area of webs were also significantly reduced in proportion to the amount of toxic aphid eaten.

The effects of toxic aphids on spider web structure were mimicked by feeding the spiders the bitter-tasting cardenolide digitoxin; a cardenolide with similar steroidal structure and pharmacological activity to the two aphid cardenolides.

These results show that the well known effects of psycho-active drugs on spider web structure are much more than interesting assays of drug activity. Similar effects produced by plant-derived chemicals in the spider's aphid prey are relevant to the ecology and evolution of interactions between prey defence and predator foraging.

TACTICS OF MONARCH BUTTERFLY SPRING MIGRATION

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Host plant derived cardenolide fingerprints of adult monarch butterflies can identify an individual monarch's larval host plant species. Since the 20 known species of eastern monarch hostplants in the milkweed genus Asclepias have distinct distributions in space and time, cardenolide fingerprints show that monarchs recolonise the eastern north american breeding range each spring by successive broods moving north, with a few individuals making a single sweep from Mexican overwintering sites to the northern USA.

Successive brood recolonisation is likely to be a more successful tactic than single sweep recolonisation because southern milkweeds are more toxic than northern milkweeds. Thus successive brood recolonisers that were reared on early spring, southern milkweeds will be better defended against northern bird predators than single sweep recolonisers, who, like overwintering monarchs, fed on northern milkweeds the previous year.

SYNERGISM AND RELATIVE EFFICIENCY OF SEMIOCHEMICALS FOR JAPANESE BEETLE (POPILLIA JAPONICA NEWMAN, COLEOPTERA: SCARABAEIDAE) ATTRACTION IN THE AZORES

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Traps baited with semiochemicals are currently used to monitor Popillia japonica Newman in Terceira Island, Azores.

Field experiments were carried out to assess the relative efficiency of several combinations of standard Japanese beetle attractants: PEP (2-phenyl ethyl propionate), eugenol (4-allyl-2-methoxyphenol), and geraniol (7,3-dimethyl-7,3-octadien-1-ol). No significant differences were detected in the efficiency of traps baited with tertiary mixtures of PEP + eugenol + geraniol combined at 1.0:1.0:1.0, 1.0:2.1:1.1, and 1.0:2.3:1.0, nor with the use of two types of dispensers. PEP + eugenol (1.0:2.3) was the most attractive of all possible binary combinations and as effective as the tertiary mixtures. Binary combinations including geraniol showed no significant differences in attractivity in comparison to eugenol alone.

The evaporation rate of PEP was about 2.5 fold higher than that of the other semiochemicals.

Experiments conducted to establish the duration of bait efficiency proved that a significant decline in trap catches occured after 8 weeks of field exposure, in accordance with a marked drop in daily evaporation rates of the attractants, recorded between the 8th and 10th week.

The addition of the female sex pheromone - (R,Z)-5-(1-decenyl)dihydro-2(3H)furanone - to the food attractants achieved a synergistic effect that was also estimated.

SOME INSECT-ACTIVE MATERIALS FROM PLANTS

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The neem tree (Azadiracta indica A. Juss., Meliaceae) produces a potent insecticide called azadiractin which is receiving a great deal of research attention. Although some 1400 species of Meliaceae plants exist in tropical and subtropical climates, relatively few have been examined from an insect control standpoint. Results of fall armyworm (Spodoptera frugiperda (J. E. Smith)) bioassays with extracts of some lesser known meliaceous plants will be discussed. We have isolated an antifeedant from one of these plants, Carapa procera DC., and its structure determination will be addressed. In addition, a summary of our research involving fall armyworm activity in materials derived from plants of other families will be presented.

DIETARY TANNINS AND THEIR ACTION IN MAMMALS

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Among the allelochemicals that plants produce to defend themselves against herbivores, tannins are frequently encountered in both natural and agricultural species. Experiments with rats fed Sorghum tannins were conducted to monitor animals dry weight gain, feed consumption and fecal output (so as to analyze growth on an ECI = AD x ECD model). Tannins did depress feed consumption, but their major effect was to lower the efficiency with which ingested food was converted to new animal biomass (ECI). Tannins did reduce the approximate digestibility (AD) of the diet by 11%, but the efficiency with which digested/absorbed food was converted to new animal biomass (ECD) was changed from a high positive value (tannin free diet) to a near-zero one where tannin was fed (several animals lost weight). This data suggests that tannins have major toxic effects and that the digestibility reducing effects normally associated with them are of a minor and perhaps secondary nature. Similar results have been obtained for insects but so far as we are aware these are the first of their kind for a mammalian species.

The toxic effects of tannins were even more severe if the production of proline-rich salivary proteins was suppressed (by drug treatment). Evidence from this laboratory indicates that mammalian herbivores (including rodents, ruminants and primates) may reduce the allelochemical potency of polyphenolics by the production of this group of proteins. These bind polyphenolics with a very high affinity thus preventing them from interfering with physiological functions.

SLAVES AND SLAVE-MAKERS AMONG ANTS: A COMPARISON OF DUFOUR GLAND SUBSTANCES

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Various evidence points to Dufour gland secretion being used in slave making raids among ants. Comparisons made between the substances in the secretions of the slave maker, the potential slave and a closely related non-slave species suggest sesquiterpenoid compounds are the 'propaganda substances'. Examples are taken from Myrmicine (Harpagoxenus) and formicine (Formica) slave-enslaver pairs.

