# ANNUAL

# INTERNATIONAL

# PLANT RESISTANCE TO

# INSECTS

# NEWSLETTER

# VOL. 26

# 2000

# Annual

# International Plant Resistance to

# Insects

# Newsletter

# Vol. 26

# 2000

*******************************************************************************
Edited by C. Michael Smith, Professor, and John C. Reese, Professor, Department of Entomology, Kansas State University, Manhattan, Kansas. Clerical assistance by Evelyn Kennedy.
*******************************************************************************

**EDITOR'S PAGE**
**2000 Newsletter**

Welcome from the Department of Entomology at Kansas State University to volume 26 of the International Plant Resistance to Insects Newsletter (IPRIN). We think the present format of the newsletter is helping plant resistance researchers continue to move into the world of 21st century digital communications. To all of you who continue to offer suggestions for further improvement, thank you very much.

For those of you reading the newsletter for the first time, we welcome your comments and contributions. If you wish to contribute items to future newsletters, they should be Word or WordPerfect files of two pages or less of text in length (tables are not printed) and can be submitted as e-mail file attachments to cmsmith@ksu.edu, or on 3.5" computer diskette to Evelyn Kennedy, Department of Entomology, Kansas State University, Manhattan, KS 66506-4004.

Other types of plant resistance to insects information continue to be accessible also. The KSU Plant Resistance to Pests listserv, established by Donna Schenck-Hamlin of the KSU Hale Library and now administered by John Reese (JREESE@OZNET.KSU.EDU), is intended for continuous information exchange among individuals globally interested in plant resistance to pests about professional meetings, conferences and research grants, as well as new research developments concerning plant resistance to arthropods and plant pathogens. To subscribe to the bulletin board, send an e-mail message to: <listserv@ksuvm.ksu.edu>, with the subject line blank, and the message "SUB PRP firstname lastname." Use the e-mail address <PRP@KSUVM.KSU.EDU>to send a message to the entire bulletin board group. Kansas State University plant resistance to insects information is available on the Worldwide Web at http://www.oznet.ksu.edu/dp_entm/welcome.htm. Items available include the Painter Reprint Collection, archive editions of IPRIN, and new this year links to related websites including the Crop Science Society of America, CGIAR (Consultative Group for International Agricultural Research), and the Technology ISB Monthly News Report. Information is also available on how to subscribe to Plant Breeding News.

Thank for your interest in the IPRIN 2000. Please send your suggestions for improvement to Mike Smith at cmsmith@ksu.edu or Mike Smith, Department of Entomology, Kansas State University, Manhattan, KS 66506-4004. Your continued support, through contributions and/or financial assistance is much appreciated. Financial contributions may be sent to LaVona Francis, Department of Entomology, Kansas State University, Manhattan, KS 66506-4004, Attention IPRIN.

## TABLE OF CONTENTS

### 14th Biennial International Plant Resistance to Insects Workshop

**PARTICIPANT LIST**
**14th Biennial Int'l Plant Resistance to Insects Workshop**
**Colorado State University -- Fort Collins, Co**
**Dates Held: 2/28/2000 to 3/2/2000**


1. Craig A. Abel
USDA-ARS
P.O. Box 346
Stoneville, MS 38776
Telephone: 662-686-5248
Fax: 662-686-5421
cabel@ag.gov

2. Hesham Agrama
Kansas State University
Department of Agronomy
2004 Throckmorton
Manhattan, KS 66506
Telephone: 785-532-5954
Fax: 785-532-6094
hagrama@ksu.edu

3. Hassan Y. Al Ayedh
Colorado State University
Dept of BSPM
Fort Collins, CO 80523
Telephone: 970-690-4317
Fax:
hayala@lamar.colostate.edu

4. Mohammad Al-Deeb
Kansas State University
Department of Entomology
123 Waters Hall
Manhattan, KS 66506
Telephone: 785-532-4730
Fax: 785-532-6232
maa5354@ksu.edu

5. James A. Anstead
Oklahoma State University
1301 N. Western Street
Stillwater, OK 76075
Telephone: 405-626-4141, x 262
Fax:
jansstead@pswcrl.ars.usda.gov

6. Jon Babcock
Dow AgroSciences
13668 Magic Stallion Drive
Carmel, IN 46032
Telephone: 317-580-1807
Fax: 317-580-0683
jmbabcock@dowagro.com

7. Amirhusin Bahagiawati
Purdue University
110-1 Married Student Courts
West Lafayette, IN 47906
Telephone: 765-494-8713
Fax: 765-496-1219
bahayiaw@expert.cc.purdue.edu

8. Cheryl Baker
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141 ext.222
Fax: 405-624-4142
cbaker@pswcrl.ars.usda.gov

9. Dean Barry
USDA-ARS
213 Rothwell Drive
Columbia, MO 65203
Telephone: 573-445-1452
Fax: 573-882-1115
BarryB@Missouri.edu

10. Fred Baxendale
University of Nebraska
202 Plant Industry Building
Lincoln, NE 68583-0816
Telephone: 407-472-8699
Fax: 407-472-4687
fbaxendale@unl.edu

11. Richard L. Bell
USDA, ARS
Appalachian Fruit Res. Station
45 Wiltshire Road
Kearneysville, WV 25430
Telephone: 304-725-3451
Fax: 304-728-2340
rlbell@aol.com

12. David Bergvinson
CIMMYT Int.
Lisboa 27, Apdo Postal 6-641
Mexico, DF 06600
Mexico 6-641
Telephone: 52-5804-2004
Fax: 52-5804-7558
d.bergvinson@cgiar.org

13. Brad Binder
USDA-ARS
Iowa State University
Ames, IA 50611
Telephone:
Fax:
bfbinder@iastate.edu

14. Jim Bing
Mycogen Seeds
301 Campus Drive
Huxley, IA 50124
Telephone: 515-597-3284
Fax: 515-597-2875
bingj@mycogen.com

15. Tracey A. Bjorksten
Colorado State University
Department of Biology
A/Z 106
Fort Collins, CO 80523
Telephone: 970-491-2058
Fax: 970-491-0649
tbjorks@lamar.colostate.edu

16. Sue Blodgett
Montana State University
Dept. of Entomology
Bozeman, MT 59715
Telephone: 406-994-2402
Fax: 406-585-8966
blodgett@montana.edu

17. Nilsa A. Bosque-Perez
University of Idaho
Dept. of P.S.E.S
Moscow, ID 83844-2339
Telephone: 308-885-7544
Fax: 308-885-7760
nbosque@uidaho.edu

18. Paul Buckley
USDA - ARS
Box 9555
Mississippi State, MS 39762
Telephone: 662-325-4078
Fax: 662-325-8441
pbuckley@dorman.msstate.edu

19. John D. Burd
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141 ext.223
Fax: 405-624-4142
jdburd@pswcrl.ars.usda.gov

20. "Casey" June Burks
Pioneer-Hi-Bred International
7301 NW 62nd Avenue
Johnston, IA 50131
Telephone: 515-253-2133
Fax: 515-253-2221
burksj@phibred.com