THE ROLE OF ENVIRONMENT-DERIVED CUES IN NESTMATE RECOGNITION IN RED CARPENTER ANT WORKERS

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In social Hymenoptera nestmate recognition is defined by the discrimination of alien individuals from members of the colony. In the red carpenter ant, Camponotus floridanus, nestmate recognition is shown by strong aggressive behaviour displayed towards alien conspecifics. Nestmate recognition cues are at least in part endogeneously produced and/or environmentally derived chemicals. In C. floridanus, the hydrocarbon pattern is colony-specific, with some age variation. This paper reports the modification induced in worker hydrocarbon patterns by a diet rich in hydrocarbons, and the consequent changes in worker nestmate recognition abilities. Colonies were split into 3 sub-colonies which were fed with the same honey but with different protein sources: one sub-colony had cockroach (Periplaneta americana), while the two others had egg yolk. Nestmate recognition was bioassayed between the 3 sub-colonies and worker chemical profiles were analysed by gas chromatography just after the split, before the different feeding regimes, and 3 times after the beginning of the differential alimentation (after 8 days, 1 month and 3 months). In addition, the effects of sub-colony separation and the uniformisation of environment of different colonies on nestmate recognition has been analysed.

CHEMICAL AND BEHAVIORAL ECOLOGY OF PHEROMONE RELEASE BY MALE CARIBBEAN FRUIT FLIES

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Male Caribbean fruit flies (Tephritidae: Anastrepha suspensa) show a strong circadian rhythm in pheromone release behavior with a broad peak extending from 10 to 14 hours into the photophase. Males contain approximately 1 hour-equivalent of pheromone in their bodies at the peak of display behavior. Age is a determinant in pheromone blend composition and in release rate. The circadian rhythm and the blend released were altered when males were exposed to 24 hours constant light for 1 or 2 days. Release rate and blend composition were determined by gas chromatography. Laboratory bioassays with sexually mature female flies confirmed differences in response behavior to the blend. Pheromone is released from the mouth and from the anus. Sealing either with molten beeswax cut pheromone release about 40-60%. Sealing both reduced release by about 80%. No significant effects upon rate of release or blend ratios have been demonstrated by treatment of males with methoprene, precocene or ecdysterone. Feeding cycloheximide to males altered the quantity of pheromone released without apparently altering their display behavior. Nine components have been identified in the blend, with 2 enantiomers of each of 2 gamma lactones counted as 4 components. A density dependent effect was demonstrated in the laboratory in the quantity of the 2 gamma lactones released. Five males release more per male per hour than 15 males. There was no significant difference in release rate when 3 vs. 5 males were compared. Other components in the blend were not significantly different in either situation. Additional studies are in progress to obtain more precise data on the density effect and to determine if it is a chemically (pheromonally) mediated effect.

ISOLATION AND BIOASSAYING OF YELLOW SQUASH (CUCURBITA PEPO) LEAF COMPONENTS FOR STIMULATION OF OVIPOSITION BY THE PICKLEWORM MOTH (DAPHNIA NITIDALIS, STOLL.)

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Squash leaf extracts were sprayed on glasswool pads and hung in cages which contained several hundred adult pickleworm moths of mixed sex. After overnight exposure, the number of eggs was counted. Crude extracts gave a nonlinear dose response relationship. Several fractions were active; most activity was contained in very polar fractions. Also, inhibitory fractions were present. In addition, volatile components played a positive role. Interpretation of the bioassays was compounded by the fact that almost any fraction gave some positive result and "background" egg laying on untreated glasswool pads was of variable magnitude. Active compounds are currently being purified and characterised.

CARDENOLIDES IN ERYSIMUM CHEIRANTHOIDES DETERRING OVIPOSITION BY THE CABBAGE BUTTERFLY, PIERIS RAPAE

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The cabbage butterfly, Pieris rapae, lays eggs on most crucifers and a few related plant families. Yet a few crucifers, including Erysimum cheiranthoides are avoided by the gravid butterflies. Extracts of E. cheiranthoides are highly deterrent to oviposition by P. rapae and the active material has been isolated by solvent partitioning and HPLC. Four active compounds have been characterized as cardenolides and the structures of three of these have been determined by FAB-MS, hydrolyses, and NMR studies.

SYNERGISTIC INTERACTION BETWEEN BIOLOGICALLY-ACTIVE SOLANUM GLYCOALKALOIDS

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The steroidal glycoalkaloids α-solanine and α-chaconine are thought to contribute to the defences of potato (Solanum tuberosum) against certain herbivores and fungi. Deterrence appears to result primarily from impairment of membrane function. Studies of the effects of solanine and chaconine on artificial lipid membranes (liposomes) have shown that the latter is the more powerful membrane-lytic compound but that in combination the two glycoalkaloids produce a marked synergistic effect. The synergism shows considerable specificity and depends on the proportion of the two compounds. Similar synergistic effects have also been observed in relation to disruption of the membranes of animal, plant and fungal cells. Details and implications of these findings will be discussed.

HOST AND NONHOST PLANT DISCRIMINATION IN TWO PHYTOPHAGOUS FLIES: THE ROLE OF CABBAGE PLANT COMPOUNDS

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The oviposition behaviour and the sensory physiology of the cabbage and the carrot fly in response to different extracts and fractions of the cabbage leaf were studied. Different fractions and compounds were found to be stimulatory or inhibitory for oviposition. The compounds stimulating the cabbage specialist, the cabbage root fly, can be, but do not have to be inhibitory for the non-cabbage (carrot) specialist, the carrot fly. The glucosinolates which have long been known to be the classical stimulants for all "cabbage specialist insects" seem to be at natural concentrations of minor importance for the oviposition behaviour of the cabbage root fly. At least two other groups of compounds must be involved in the host plant perception also. The chemorceptors sensitive to host and non-host compounds in both flies are under investigation.

THE BIOGEOLOGY AND ECOTOXICOLOGY OF MERCURY IN PLANTS

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Over evolutionary history most land areas have been subjected to volcanic activity. In the past century hundreds of eruptions have occurred on continents, continental margins and in the ocean basins. Currently 50 volcanoes and hundreds of geothermal sites are active, many in tropical latitudes where productive forest ecosystems flourish. Mercury emissions are characteristic of these sites, and therefore many organisms and habitats have been regularly exposed to mercury. Fungi and green plants commonly accumulate mercury and reflect their historic exposure to geothermal sources. Plants commonly accumulate mercury from their substrata. In non-thermal areas with low baseline values the accumulation ratio may exceed 1000; in plants close to active thermal sources low ratios of less than 1.0 are common.

Geochemical mercury exists predominantly as Hg^0 in the air and as $HgCl_2$ in the soil and groundwater. Air values near geothermal sites range up to 50 $ng.\ell^{-1}$, but can exceed 200 $ng.\ell^{-1}$. At such levels, mature plants defoliate but young seedlings are not harmed. In contrast the Hg-ion, which has a slight effect on abscission in mature plants, causes leaf necrosis and inhibits growth, especially in seedlings. Mature plants, however, when exposed to $HgCl_2$ solutions produce Hg^0 which can cause nearby mature plants to defoliate. The release of mercury vapor has been measured in over 60 species of plant, in isolated organs (eg. detached leaves) and in intact trees in situ. Freshly detached leaves supplied $HgCl_2$ at 200 $\mu g.\ell^{-1}$ (ppb) release 74 $ng.g^{-1}\ hr^{-1}$ (ave. of 15 species) but may reach 240 $ng.g^{-1}\ hr^{-1}$.

Mercuric-ion at 200 ppb is a common level in volcanic soils, and, in extreme cases, the soil Hg may exceed 50,000 ppb. The most active species examined to date releases 240 $ng.g^{-1}\ hr^{-1}$ of Hg^0 vapor from a 200 $\mu g.\ell^{-1}$ HgCl solution. This corresponds to 9600 µg of Hg released per hr per m^3 of air space around plants (40 $kg.m^{-2}$ biomass density) on the forest floor.

Detoxification together with allelopathic and defensive processes appeared to have evolved in plants in response to the unavoidable presence of Hg in volcanic environments.

ELECTROPHYSIOLOGY OF TASTE RECEPTORS: A BIOASSAY TOOL

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The possibilities and limitations of the use of electrophysiological techniques in aiding our study into the role of allelochemicals is discussed with respect to carbohydrate and some diterpenoids. Our recordings have shown that with lepidopterous larvae there is no single electrophysiological response pattern signalling acceptability nor is there a single pattern signalling unacceptability. The present paper elucidates further the neural codes associated with antifeedants.

THE USE OF CHEMICAL CHARACTERS IN DEFINING POPULATIONS OF FIRE ANTS IN THE UNITED STATES AND SOUTH AMERICA

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The fire ants, Solenopsis invicta and S. richteri were accidently imported into the United States in the first half of this century from South America. In their adopted habitat the imported fire ants have thrived causing considerable medical and agricultural problems in the nine widely infested states of the south and southeast. The red imported fire ant, S. invicta, was considered the dominant ant in the infested areas, having displaced the black imported fire ant, S. richteri, into a small enclave in northeastern Mississippi. However, through chemical analysis, a large reproductively viable S. invicta/S. richteri hybrid population was recently discovered across northern Alabama and into Mississippi and Georgia. This paper reports on the use of three species-specific chemical characters (venom alkaloids, cuticular hydrocarbons, and trail pheromones) to define S. invicta, S. richteri, and hybrid populations in the United States. In addition, these characters have been used to elucidate fire ant taxonomy in South America. These results have important consequences regarding A) the species status of the two imported fire ants, B) the development of species-specific bait systems, C) the search for specific biocontrol agents in South America, and D) the taxonomy of fire ant populations in South America.