21. Oonagh Byrne
CLIMA, Faculty of Agriculture
Univ. of Western Australia
Perth, WA
Australia 6907
Telephone: (+61 8) 9380-1981
Fax:(+61 8) 9380-1140
oonagh@cyllene.uwa.edu.au

22. Ann Callahan
USDA-ARS
Appalachian Fruit Res. Stn.
45 Wiltshirie Road
Kearneysville, WV 25430
Telephone:304-725-3451 x 356
Fax: 304-728-2340
acallaha@afrs.ars.usda.gov

23. Vincent Cambier
Universite Catholique
Louvain-LA-NE
Place De L Universite 1
Brussels,
Belgium
Telephone:
Fax:

24. John E. Campbell
Campbell Enterprises
5344 NW 91st Ct.
Johnston, IA 50131
Telephone: 515-278-6952
Fax:
campbelljent@aol.com

25. Dan E. Cervantes
University of Idaho
Dept. of P.S.E.S.
Moscow, ID 83844-2339
Telephone: 208-885-3513
Fax:
cerv9570@uidaho.edu

26. Juan C. Cordero
Kansas State University
2002 Throckmorton Hall, KSU
Manhattan, KS 66506
Telephone: 785-532-7798
Fax:
juanca@ksu.edu

27. Frank M. Davis
USDA/ARS, retired
201 Honeysuckle Lane
Starkville, MS 39759
Telephone:
Fax:

28. Kevin J. Delaney
University of Nebraska-Lincoln
Dept. of Entomology
208 Plant Industry Bldg.
Lincoln, NE 68583-0816
Telephone: 402-472-8698
Fax: 402-472-4687
kjdelaney@alumni.indiana.edu

29. Sanford Eigenbrode
University of Idaho
Dept. of P.S.E.S.
Moscow, ID 83844-2339
Telephone: 308-885-2972
Fax: 308-885-7760
sanforde@uidaho.edu

30. Michael Flinn
Kansas State University
Department of Entomology
123 Waters Hall
Manhattan, KS 66506
Telephone: 785-532-6082
Fax: 785-532-6232
mflinn@oz.oznet.ksu.edu

31. John E. Foster
University of Nebraska
7100 Holmes Park Road
Lincoln, NE 68506
Telephone: 402-472-8686
Fax: 402-472-4687
jfoster1@unl.edu

32. Thomas Freeman
North Dakota State University
Electron Microscopy Center
NCSL
Fargo, ND 58105
Telephone: 701-231-8234
Fax: 701-239-1395
thfreeman@badlands.nodak.edu

33. Lee French
French Ag. Research, Inc.
RR #2
Box 294
Lamberton, MN 56152-9536
Telephone: 507-752-7274
Fax: 507-752-6132
efrench@rrcnet.org

34. Roger Fuentes
Oklahoma State University
127 Noble Research Center
Stillwater, OK 74078
Telephone: 405-744-4774
Fax:

35. Assefa Gebre-Amlak
Colorado State University
BSPM
C120 Plant Science
Fort Collins, CO 80523
Telephone: 970-491-5261
Fax: 970-491-3862

36. Michael E. Gray
University of Illinois
S-320 Turner Hall
1102 South Goodwin Avenue
Urbana, IL 61801
Telephone: 217-333-6652
Fax: 217-333-5245
m-gray4@uiuc.edu

37. Baozhu Guo
USDA-ARS-IBPMRL
2747 Davis Road
Tifton, GA 31794
Telephone: 912-387-2326
Fax: 912-387-2321
bguo@tifton.cpespeachned.edu

38. W. D. Guthrie
Retired
58442 260th Street
Nevada, IA 50201
Telephone: 515-382-4688
Fax:

39. Scott Haley
Colorado State University
7906 Rollingwood Drive
Fort Collins, CO 80525
Telephone: 970-416-7370
Fax: 970-491-0564
shaley@lamar.colostate.edu

40. Abner Hammond
LSU Ag Center
Dept. of Entomology
Room 402, Life Sciences
Louisiana State University
Baton Rouge, LA 70803
Telephone: 225-388-1828
Fax: 225-388-1643
ahammond@agctr.lsu.edu

41. Ronald Hammond
Ohio State University
1800 Cannon Drive
Lincoln Tower - Suite 720
Columbus, OH 43210
Telephone: 614-292-6831
Fax:

42. Tom Harvey
Kansas State University
1232 240th Avenue
Hays, KS 67601-9228
Telephone: 785-625-3425
Fax: 785-623-4369
tharvey@oz.oznet.ksu.edu

43. Gary Hein
University of Nebraska
4502 Avenue I
Scottsbluff, NE 69361
Telephone: 308-632-1369
Fax: 308-632-1365
ghein1@unl.edu

44. Short Heinrichs
University of Nebraska
3930 Village Court
Lincoln, NE 68516
Telephone: 402-472-1182
Fax:
eheinrichs@unl.edu

45. Tiffany Heng-Moss
University of Nebraska
202 Plant Industry
Lincoln, NE 68583-0816
Telephone: 402-472-8702
Fax: 402-472-4687
tiffany@unlserv.unl.edu

46. Louis Hesler
USDA-ARS
2923 Medary Avenue
Brookings, SD 57006
Telephone: 605-693-5228
Fax: 605-693-5240

47. Bruce E. Hibbard
USDA-ARS
109 Curtis Hall
University of Missouri
Columbia, MO 65211
Telephone: 573-882-6281
Fax: 573-884-7850
hibbardb@missouri.edu

48. Leon Higley
University of Nebraska-Lincoln
Dept. of Entomology
202 PI Bldg.
Lincoln, NE 68583-0816
Telephone: 402-472-8689
Fax: 402-472-4687
lhigley@unl.edu

49. D. Michael Jackson
USDA-ARS
U.S. Vegetable Laboratory
2875 Savannah Highway
Charleston, SC 29414
Telephone: 843-556-0840
Fax: 843-763-7013
mjackson@awod.com

50. Johnie N. Jenkins
USDA-ARS
P.O. Box 5367
Mississippi State, MS 39762
Telephone: 662-320-7387
Fax: 662-320-7528
jjenkins@ra.msstate.edu

51. M. Tracy Johnson
University of Hawaii
Dept. of Entomology
3050 Maile Way
Gilmore 310
Honolulu, HI 96822
Telephone: 808-956-4720
Fax: 808-956-2428
mtracyj@aol.com

52. Thomas Juba
North Carolina State Univ.
P.O. Box 7630
Raleigh, NC 27695
Telephone: 919-515-1657
Fax: 919-515-3748
trjuba@unity.ncsu.edu

53. Von Kaster
Garst Seed Company
2369 330th Street
P.O. Box 500
Slater, IA 50244
Telephone: 515-685-5111
Fax: 515-685-5190
von.kaster@garstseedco.com