DENSITY-DEPENDENT PHYTOTOXICITY: A PROMISING METHOD FOR ALLELOPATHIC INVESTIGATIONS

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Experiments reported at the 1986 ISCE meeting, in which solution volume and seed number were manipulated, demonstrated that cucumber radicle growth decreases as the amount of ferulic acid available per seedling at any given concentration increases. The data suggested similar effects may be important in field and greenhouse studies of allelopathy. In a given soil volume, more phytotoxin is available for uptake per plant to plants in low rather than high densities. Within a critical concentration range, plants at low densities could suffer serious growth reductions while plants at high densities could be unaffected because available phytotoxin is shared and each receives a sub-lethal dose. Decreased growth as density decreases is a reversal of effects normally observed when plants compete. Demonstration of such an effect would make possible the experimental separation of allelopathic and competitive plant-plant interference. We herein report on studies with two natural systems. Polygonella myriophylla is an important perennial shrub in the Florida scrub for which there is strong evidence of allelopathic effects toward grasses and forbs. Hydroquinone and a compound tentatively identified as an isomer of gallic acid are the probable toxins. Juglans nigra is well known for phytotoxic effects caused by juglone (5-hydroxy-1,4-naphthoquinone). Under controlled conditions, soils from beneath and adjacent to Polygonella and Juglans were planted with various densities of test species. Plant performance was measured by standard growth analysis techniques.

LIMONENE: ITS ROLE IN DEFENSE OF SPRUCE AND TAMARACK FROM ATTACK BY BARK BEETLES

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Limonene, present in the phloem of white spruce, Picea glauca (Moench) Voss, and tamarack, Larix laricina (DuRoi) K. Koch, was tested for its effect on spruce beetle, Dendroctonus rufipennis (Kirby), and eastern larch beetle, Dendroctonus simplex LeConte. Vapors from synthetically manufactured limonene (97% pure) caused significant adult beetle mortality to both Dendroctonus species in the laboratory bioassays. Higher concentrations of limonene were found in wound tissue of white spruce as opposed to unwounded tissue. Likewise, high limonene concentrations were found in phloem tissues of tamarack following one year of complete defoliation but declined significantly with two years of successive defoliation, after which trees were successfully attacked by Dendroctonus simplex. Present evidence indicates that limonene plays an important role in host resistance to Dendroctonus bark beetles.

THE PHEROMONE OF THE COCOA POD BORER MOTH, CONOPOMORPHA CRAMERELLA AND ITS USE IN AN INTEGRATED PEST MANAGEMENT STRATEGY

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Since 1982, the Tropical Development and Research Institute, the Silwood Centre for Pest Management Studies at Imperial College, the East Malaysia Planters Association and the Malaysian Cocoa Growers Council have been collaborating on the identification and field use of the pheromone of the cocoa pod borer moth, CPBM, Conopomorpha cramerella (Snellen) (Lepidoptera: Gracillariidae) in Sabah, E. Malaysia.

Following successful identification and synthesis of the female sex pheromone of CPBM, field evaluation studies aimed at developing the use of the pheromone as a pest control agent were carried out in Sabah, E. Malaysia (J. Chem. Ecol. Vol. 12, pp 1-23, 1986). During these studies, the importance of synergism between the acetate and alcohol components in the attractancy of the pheromone blend was clearly shown. Also results during these studies indicated that the male moth population could be trapped out using the "sandwich" and later, "lobster pot" traps.

A 200ha experiment was therefore run on the BAL Estates, Sabah, to test the effect of mass-trapping and cultural control practices on cocoa pod damage levels. Over a one year period and covering two crop cycles, heavy infestation levels were reduced by approximately 30 per cent.

In areas where the integrated pest management strategy is operated efficiently, levels of heavy CPBM infestation have been reduced from about 40-50 to about 10 per cent.

Synthetic pheromone-baited traps at a density of 4 or 8 traps/ha are currently used commercially over 11,000ha of cocoa in Sabah, as part of the integrated pest management strategy involving cultural practices and/or limited insecticide application.

The recommended practice for CPBM control in Sabah is:

1. Pheromone baited traps at a density of 8 traps/ha or 4 traps/ha plus trough crop insecticide spraying.
2. Cocoa tree pruning to ensure accessibility of all pods.
3. Weekly harvesting of all ripe pods.
4. "Bagging" of empty pod husks to ensure that larvae and pupae contained therein, are killed.

AN AGGREGATION PHEROMONE OF THE PEA AND BEAN WEEVIL, SITONA LINEATUS

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The pea and bean weevil, Sitona lineatus, is a pest of leguminous crops throughout W. Europe, the Middle East and the northwest region of North America. We undertook a study of the production by S. lineatus of pheromones which might be used to monitor populations in order to time insecticide application; or to mass trap these insects as an alternative to insecticide treatment.

The presence of a male-produced aggregation pheromone in this species was demonstrated in a field experiment in early spring. Identification of the pheromone components was achieved by means of differential air entrainment, coupled gas chromatography-electrophysiology and mass spectrometry. The major pheromone component was found to be 4-methyl-3,5-heptanedione, the activity of which was synergised by the host-derived (field bean) metabolites, (Z)-3-hexen-1-ol, (Z)-3-hexenyl acetate and linalool. In the spring, a synthetic mixture of these four compounds was strongly attractive to both sexes of S. lineatus in the field.

A T-shaped wind-tunnel olfactometer is now being used for further studies on the insect-host plant interactions.

DEVELOPMENT OF THE TERGAL PHEROMONE GLAND IN MALE LUTZOMYIA LONGIPALPIS (DIPTERA: PSYCHODIDAE)

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The males of the sandfly Lutzomyia longipalpis are polymorphic for the presence of pale tergal spots. The spots bear small convex papules which are the emission sites for pheromones produced in glandular tissue beneath the cuticle.