54. Catherine Katsar
USDA-ARS
123 West Waters Hall
Kansas State University
Manhattan, KS 66506
Telephone: 785-532-4719
Fax: 520-962-2752
ckatsar@oznet.ksu.edu

55. Robert Lamb
Agriculture Canada
291 Dafoe Road
Winnipeg, MB
Canada R3T 2M9
Telephone: 204-983-1458
Fax: 204-983-4604
rlamb@em.agr.ca

56. Steve Lefko
Monsanto
3100 Sycamore Road
Dekalb, IL 60115
Telephone: 815-758-9579
Fax: 815-758-3117
salefk@dckalb.com
Fax: 860-486-0682

57. Ana Legrand
University of Connecticut
Dept. of Plant Science
1376 Storrs Road,
V-67
Storrs, CT 06269
Telephone: 860-486-0869
alegrand@canr.uconn.edu

58. Xuming Liu
Kansas State University
Department of Entomology
123 Waters Hall
Manhattan, KS 66506
Telephone: 785-532-6082
Fax: 785-532-6232
lxuming@oznet.ksu.edu

59. Tulio Macedo
University of Nebraska-Lincoln
Dept. of Entomology
202 Plant Industry Bldg.
Lincoln, NE 68583-0816
Telephone: 402-472-8698
Fax: 402-472-4687
macedo@unlserve.unl.edu

60. Richard Mayer
USDA-ARS
US Horticultural Research Lab
2001 South Rock Road
Fort Pierce, FL 34945
Telephone: 561-462-5800
Fax: 561-462-5986
rmayer@ix.netcom.com

61. Heather McAuslane
University of Florida
4513 NW 130th Street
Gainesville, FL 32606
Telephone: 352-392-1901x129
Fax: 352-392-0190
hjm@gnv-ifus.ufl.edu

62. Jack C. McCarty
USDA, ARS
P.O. Box 5367
Mississippi State, MS 39762
Telephone: 662-320-7389
Fax: 662-320-7528
jcm@ra.msstate.edu

63. Michael D. McMullen
USDA-ARS
301 Curtis Hall
University of Missouri
Columbia, MO 65211
Telephone: 573-882-7606
Fax: 573-884-7850

64. Mitch Meehan
Garst Seed Company
2369 330th Street
Slater, IA 50244
Telephone: 515-685-5166
Fax: 515-685-5080
mitch.meehan@garstseedco.com

65. Samuel Migui
Graduate Student
Agriculture Canada
291 Dafoe Road
Winnipeg, MB
Canada
Telephone: 204-984-4889
Fax: 204-983-4604

66. John Mihm
French Ag. Research, Inc.
RR #2
Box 294
Lamberton, MN 56152-9536
Telephone: 507-752-7274
Fax: 507-752-6132
jmihn@rrcnet.org

67. Hayley Miller
Colorado State University
Dept. Bioag. Sci&Pest Mgm
Fort Collins, CO 80523
Telephone: 970-491-5675
Fax: 970-491-6990
hmiller@lamar.colostate.edu

68. William J. Moar
Auburn University
Dept. of Entomology
301 Funchess Hall
Auburn, AL 36849
Telephone: 334-844-2560
Fax: 334-844-5005
wmoar@acesag.auburn.edu

69. Dan Moellenbeck
Pioneer Hi-Bred
7250 NW 62nd Avenue
Johnston, IA 50131
Telephone: 515-270-4083
Fax: 515-334-4722
moellenbeckd@phibred.com

70. Do Mornhinweg
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141
Fax: 405-624-4142

71. Itor Emmanuel Nanji
Cameroon Development Corp.
P.O. Box 18 BOTA
Limbe,
Cameroon
Telephone: 237 33-44-27
Fax: 237 47-08-13
mbellajoe@yahoo.com

72. Eric Natwick
University of California
1050 East Holton Road
Holtville, CA 92250
Telephone: 760-352-9474
Fax: 760-352-0846
etnatwick@ucdavis.edu

73. Dennis R. Nelson
USDA-ARS
Biosciences Research Lab
1605 Albrecht Boulevard
Fargo, ND
Telephone:
Fax: xni@montana.edu

74. Xinzhi Ni
Montana State University
Department of Entomology
Bozeman, MT 59717
Telephone: 306-994-7626
Fax: 406-994-6029

75. James L. Overman
Monsanto
Union City, TN 38261
Telephone: 901-885-7421
Fax: 901-885-7422

76. Dan Palmer
13655 102nd Street
Cologne, MN 55322
Telephone: 612-442-4790
Fax: 612-442-4790
mdjp@msn.com

77. Frank Peairs
Colorado State University
Dept. of Bioag. Sci & Pest Mgm
Fort Collins, CO 80523
Telephone: 970-491-5675
Fax: 970-491-6990
fbpeairs@lamar.colostate.edu

78. Yvan Pelletier
Potato Research Cntr., AAFC.
P.O. Box 20280
Fredericton, NB
Canada E3B 4Z7
Telephone: 506-452-3260
Fax: 506-452-3316
pelletiery@em.agr.ca

79. Fred Perlak
Monsanto
Cotton Technology
700 Chesterfield Pkw North
Chesterfield, MO 63198
Telephone: 636-737-6212
Fax: 636-737-5250
frederick.j.perlak@monsanto.com

80. Mel Peters
Pioneer Hi-Bred International
7250 NW 62nd Avenue
Johnston, IA 50131
Telephone: 515-253-2156
Fax: 515-334-4722
petersml@phibred.com

81. Laura O. Petro
University of CA-Riverside
Department of Entomology-41
Riverside, CA 92521
Telephone: 909-787-4733
Fax: 909-787-3086
laurap@citrus.ucr.edu

82. Clinton D. Pilcher
Monsanto Company
Monmouth Agronomy Center
1677 80th St.
Monmouth, IL 61462
Telephone: 309-734-3407
Fax: 309-734-6957
clinton.d.pilcher@monsanto.com

83. David R. Porter
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141
Fax: 405-624-4142
dporter@pswcrl.ars.usda.gov

84. Wilf Powell
IACR-Rothamstead
Entomology and Nematology Dept
Harpenden, Herts,
United Kingdom AL5 2JQ
Telephone: 44-1582-76-3133
Fax:
wilf.powell@bbsrc.ac.uk

85. Gary J. Puterka
USDA-ARS
Appalachian Fruit Res. Stn.
45 Wiltshire Road
Kearneysville, WV 25443
Telephone: 304-725-3451 x361
Fax: 304-728-2340
gputerka@afrs.ars.usda.gov

86. Jim Quick
Colorado State University
Soil and Crop Sciences
C128 Plant Sciences
Fort Collins, CO 80523
Telephone: 970-491-6501
jquick@agsci.colostate.edu

87. Terri Randolph
Colorado State University
Dept. of Bioag. Sci & Pest Mgm
Fort Collins, CO 80523
Telephone: 970-491-5675
Fax: 970-491-6990
Fax: randolph@lamar.colostate.edu