After male emergence from the pupa the development of the gland was followed by sectioning the gland at intervals. Extracts of the glands were also made and subjected to gas chromatography and mass spectroscopy.

At 0-6 hours a heavily stained undifferentiated cell layer was evident which by 24 hours had elongated to produce distinct columnar cells with an end apparatus. At 7 days the cells had expanded into a vacuolated spongy tissue. An incomplete mass spectrum was observed at 24 hours but was complete and consistent with a farnasene or homofarnasene-like structure at 7 days.

SEX PHEROMONE OF THE WHITE RICE STEMBORER MALIARPHA SEPARATELLA

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Rice is a major food crop in Africa, West Africa alone having 2.75 million ha under cultivation. The main insect pests of rice in the region are stemborers, of which the white rice stemborer, Maliarpha separatella is frequently the most prevalent. Yield losses in excess of 10% are often attributed to the boring activities of its larva. The West African Rice Development Association (WARDA) has shown that it can be controlled by the application of systemic insecticides. However, the cost of such remedial treatment to the local farmer can only be justified if infestation levels can be shown to be potentially economically damaging. The larvae of M. separatella cause very little visible damage to the crop and the true extent of an infestation only becomes apparent at harvest. The Tropical Development and Research Institute (TDRI) has collaborated with WARDA to identify the sex pheromone of M. separatella with the intention of employing pheromone traps to monitor infestation levels.

Analyses of female ovipositor washings by gas chromatography linked to an electroantennogram (GC-EAG) confirmed the presence of three electrophysiologically active compounds. These were subsequently identified as (Z)-9-tetradecen-1-ol, (Z,E)-9,12-tetradecadien-1-ol, and (E,E)-10,12-tetradecadien-1-ol, by comparison of GC retention times with standards. Field testing of these compounds in Sierra Leone has shown that the diene alcohols, (Z,E)-9,12-tetradecadien-1-ol and (E,E)-10,12-tetradecadien-1-ol are essential for attraction, but (Z)-9-tetradecen-1-ol had no significant effect on catch.

A 9:1 mixture of (Z,E)-9,12-tetradecadien-1-ol and (E,E)-10,12-tetradecadien-1-ol dispensed from rubber septa at a 200µg. loading in a delta trap was found to produce a highly effective lure for male M. separatella. This lure is currently being evaluated in the different agroecosystems found in Guinea, Guinea Bissau and Sierra Leone.

SEASONAL FLUCTUATIONS OF PLANT PHENOLIC ACIDS IN SOILS OF A BOTTOMLAND DECIDUOUS FOREST IN THE SOUTHEASTERN UNITED STATES

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While much is already known about the synthesis, structure and in vitro toxicity of plant phenolic acids, there are still many unanswered questions concerning their concentration, persistence, mobility and seasonal fluctuation in natural systems. To address these questions, a year-long field study was initiated in a mature bottomland deciduous forest of the southeastern United States. Field design, methodology and preliminary data are reported here.

Soil samples collected monthly will be analyzed using four different soil extraction procedures to determine the fraction of phenolic acids associated with different soil component phases. Soil pore waters will be concurrently monitored for concentrations of phenolic acids.

The input of phenolic acids to the soil from leaf litter will be investigated via decomposition and leaching studies. In situ litter bags will be periodically collected and analyzed for leachable and non-structural phenolic acids and lignin content. In a separate experiment, apparatus to collect leachable phenolic acids from the leaf litter of eight tree species will be sampled for volume and concentration after precipitation events.

AN APHID SEX PHEROMONE

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Sexual females of the vetch aphid Megoura vicae produce a sex pheromone from structures on their hind tibia. An analysis of a female leg extract, which attracted males in a laboratory bioassay, showed two components that stimulated the olfactory receptors associated with the secondary rhinaria on the male antenna. These compounds were identified as (4aS,7S,7aR)-nepetalactone I and (4aS,7S,7aR)-nepetalactol II. A 1:1 mixture of these two compounds was as active in the laboratory bioassay as the natural leg extract.

A number of other aphid species also possess olfactory receptors for these two compounds. In addition, the black bean aphid, Aphis fabae Scopoli and the pea aphid, Acyrthosiphon pisum (Harris) have been shown to produce both I and II, although in different proportions. The ratio is heavily biased towards the nepetalactol in A. pisum whilst the reverse situation exists for A. fabae.

THE ROLE OF 4-CRESOL AND 3-n-PROPYLPHENOL IN THE TSETSE ATTRACTION OF BUFFALO URINE AND THEIR ORIGIN

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Seven phenolic compounds (phenol, 3- and 4-methylphenols, 3- and 4-ethylphenols, and 3- and 4-propylphenols) previously shown to be components of a fraction of an extract of buffalo urine active as a tsetse attractant, were evaluated in field trapping experiments, individually and in blends. The results show that 4-cresol and 3-n-propylphenol are the two most important components and account for most of the activity of the phenolic fraction. The phenols are released gradually from urine samples and it has been shown that this occurs as a result of microbial action on water-soluble precursors.