88. Roger Ratcliffe
USDA-ARS
Room 101 Entomology Hall
Purdue University
West Lafayette, IN 47907
Telephone: 765-494-4606
Fax: 765-494-5105
roger_ratcliffe@cntm.purdue.edu

89. Brian Rector
USDA-ARS
SAA, IBPMRL
P.O. Box 748
Tifton, GA 31793
Telephone: 912-387-2340
Fax: 912-387-2321
rector@tifton.cpes.peachnet.edu

90. Ahnya Redman
Pennsylvania State University
Department of Entomology
501 ASI Building
University Park, PA 16802
Telephone: 814-632-9712
Fax: 814-865-3048
amr 161@psu.edu

91. John C. Reese
Kansas State University
Dept. of Entomology
Waters Hall
Manhattan, KS 66506
Telephone: 785-532-4708
Fax: 785-532-6232
jreese@oznet.ksu.edu

92. James A. Reinert
Texas A&M University
17360 Coit Road
Dallas, TX 75252
Telephone: 972-231-5362
Fax: 972-952-9216
j-reinert@tamu.edu

93. Jon Sagers
Novartis Seeds, Inc.
317 330th Street
Stanton, MN 55018
Telephone: 507-663-7629
Fax: 507-645-7519
jon.sagers@seeds.novartis.com

94. Yehoshua Saranga
Hebrew Univ. of Jerusalem
P.O. Box 12
Rehovot, 76100
Israel
Telephone: 972 8-9489040
Fax: 972 8-9468265
saramya@agri.huji.ac.il

95. Floyd W. Shockley
University of MO-Columbia
Dept. of Entomology
1-87 Agriculture Building
Columbia, MO 65211
Telephone: 573-882-8243
Fax: 573-882-1469
shockleyf@missouri.edu

96. Kevin A. Shufran
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141
Fax: 405-624-4142
kashufran@pswcrl.ars.usda.gov

97. Roxanne Shufran
Kansas State University
Department of Entomology
124 W. Waters Hall
Manhattan, KS 66506-4004
Telephone: 785-532-6154
Fax: 785-532-6232
entomology@ksu.edu

98. Richard Shukle
USDA-ARS
Dept. of Entomology
Purdue University
West Lafayette, IN 47906
Telephone: 765-494-6351
Fax: 765-496-1219
rich_shukle@entm.purdue.edu

99. Alvin M. Simmons
USDA-ARS
U.S. Vegetable Lab
2875 Savannah Highway
Charleston, SC 29414
Telephone: 843-556-0840
Fax: 843-763-7013
asimmons@awod.com

100. Jai Puran Singh
Sinter - MM
Masherovo, Street - 45
Minsk City,
Republic of Belarus
Telephone: 375 172 318118
Fax: 375 172 112843
lumbini@usa.net

101. Phil Sloderbeck
Kansas State University
2510 John Street
Garden City, KS 67846
Telephone: 316-275-9164
Fax: 316-276-4130
psloderb@oznet.ksu.edu

102. Mike Smith
Kansas State University
Department of Entomology
123 Waters Hall
Manhattan, KS 66506
Telephone: 785-532-4700
Fax: 785-532-6232
csmith@ksu.edu

103. Julie Soroka
Agriculture&Agri-Food Canada
Saskatoon Research Centre
107 Science Place
Saskatoon, SK
Canada S7N OX2
Telephone: 306-956-7294
Fax: 306-956-7247

104. Rick Story
LSU Ag Center
Dept. of Entomology
Room 402, Life Sciences
Louisiana State University
Baton Rouge, LA 70803
Telephone: 225-388-1833
jstu@entm.purdue.edu

105. Jeff Stuart
Purdue University
Dept. of Entomology
1158 Smith Hall
West Lafayette, IN 47907
Telephone: 765-494-4561
Fax: 765-496-1219
sorokaj@em.agr.ca

106. George L. Teetes
Texas A&M University
Department of Entomology
College Station, TX 77843
Telephone: 409-845-8980
Fax: 409-847-8668
g-teetes@tamu.edu

107. Irene Terry
University of Utah
Department of Biology
1400 East 257 South
Salt Lake City, UT 84112-0840
Telephone: 801-585-3139
Fax: 801-581-4668
terry@biology.utha.edu

108. Patrick V. Vail
USDA-ARS
2021 South Peach Avenue
Fresno, CA 93727
Telephone: 559-453-3002
Fax: 559-453-3088
1fouse@asrr.arsusda.gov

109. Fernando Valicente
Purdue University
Dept. of Entomology
1158 Smith Hall
West Lafayette, IN 47907
Telephone: 765-494-1438
Fax: 765-494-0535
fernando_valicente@entm.purdue.edu

110. Jose Magid Waquil
Embrapa Milho de Sporgo
University of Nebraska
312H Plant Industry Bldg
East Campus
Lincoln, NE 68585-0816
Telephone: 402-472-1184
Fax:401-472-4687
jwaquil@cnpms.embrapa.br

111. Jim Webster
USDA-ARS
1301 North Western
Stillwater, OK 74075
Telephone: 405-624-4141 ext. 245
Fax: 405-624-4142
jwebster@pswcrl.ars.usda.gov

112. James White
Novartis Seeds
R. R. 13, Box 166
Bloomington, IL 61704
Telephone: 309-823-8563
Fax: 309-823-8568
james.white@seeds.novartis.com

113. Neil Widstrom
USDA-ARS
P.O. Box 748
Tifton, GA 31798
Telephone: 912-387-2341
Fax: 912-387-2321
nwidstro@tifton.cpes.peachnet.edu

114. Gerald Wilde
Kansas State University
Department of Entomology
123 Waters Hall
Manhattan, KS 66506
Telephone: 785-532-4729
Fax: 785-532-6232
gwilde@oz.oznet.ksu.edu

115. Charistie Williams
Purdue University
101A Entomology Hall
West Lafayette, IN 47907
Telephone: 765-494-6763
Fax: 765-494-5105

116. Paul Williams
USDA - ARS
Box 9555
Mississippi State, MS 39762
Telephone: 662-325-4078
Fax: 662-325-8441
pwilliams@dorman.mmstate.edu

117. Valerie Williamson
University of California
Dept. of Nematology
Davis, CA 95616
Telephone: 530-752-3502
Fax: 530-752-5809
vmwilliamson@ucdavis.edu

118. Dick Wilson
USDA-ARS
Plant Introduction Station
G-204 Agronomy Hall
Iowa State University
Ames, IA 50011
Telephone: 515-294-8583
Fax: 515-294-4880
rlwilson@iastate.edu

119. Mohammed Yusuf
King's College
153 Gibbs Green
West Kensington,
London W14 9NE
Telephone: 44-171-385-5443
Fax: 44-171-848-4500
mohammed.yusuf@kcl.ac.uk

120. Geoffrey Zehnder
Auburn University
206 Extension Hall
Auburn University, AL 36849
Telephone: 334-844-6388
Fax: 334-844-5002
gzehnder@acesag.auburn.edu

121. Xuemei Zhang
Hollar Seeds
P.O. Box 106
Rocky Ford, CO 81067
Telephone: 719-254-7411
Fax: 719-254-3539
xuemei@ria.net

**Abstracts of presentations made during the <u>Graduate Student Symposium: Tri-Trophic Interactions and the Impact of Host Plant Resistance on Non-Target Organisms.</u>**
**14th Biennial, INTERNATIONAL PLANT RESISTANCE TO INSECTS WORKSHOP, Feb. 29 - Mar. 2, 2000, Fort Collins, Colorado.**

**Organizer/Moderator: Kevin A. Shufran, USDA-ARS, 1301 N. Western Rd., Stillwater, OK 74075**

Bold lettering indicates the presenting author.