EFFECTS OF WEED AND CROP ALLELOCHEMICALS

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Secondary metabolites influence many organisms which interfere with the plant that produces them. Acting as allelochemicals, secondary metabolites tend to elicit similar responses from receiver plants at morphological and cellular levels. Experiments with the weed Camelina sativa and the crop plant barley (Hordeum vulgare) demonstrate this principle. When applied to test species, allelochemicals from Camelina and Hordeum reduced radicle length but increased the amount of vacuolation in radicle tip cells. Evidence for phagocytosis was also apparent.

Allelochemicals and their modes of action may be significant to herbicide development. Their presence in crop plants suggests that enhanced allelochemical concentration may be a worthwhile plant breeding objective.

VOLATILES OF SORGHUM BICOLOR (L.) MOENCH - ELECTROANTENNOGRAM RECORDINGS ON CHILO PARTELLUS (SWINHOE) MOTHS

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Volatile compounds associated with 4-week old Sorghum bicolor (L.) Moench (Serena variety) plants were trapped on Tenax TA adsorbent. The trapped volatiles were released directly into a capillary gas chromatograph-mass spectrometer (GC-MS) for analysis by heating the Tenax trap in the GC carrier gas stream. Eight volatile compounds, toluene, hexanal, (Z)-3-hexen-1-ol, m-xylene, o-xylene, (Z)-3-hexen-1-ol acetate, nonanal and decanal were identified. Electroantennogram (EAG) recordings were performed to measure the antennal olfactory responsiveness of Chilo partellus (Swinhoe) moths to authentic samples of the eight identified volatile compounds. Decanal and nonanal evoked the highest EAG responses followed by (Z)-3-hexen-1-ol acetate. Male antennae were more responsive than female antennae.

CONSTITUENTS OF THE VOLATILE OIL OF THE DECIDUOUS SHRUB, COMMIPHORA ROSTRATA: POSSIBLE ROLE IN PLANT DEFENCE

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The deciduous shrub, Commiphora rostrata contains a highly volatile oil which is rapidly released when the bark is bent or cut. The oil spreads and volatilizes readily. Gas chromatography and gas chromatography-mass spectrometry have revealed the presence of at least 30 components. 2-Decanone makes up about 65% of the oil while 2-undecanone and 2-dodecanone make up about 24% and 5% respectively. 2-Octanone, 2-nonanone, 2-tridecanone, 2-tetradecanone and 2-pentadecanone are present in quantities of less than 1% of the total oil. 3-Undecanone, 3-dodecanone and 3-tridecanone are also present in amounts of less than 1% of the total. The secondary alcohols 2-decanol, 2-undecanol and 2-dodecanol are present in trace amounts (less than 1%).

An homologous series of saturated long chain aldehydes are also present, starting at tridecanal up to octadecanal, in an approximate ratio of 1:1:1:18:5:3, where the hexadecanal constitutes approximately 1.5% of the oil. Other components remain to be identified.

The possible role of the constituents of this oil in plant defence are discussed. Preliminary information suggests that one of the oil components, 2-decanone, is repellent to the maize weevil, Sitophilus zeamais.

SUNFLOWER POLLEN: ITS IMPORTANCE IN THE REPRODUCTIVE BIOLOGY OF HOMOEOSOMA ELECTELLUM (LEPIDOPTERA: PYRALIDAE)

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In a previous study (Delisle et al., submitted) we demonstrated that sunflower pollen contains an oviposition stimulus for the sunflower moth, a known migrant species. We therefore examined the possibility that pollen also influences female reproductive behaviour and physiology. The mean age at which females initiated calling (emission of the sex pheromone) following emergence was less than 3 days in the presence of pollen compared with more than 7 days when provided only with sucrose. The rate of ovarian development was significantly accelerated in the presence of pollen, which could explain the advance in the onset of calling behaviour. Direct contact with pollen was not necessary to initiate the observed changes, indicating that pollen acted as a kairomone rather than an additional food source. The role of pollen in the reproduction and migration of H. electellum will be discussed.

DETERRENCY, TOXICITY AND MODE OF ACTION OF AZADIRACHTIN IN SCHISTOCERCA GREGARIA AND LOCUSTA MIGRATORIA

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Azadirachtin, a limonoid from the Indian neem tree, Azadirachta indica is a most effective antifeedant and toxicant against many insect pests including the locusts S. gregaria and L. migratoria. It was the most toxic of 8 plant secondary compounds (nicotine, quinine, tomatine, salicin, umbelliferone, sinigrin, allylisothiocyanate, azadirachtin) tested against the two species of locust and was also the most deterrent of the 8 to S. gregaria.

A significant positive correlation was found in both species of locust between deterrency and acute toxicity of the 8 compounds tested revealing a physiological basis for the degree of deterrency of different compounds.

The toxic action of azadirachtin involves marked insect growth regulatory effects. These include, in a dose-dependent fashion, a lack of feeding and of growth; death during ecdysis; death immediately prior to the moult; greatly extended instars with moult inhibition, or death soon after treatment. These effects are shown to be due in part to a direct inhibitory effect on gut contractility. Such an inhibition may have important bearings on the success of feeding, the digestion of food, moult initiation by stretching of the gut and successful ecdysis following the swallowing of air. Azadirachtin also has an indirect effect on haemolymph ecdysone levels and hence moult initiation.

Present work on the mode of action of azadirachtin on gut muscle reveals a direct inhibition of proctolin and glutamate stimulated contractions of the hindgut.