*******************************************************************

**<u>Tritrophic Interactions Among Tobacco Budworm, (*Heliothis virescens*, Lepidoptera: Noctuidae), a Parasitoid of the Budworm (*Campoletis sonorensis*, Hymenoptera: Ichneumonidae), and Budworm Resistant Tobaccos</u>**. **Juba, T. R.**, Sorenson, C. E., Southern, P. S. Department of Entomology, North Carolina State University, Raleigh, NC 27695

Effective management of pests of flue-cured tobacco requires several components including insecticidal sprays, baits, beneficial insects, and, recently, host-plant resistance. Understanding interactions among different management strategies facilitates integration of them into one system. Tobaccos CU 263 and CU 370 were bred for resistance to the tobacco budworm (*Heliothis virescens*), which feeds upon the developing vegetative growth of the plant. *Campoletis sonorensis*, a significant natural enemy of the budworm larvae in North Carolina, parasitizes the second and third instars of the budworm. Using the variety K 326 as a susceptible standard, three experiments were performed to evaluate how host-plant resistance may effect the parasitoid in the laboratory and field. In the first experiment, *H. virescens* that had been reared on the different tobaccos were offered for parasitization to *C. sonorensis*. The larvae and any parasitoids that developed in them were maintained until emergence of adult parasitoids or pupation of the larvae. Measurements included weight of the budworms at parasitization, weight of the parasitoid pupae in cocoons, weight of the parasitoid adults, length of time from parasitization until parasitoid pupation, and length of time from parasitoid pupation until adult parasitoid emergence. The only significant difference in these parameters was a higher weight of pupae in cocoons from K 326 and CU 263 than CU 370 (the more resistant line). The objective of the second experiment was to determine whether there were any differences in parasitoid orientation to the host-plant in a wind tunnel assay. In addition to the three tobaccos, there were three treatments. Plants were uninjured, injured mechanically, or injured by budworm feeding with the larval budworm present in the wind tunnel. While no differences existed among the tobaccos within each treatment, the parasitoid females responded most to the plants injured by the budworm feeding, then the mechanically injured plants, and least to the uninjured tobacco. Finally, the interaction between resistant host-plant and parasitoid was evaluated in the field. Rows of each tobacco variety were planted in the field and infested with laboratory-reared *H. virescens* of an appropriate size. After three or four days, the plants were searched for surviving budworms. Recovered larvae were maintained on artificial diet in an incubator. The experiment was repeated 6 times over time. Significantly more budworms were recovered in K 326 than CU 370; recovery rates in CU 263 were similar to both other varieties. There was no clear significant trend over time. Early in the season significantly more of the recovered larvae had been parasitized than those recovered later in the season. No differences in proportion of larvae parasitized occurred among the varieties. Similarly, if total mortality is defined as unrecovered budworms plus parasitized budworms, then significantly more mortality occurred earlier in the season than later. Greater mortality also occurred on the resistant tobaccos than K 326. Finally, significantly more parasitized budworms from K 326 yielded adult parasitoids than the resistant tobaccos. The lower percent emergence in the resistant varieties may reflect a fitness cost of the lower pupal weight in cocoons in the first experiment. While there may be a fitness cost to the parasitoid, the second and third experiments demonstrate that parasitoid efficacy is unhindered and total mortality of budworms may be enhanced in the resistant tobaccos.

***********************************************************************

**Effects of plant morphological complexity on the efficacy and efficiency of *Coccinella septempunctata* L. as a predator of the pea aphid *Acyrthosiphon pisum* Harris.** **Ana Legrand** and Pedro Barbosa. Department of Plant Science, 1376 Storrs Road, U-67, University of Connecticut, Storrs, CT 06269 and Department of Entomology, Plant Science Building, University of Maryland College Park, MD 20742.

Host plant resistance relies on both chemical and physical plant traits. At the same time as these traits deter or harm insect herbivores, they can also have an effect on insect natural enemies. Physical plant characters that have been shown to impact the effectiveness of insect natural enemies include non-glandular trichomes, surface waxes and the size and shape of plant organs and protective structures. Another physical character that could influence the interaction between a herbivore and its natural enemies is plant morphological complexity. Plant complexity could provide a physical refuge to the prey or could interfere with foraging activities of a natural enemy. Andow and Prokym (1990) and Lukianchuk and Smith (1997) showed that egg parasitism was reduced when wasps searched for hosts on complex rather than on simple surfaces. Thus, the objective of this research was to test the hypotheses that increased plant morphological complexity reduces the area search efficiency and predation efficacy of *Coccinella septempunctata* L. a predator of the pea aphid *Acyrthosiphon pisum* Harris. Essential to testing these hypotheses is the use of near-isogenic lines of the pea plant. The *Normal*, *tl* and *aftl* near-isogenic lines were selected because they represented changes in morphological complexity that could be ranked from low to high complexity. Further, the use of these genetic isolines allowed for the control, as much as possible, of non-morphological plant characters such as phytochemicals and surface waxes.

The first step was to establish how plant morphological complexity might influence the herbivore. Changes in plant morphology did not have a significant effect on pea aphid total fecundity or intrinsic rate of increase. Moreover, plant morphology did not affect the choice of settling location by the pea aphid. Therefore it is unlikely that changes in plant morphological complexity have indirect effects on the predator via the aphid prey. While there were no significant effects on the prey, plant morphological complexity had a significant effect on the foraging efficiency of the coccinellid. Plant complexity influenced the foraging time of the predator and as a consequence residence time was longest on the most complex leaves (*aftl* plants), regardless of aphid presence. Due to the localized movements within a small fraction of the most complex leaf, coccinellids had a significantly reduced area search efficiency. Although the predation efficacy of the beetle was not affected by the morphology of the plants, plant complexity had a significant effect on the degree of prey disturbance by the predator. More aphids dropped or moved from their original position when the predator searched the *tl* plants which were intermediate in complexity. The results from separate experiments showed that the predator achieves the highest area search efficiency on *tl* leaves. This might explain why the coccinellid disturbed more prey on this plant type. The results presented in this study support the notion that plant complexity can interfere with the foraging activity of an insect predator.

Andow, D.A. and D.R. Prokym. 1990. Plant structural complexity and host finding by a parasitoid. Oecologia 82: 162-165.

Lukianchuk, J. L. and S. M. Smith.1997. Influence of plant structural complexity on the foraging success of *Trichogramma minutum*: a comparison of search on artificial and foliage models. Entomologia Experimentalis et Applicata 84: 221-228.

************************************************************************

**Tritrophic effects of volatile chemicals associated with induced resistance in solanaceous plants.**

**Ahnya M. Redman**, Jack C. Schultz, and James H. Tumlinson. Entomology Department, Pennsylvania State University, 501 Agricultural Sciences and Industries Bldg., University Park, PA 16802; Entomology Department, Pennsylvania State University, Pesticide Research Laboratory, University Park, PA 16802; and USDA- ARS, Center for Medical and Veterinary Entomology, 1700 SW 23rd Drive, Gainesville, FL 32608.

There has been a flurry of interest recently in tritrophic interactions and the potential use of herbivore-induced volatile compounds in agriculture. But, a critical question that has not been answered is whether the release of these compounds actually benefits plants, and thus growers utilizing these chemicals for biological control, by reducing pest populations. This question is equally important to ecologists interested in whether damage-induced volatiles have evolved to protect plants from herbivore-damage. Laboratory demonstrations of parasitoid-attraction to volatiles abound, but nothing is known about the function of these compounds in nature. We attempted to determine if natural enemies were attracted to volatile compounds in the field, using two solanaceous plants, tomato and eastern black nightshade, as well as the herbivore *Manduca sexta* (Lepidoptera: Sphingidae). First, we measured parasitoid-recruitment to tomato plants induced with natural damage (imposed at night, with herbivores removed each morning); to plants induced with 5 mM jasmonic acid (JA), a natural plant elicitor, biweekly; to untreated plants; and to plants treated with the solvent used to dissolve JA. Plants were protected from background herbivory by hand-picking, and parasitoid-recruitment was measured by recruitment to sticky traps and by parasitism of sentinel *M. sexta* caterpillars confined in mesh bags near treated plants. Parasitism of sentinels was significantly elevated on the induced plants over the two controls, and sticky traps showed a similar pattern, indicating that plants, not larvae themselves, attracted parasitoids. Parasitioids included some unidentified tachinids (Diptera), but were primarily *Cotesia congregata* (Hymenoptera: Braconidae).

The following field season, another experiment was conducted, utilizing both nightshade and tomato, to ascertain whether the same pattern could be detected when plants were exposed to background herbivory in addition to our treatments, and also to compare the effect of *M. sexta* regurgitant with the other two means of inducing resistance in plants. Parasitism of sentinels was measured on tomato plants treated with natural damage, JA, *M. sexta* regurgitant, no damage, solvent, or mechanical damage (the control for regurgitant). Natural damage received the highest level of parasitism, followed by JA and regurgitant, and all three differed from untreated, solvent-treated, and mechanically damaged plants. Nightshade plants were subjected to the same treatments, except for regurgitant and mechanical damage. Natural damage elevated parasitism compared to untreated plants, and although JA increased parasitism somewhat as well, it did not differ from either of the two controls.

In addition, we found in a census of arthropods on the foliage of treated tomato plants, that the relative composition of three functional feeding guilds (natural enemies; herbivores; and miscellaneous arthropods, which were primarily nectar-feeders) differed between treatments. The relative proportions of natural enemies and miscellaneous arthropods were higher than expected on naturally damaged and JA-treated plants, and proportions of herbivores were lower.

Headspace-sampling of plants grown in a greenhouse revealed increased levels of myrcene, á-terpinene, 2-carene, â-phellandrene, caryophyllene, and á-humulene released by plants treated with *M. sexta* damage v. untreated plants, as well as slightly (but significantly) increased levels of these same compounds by regurgitant-treated plants v. mechanically damaged plants.

**Effect of *Bt* corn on the predator *Orius insidiosus* (Say)**. **Mohammad A. Al-Deeb**[*] (Presenter) and Gerald E. Wilde

Laboratory feeding studies were conducted to determine the effect of feeding *Orius insidiosus* nymphs on 1 day old European corn borer *Ostrina nubilalis* (Hbn) larvae which had ingested diet containing *Bt* toxins (Dipel ES). A commercial formulation of *Bacillus thuringiensis* subsp Kurstaki (Dipel ES) was incorporated into a meridic diet used to feed European corn borer larvae; they were then offered as food to *Orius* nymphs. Immediately after eclosion *Orius* adult sex was determined, body weight and length were measured, and developmental time was calculated. Another feeding study was conducted to determine the effect of *Bt* corn silk on immature mortality of *O. insidiosus*. Fresh corn silks of *Bt* and non-*Bt* corn plants were offered to *Orius* nymphs till they reached maturity. Mortality counts were made daily. Finally, visual counts of *O. insidiosus* were made on *Bt* and non-*Bt* corn at three locations in Kansas (Abilene, Clay Center 1, 2). Number of *Orius* nymphs and adults were recorded on 40 plants per location on 2 sampling dates.

There was no significant difference in developmental time, body weight, body length of mature *Orius*, and immature mortality of *Orius* when reared on ECB larvae fed a diet containing Dipel ES. *Orius* nymphs feeding only on *Bt* and non-*Bt* corn silk suffered 100% mortality. There was no significant difference in immature mortality when *Orius* nymphs were fed a day on *Bt* and non-*Bt* silk and the other day on corn earworm eggs. Numbers of *Orius* adults and nymphs in *Bt* corn fields did not significantly differ from those of non-*Bt* fields. Our results suggest that *Bt* corn does not have a significant effect on the predator *O. insidiosus* (Say).

**Biotypic and genotypic variation of greenbug populations collected from non-cultivated grass hosts**. James A Anstead, John D Burd, Kevin A Shufran

The greenbug is an important pest of small grains in sorghum in North America. Resistant varieties have been deployed to control greenbug damage, but biotypes able to overcome this resistance have continued to cause significant loses. Very little is known about the biotypic or genotypic makeup of greenbug populations on grass hosts. It is hypothesized that non-cultivated grasses serve as a reservoir of diversity in the greenbug and that greenbugs move locally from non-cultivated hosts to exploit crops. It is also hypothesized that greenbug biotypes are in fact host specific races that evolved on non-cultivated grasses.

Greenbugs collected from a number of non-cultivated hosts and nearby cultivated hosts were tested for virulence against standard differentials to determine their biotype. Biotypic diversity was then compared between the cultivated and non-cultivated hosts.

The COI gene has been used to elucidate the relationships between the known greenbug biotypes (Shufran et al. unpublished data). They were found to fall into 3 clades; the biotypes predominantly found on sorghum (C, E, I and K) and J formed a single clade; biotypes B and the Canada Wild Rye isolate formed a single clade; the New York isolate (a possible example of biotype A) and biotypes F and G formed a separate clade. Biotype H diverged completely separately to the rest of the biotypes and was the most divergent.