PHEROMONE DISC CONTACT BIOASSAY OF THE SANDFLY LUTZOMYIA LONGIPALPIS (DIPTERA: PSYCHODIDAE)

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The sandflies belonging to the Lutzomyia longipalpis complex are the vectors of visceral leishmaniasis in South and Central America. Males bear pale tergal spots which are the emission sites for either diterpenoid or farnasene/homofarnasene-like chemicals. A simple bioassay was devised to investigate the mode of action of these pheromones. Gland extracts on filter paper discs were placed on the abdomens of anaesthetized hamsters and the number of fly contacts with the disc were recorded over a 30 minute period.

Pheromone discs were found to attract only female flies and the response decreased with length of exposure. Increased pheromone concentration resulted in more contacts. Storage of extract discs at ambient temperature ($23^{\circ}C \pm 3$) in closed vials for up to 6 days increased their attractivity to female flies.

CHEMICAL ECOLOGY OF OREINA CACALIAE: VARIATION AT THE SUBSPECIES AND POPULATION LEVEL

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Host plant preferences in the field and the laboratory as well as the defensive chemistry of 4 populations belonging to the 2 subspecies O. cacaliae cacaliae and O. cacaliae tristis were investigated. Marked differences were found both between populations and between subspecies. The most prefer host plant in the field for each population is the most abundant of the potential host plants present. The same preference was shown in the laboratory in choice experiment.

The defensive chemistry is not directly influenced by the host plants, although some are known to contain toxins. There are major differences in composition of the secretions of the different populations and subspecies. One population of each subspecies secretes cardenolides, in addition to other still unidentified compounds. The other 2 populations lack the cardenolides. Genetic distances between these populations are being investigated by alloenzyme electrophoresis.

MALE SEX PHEROMONE IN THE GENUS XYLOTRECHUS AND ITS RELATED GENERA

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Several species of the genus Xylotrechus (Coleoptera: Cerambycidae) and of related genera are widely distributed in Japan. Some of them are noted to be important pests.

Recently, we have showed that the mating system of the grape borer, Xylotrechus pyrrhoderus Bates, which is an important pest of the grapevine, involves a male-produced sex pheromone which is a mixture of (2S,3S)-octanediol and (2S)-hydroxy-3-octanone (in ratios of 80:20 to 95:5) and which is attractive to females over a distance of 1 to 2m.

As it is interesting to know if the same components exist universally in the genus Xylotrechus and other related species or genera, we checked by GC-MS analysis the male sex pheromone components in the hexane washings of a vessel which contained males.

Among 10 species (sex Xylotrechus and four related genera), X. chinensis, X. rufilius, X. villioni, and Plagionotus christophi showed the presence of these substances.

By observation, X. chinensis shows the same type of mating behavior as X. pyrrhoderus. These substances would act as male sex pheromone components in this species, while sufficient observations have not been made to establish this with other species.

A large amount of pheromone (more than 1 mg/male per hour) was detected in hexane extracts from X. pyrrhoderus, X. chinensis, and X. villioni, but in X. rufilius and P. christophi only small amounts of less than 5 ng were detected. The evolutionary development of male pheromone-mediated systems and morphological modification associated with pheromone production will also be discussed.

APHID RESPONSE TO NON-PROTEIN AMINO ACIDS OF CALLIANDRA

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Non-protein amino acids isolated from the tropical legume genus Calliandra were assayed for biological activity against aphids. Four imino acids (amino acids with a heterocyclic nitrogen ring), pipecolic acid, cis-5-hydroxypipecolic acid, 2,4-cis-4,5-trans-4,5-dihydroxypipecolic acid and 2,4-trans-4,5-trans-4,5-dihydroxypipecolic acid and one sulphur-containing amino acid, S-beta (carboxyethyl)-cysteine were tested alone and in mixtures at concentrations ranging from 10^{-6} to 10^{-3} molar. The mixtures tested mimicked combinations found in Calliandra species. Compounds were added to water in which two week old decapitated bean plants were growing. Aphids were placed on the plants and their performance monitored over 5 days. The sulphur-containing amino acid and the imino acids alone had little effect on mortality, fecundity or movement of the aphids. Significant effects were seen, however, with combinations of imino compounds especially when the sulphur amino acid was included. This is of interest as the sulphur amino acid is a major component of seeds and young leaves.

THE CHEMICAL RELATIONS BETWEEN ALLIUM, THE LEEK-MOTH AND ITS ENTOMOPHAGE

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Mining larvae of the leek-moth, Acrolepiopsis assectella, develop only on Allium plants. Young pupae of this lepidopteran are parasitized by the wasp Diadromus pulchellus (Ichneumonidae). The effects of Allium chemicals were studied on the host-plant search and on the oviposition specificity of the moth. Next, they were studied on the search for the host-pupae and its habitat by the parasitoid wasp.

Allium spp. produce allelochemicals, particularly sulfur compounds, some of which we have identified by V.P.C. and T.L.C. in leek volatiles. The leek-moth is attracted by them and mostly by labile propyl propanethiosulfinate and by some analogues we have synthesized. The non volatile stable specific chemicals which stimulate egglaying (and vitellogenesis) in the moth are perceived at the tarsus level and do not belong to the metabolic pathway of the sulfur compounds. The locomotor activity of the wasp is stimulated by leeks especially those damaged by moth larvae, by the stable disulfides we have found in the leek-moth frass and by cabbage volatiles.

The allelochemicals of the primary producer, the Allium, act with great diversity on several levels of the trophic chain.

EFFECTS OF MICROALGAL METABOLITES ON PARTICLE SELECTION AND FILTRATION RATES OF MUSSELS

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Evidence is presented which indicates that nontoxic microalgal ectocrines mediate the feeding behaviour of the mussel Mytilus edulis (L.). Monoclonal cultures of three species of marine microalgae were grown in the laboratory on Guillard's f/2 medium. Cells were removed from cultures by gentle filtration, leaving dissolved microalgal ectocrines in culture filtrates. These filtrates were then used to determine effects of adsorbed epiparticulate ectocrines on the particle selection of mussels and effects of dissolved ectocrines on the filtration rate of mussels.

Ectocrines were adsorbed onto either reverse phase (lipophillic) or normal phase (hydrophillic) microparticles (10.0 μm) and delivered to mussels with an equal concentration of particles treated with sea water and a nutrient control. Feces and pseudofeces were collected and the proportions of treated and control beads were compared. Results indicated that mussels select microparticles treated with ectocrines over those treated with the control.

Dissolved ectocrines were delivered to mussels in a nonstatic flow-through apparatus and removal of polystyrene beads (4.0 - 5.0 μm) was used to determine filtration rates. Bioassay results showed that mussels exposed to dissolved ectocrines had significantly higher filtration rates than mussels exposed to sea water and a nutrient control.

This research provides evidence that pre-ingestive chemical cues from microalgae influence mussel feeding behaviour. Further experiments are being conducted to fractionate culture filtrates and determine the chemical nature of stimulatory substances.

FEMALE LUTZOMYIA LONGIPALPIS (DIPTERA: PSYCHODIDAE) RESPONSE TO HOSTS IN THE PRESENCE OF A PHEROMONE

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The sandfly Lutzomyia longipalpis is the vector of Leishmania chagasi the causative organism of visceral leishmaniasis, a disease which causes fatalities in infants in the Neotropics. Recently it has been shown that there are at least two sibling species of this insect that are reproductively isolated by differences in pheromones produced by the males. Field observations suggest that the sexes aggregate on mammalian hosts not only for females to seek a blood meal, but also for courtship and copulation.

A simple 3 cage olfactometer was used to determine whether the presence of male flies on hosts enhances their attractivity to females. In addition, crude hexane extracts of the male tergal pheromone on filter paper discs were used in conjunction with hosts to determine their attractivity to hungry females. In the presence of males, hosts attracted 57.6% of females in contrast to only 10.4% responding to a host without males. Similarly male gland extract in the presence of a host attracted 54.2% of females, whilst only 6.7% responded to the host in the presence of a control solvent disc.

CATERPILLAR/HOST PLANT INTERACTIONS: ENZYME INDUCTION AND INSECTICIDE TOLERANCE

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The influence of the host plant on detoxifying enzyme activity and insecticide tolerance was studied in the Cotton Bollworm, Heliothis armigera (Hbn.). Larvae were maintained on a standard diet until the end of the fifth instar. The newly moulted sixth instar larvae were then fed either chickpea pods, cotton bolls, sorghum heads, tomato fruits or a blank diet devoid of allelochemicals, for between one and four days, prior to enzyme assay or topical application of insecticide. Larvae fed on tomato fruits were considerably more susceptible to carbaryl and monocrotophos than larvae fed the other host plants. After three days of feeding the estimates of 'total enzyme activity per larva' for both carboxylesterases and glutathione S-transferases decreased in the following order; sorghum > cotton > chickpea > tomato. Measurements of specific carboxylesterase activity reveal up to 15 times more activity in the midgut than in the fatbody, whereas specific glutathione S-transferase activity is comparable in the two tissues. These initial findings suggest some physiological connection between diet, enzyme activity and insecticide tolerance in this particularly damaging pest insect.

EVIDENCE FOR ALLELOPATHIC EFFECTS OF POLYGONELLA MYRIOPHYLLA

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The Florida scrub is a plant community found throughout Florida. Open scrub sites are characterized by widely-spaced evergreen shrubs including Polygonella myriophylla, and by dense mats of fruticose lichens including various Cladina spp. Few plants grow in the open areas between shrubs, and there is a noticeable lack of ground cover in the form of herbs and forbs. The scrub contrasts sharply with the sandhill community type, also widespread in Florida and found on similar soils. These areas, dominated by various pines and oaks, have a dense herbaceous understory of grasses. The dominance of Polygonella myriophylla at several central Florida sites lead to its selection for further investigation. Numerous lines of evidence support the hypothesis that allelopathic interference by Polygonella is important in the Florida scrub. Field measurements of plant biomass demonstrated striking zones of inhibition around mature Polygonella plants. Bioassays with Paspalum notatum (Bahia grass) found growth reductions of as much as 50% when planted in Polygonella soil. Phenolic compounds are the major secondary chemical constituents of Polygonella. Hydroquinone and another compound, tentatively identified as an isomer of gallic acid, occur in high concentrations both in foliage and in rain drip, and are the probable allelopathic agents. Concentrations of both toxins in the soil have been measured.

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