The genetic relationship amongst isolates collected in this study were estimated by the same molecular phylogenetic techniques. A dendogram, based on a 1kb section of the COI mtDNA gene, and including sequence data from the laboratory biotype colonies and field collected colonies was produced. The relationships between host, biotype and genotype will be discussed.

**"Plant Allocation to Secondary Defensive Compounds: Testing the Carbon/Nutrient Balance Hypothesis in Elevated CO2"**. Carlos E. Coviella (1,2) and John T. Trumble (1), (1)University of California Riverside (2)Universidad Nacional de Lujan, Argentina

Plant resistance to herbivorous insects depends in part on plant allocation to defensive secondary compounds. The Carbon/Nutrient Balance Hypothesis (CNB) predicts that, when grown in elevated CO2, plants should allocate relatively more resources to carbon-based defenses as compared to plants grown in ambient CO2 levels. On the other hand, concentrations of nitrogen-based defenses should decline. We tested the CNB using a system that allowed us to simultaneously assess CO2 and nitrogen fertilization effects on plant total carbon and nitrogen, allocation to carbon-based and nitrogen-based defenses, and relating these results with potential impacts on herbivorous insects. We used transgenic Bt cotton plants as well as a near isogenic line without the Bt gene, grown in both ambient (370 L/L) and elevated (900 L/L) CO2 levels. We selected a split-plot design with CO2 level as whole plots, and with a 2 x 2 factorial for two levels of nitrogen fertilization and two levels of nitrogen-based defenses. We measured the effects of both elevated CO2 and nitrogen fertilization on total plant Carbon, and total plant Nitrogen. The nitrogen-based compound (the Bt toxin) and the carbon-based compounds in cotton (total phenolics, condensed tannins, and gossypol) were analyzed and quantified. We also examined the response of the insect herbivore Spodoptera exigua (Hbner) using foliar bioassays. The performance of the CNB hypothesis and the biological significance of the observed changes in plant resistance to insects are discussed.

**Molecular Markers Linked *to* Greenbug (Homoptera: Aphididae) Biotype I Tolerance in *Aegilops tauschii***. Michael Flinn[1], C. Michael Smith[1], John C. Reese[1], and Bikram Gill[2]
[1]Department of Entomology, Kansas State University, Manhattan, KS 66506-4004
[2]Department of Plant Pathology, Kansas State University, Manhattan, KS 66506-5502

New advances in molecular biology are being used to enhance the future development of insect resistant lines of wheat. In developing insect resistance molecular markers, the categories of resistance the marker identifies must be identified. *Aegilops tauschii* accession TA 1675 (resistant donor), 'Wichita' (susceptible wheat cultivar), and line 97-85-3 (resistant offspring), were investigated and the category of resistance determined in each. Antibiosis was determined by calculating and comparing the intrinsic rate of increase of aphid population on 'Wichita', TA1675, and 97-85-3. Antixenosis was determined by measuring the number of aphids moving to each line of wheat planted around the perimeter of a 12cm pot. TA1675 exhibited antixenosis, but this resistance was not passed on to 97-85-3. Comparisons of SPAD meter readings and proportional dry plant weights were used to determine tolerance in each line. TA1675 and 97-85-

3 were found to be highly tolerant compared to ‘Wichita’. This tolerance provides a unique opportunity for it to be combined with biocontrol techniques as effective alternatives to insecticides.

Preliminary evaluations indicate polymorphism between ‘Wichita’, compared to TA1675 and 97-85-3 genomic DNA when amplified by PCR with wheat microsatellite (WMS) 428, and primers developed from the wheat resistance gene analog (RGA)1 gene and the barley chitinase (Cht)1b gene. These putative linkages will be determined by genotypic and phenotypic evaluation of $F_2$ progeny from the cross TA1675 x ‘Wichita’. When confirmed, these molecular markers will help wheat breeders, geneticists, and entomologists quickly and efficiently screen segregating wheat populations and new accessions of wheat for greenbug resistance.

**Morphological and Molecular Quantification of the Hessian Fly/Wheat Interaction**, Luke Gumaelius and Roger Ratcliffe, Department of Entomology, Purdue University, West Lafayette Indiana 47907

The Hessian Fly (HF), *Mayetiola destructor* (Say), has been a economically significant insect wheat pest since its introduction to the United States in the late 1700s, causing massive crop losses throughout wheat growing regions of the country. Cultural controls and the institution of intensive resistance breeding programs have reduced, but not eliminated crop loss. The fly’s life cycle begins in the fall with the emergence of pupating adults. The short-lived adults mate, lay eggs and die within 2-3 days. Upon hatching, the first instar larvae crawl down the leaf surface into the growing point where a series of feeding sites are established. The feeding process causes localized cell permeability and stunting of the developing third leaf. The eventual effect of this feeding is a severely stunted main stem that gradually turns darker green. Uninfested tillers visually appear to be unaffected by main stem infestation. This phenotype often persists throughout the plant’s life. Although stereotypic, the aforementioned phenotype is not absolute. To the contrary, HF associated phenotypes are highly variable due to abiotic and biotic mediation.

My research is aimed at quantifying the range of morphological and molecular effects associated with HF feeding. Specifically, I have investigated: protein titre and size, chlorophyll titer, photosystem health, amino acid ratios, sugar pool sizes, root structure and whole plant morphometrics. Maggot size, infesting number and subsequent growth rate have been coupled with the plant measurements. Together these measures will indicate the relative sink strength of the infesting maggots and a biomass conversion ratio. This study will provide a baseline for future studies involving mechanisms of resistance and resistance gene introgression.

**Phylogenetic Relationships Among Greenbug Biotypes,** Andrea B. Jensen, J. Spencer Johnston, and George L. Teetes, Dept. of Entomology, Texas A&M Univ., College Station, TX 77843

The family Poaceae, the grasses, comprises 90% of the world's food crops. Greenbug, *Schizaphis graminum*, infests 70 species in this family, including wheat, barley, and sorghum. Understanding biotype development has application to sustainable production of sorghum, small grains, and many other crops for which insect-resistant varieties are available but resistance is periodically lost due to resistance-breaking biotypes. Determining biotype relatedness among greenbugs contributes to an understanding of pest-host plant relationships. Biotype relatedness was determined by sequencing 640 bp from the mitochondrial cytochrome oxidase II (COII) and 530 bp from the 16S ribosomal RNA (16S rRNA) subunits from multiple individuals of each greenbug biotype. Sequence data is examined as phylogenetic relationships (gene trees) using maximum parsimony. Gene fragments from the COII and 16S rRNA subunits show congruence. Significant diversity exists that gene trees are resolved and results are compared to biotypes and biogeography.

**Antibiosis and tolerance of Canadian spring wheats to cereal aphids**, S.M. Migui, Department of Entomology, University of Manitoba, Winnipeg, Manitoba R3T 2N2

Cereal aphids are pests of adult, spring-sown wheat plants in Canada. Previous research on resistance to cereal aphids concentrated on young winter wheat plants. To initiate research on identification and incorporation of resistance to aphids for Canadian wheats, the susceptibility of young and adult plants were compared for commonly grown wheats and pest aphids. Cultivars of three wheat classes were exposed to three aphid species, *Rhopalosiphum padi* (L.), *Schizaphis graminum* (Rondani) and *Sitobion avenae* (Fabricius). Antibiosis was measured as the change in aphid biomass during infestation. For young and adult plants, antibiosis to aphids was similar among wheat cultivars, but *R. padi* produced more biomass on young plants and *Sc. graminum* and *Si. avenae* produced more biomass on adult plants. The impact of the aphids on plants was measured as differences in biomass between control and infested plants. Aphid infestation reduced biomass production of young plants equally among cultivars, but *R. padi* and Sc. *graminum* reduced biomass of all cultivars more than *Si. avenae*. The foliage biomass of adult plants did not differ between infested and control plants, although infestation greatly reduced seed yield. *Schizaphis graminum* and *Si. avenae* caused the greatest yield reduction for all cultivars, but some cultivars were more tolerant than others. To compare tolerance levels for the three aphids and two plant growth stages, specific impacts were estimated based on a biomass conversion ratio (units of biomass lost by plants per unit gained by aphids). The specific impacts ranged from 1.0 to 3.5 for young and 3.3 to 20.7 for adult plants, with young plants more tolerant of aphids than adult plants. Young wheat plants cannot be used as a model for antibiosis or tolerance of adult plants for these aphids. Adult plants of some Canadian cultivars are more tolerant to infestation by aphids than others.

**Effect of leaf color on growth and development of armyworms in cotton**, D. Jones[1], G.O. Myers[1], and B.R. Leonard[2] [1] Louisiana State University, Department of Agronomy, Baton Rouge, LA 70803, [2] Louisiana State University Agricultural Center, Macon Ridge Research Center, Winnsboro, LA 71295

In cotton, both the fall armyworm (*Spodoptera frugiperda*) and the beet armyworm (*Spodeptera exigua*) aresporadic but economically important pests. Traditional control measures rely on the use of costly insecticides. Little research has been done on possible host plant resistance mechanisms. In 1998 it was observed that cotton germplasm expressing the red leaf color phenotype showed less foliar damage than normal green leaf color genotypes. In 1999 studies were performed to assess the effect of leaf color on armyworm growth and development. Fresh leaves of closely related green and red cotton genotypes were placed in petri dishes and infested with 2$^{nd}$ instar larvae of laboratory reared cultures of both armyworm species. Larval mortality and weight gain were recorded at 2 day intervals for a period of 12 days (or until pupation). The possible utility of cotton leaf color as a host plant resistance mechanism which functions by suppressing armyworm feeding and subsequent development will be discussed.

**Host Plant Preference and Performance of *Bemisia argentifolii* (Homoptera:Aleyrodidae) on poinsettia *(Euphorbia pulchirrima)* in relation to cultivar.** Laura O. Petro and Richard A. Redak, Department of Entomology, University of California, Riverside, CA 92521, USA

We investigated the resistance qualities of seven economically important red cultivars of poinsettias against its major pest, the silverleaf whitefly, *Bemisia argentifolii*, Bellows and Perring. Additionally, two cultivars selected on the basis of previous adult preference studies (representing preferred and non-preferred) were monitored for nymphal development and survivorship. After 6 d of exposure, the cultivars "Red Velvet", "Supjibi", and "Pepride" were less preferred as oviposition sites than the other 4 cultivars evaluated. "Peterstar" was the most preferred host for ovipostion. After 21 days of exposure, there were significantly fewer eggs and nymphs observed on "Pepride " and "Red Velvet", and "Peterstar" again had significantly more eggs than the other preferred cultivars. The "Success" and "Petoy" had a significantly greater number of surviving nymphs than the other cultivars evaluated Total numbers of all live stages observed were significantly lower on "Freedom Red", "Red Velvet" and "Pepride". These latter cultivars demonstrated the greatest potential for resistance against the silverleaf whitefly. Observed plant morphology in addition to plant chemistry may explain the differences in suitability among the poinsettia cultivars. The population dynamics of silverleaf whiteflies on the most preferred and non-preferred poinsettia hosts are represented as life tables. The wider implications of the mechanisms of poinsettia resistance to whiteflies and future uses in integrated pest management for greenhouse cropping systems will be discussed.

**Potato Leafhopper Resistance in Glandular-haired Alfalfa: A Comparative Study**, Floyd W. Shockley and Elaine A. Backus, Dept. of Entomology, 1-87 Agriculture Building, University of Missouri, Columbia, MO 65211

Comparisons were made among seven different genotypes of glandular-haired alfalfa supplied by two different companies, Cal/West Seeds and Forage Genetics, in order to: 1) determine the relative resistance to hopperburn and the potato leafhopper, and 2) suggest possible physiological mechanisms of that resistance. A bioassay was designed to collect data on leafhopper mortality, number of excretory droplets (a gross measure of feeding), settling on various plant parts, hopperburn symptoms and severity, plant stunting under constant leafhopper pressure, and glandular trichome density on stems. A second bioassay was developed that would determine whether the physical presence of intact glandular trichomes changed the responses of the leafhoppers. This bioassay involved removing the stem glandular trichomes by rubbing them off with a Kleenex® tissue and then infesting those plants with leafhoppers. Three of the seven genotypes showed increased leafhopper settling with trichome removal, an expected response if the resistance factor was located primarily in the trichomes. However, four of the genotypes showed decreased leafhopper settling, suggesting that the insects are responding to something other than physical contact with the intact hairs. In order to ascertain whether morphological differences in the glandular trichomes could explain variations in resistance, scanning electron micrographs were taken of all of the genotypes. The trichomes showed little difference from genotype to genotype; all appeared as a simple ball atop a multicellular stalk. Further observational evidence to be discussed suggests that the glandular trichomes produce some type of chemical, either in the form of a volatile repellent or a contact deterrent. Future studies will involve testing of some of these genotypes for volatility and contact deterrency in the trichomes.

**Induction of resistance in the black mustard *Brassica nigra* depends upon resistance trait and herbivore**, Brian Traw Section of Ecology and Systematics, Corson Hall, Cornell University, Ithaca, NY 14853

Plant resistance occupies a continuum from traits which are generally effective against most herbivores to traits which are only effective against a small proportion of herbivores. On the one end is allylglucosinolate, a chemical produced by the black mustard *Brassica nigra* which deters generalists but actually attracts specialists to oviposit and/or feed. On the other end are trichomes, which at high densities deter both generalist and specialist herbivores of mustards. We are interested in how the environment influences plant allocation of resources between these two resistance traits. We compared leaf allylglucosinolate concentration and trichome density in black mustard plants damaged by three different herbivore species. Our primary question was whether these plant resistance traits would be induced. We predicted that leaf trichome density would be more likely than leaf allylglucosinolate concentration to be induced by the herbivores, especially when the feeding was by a specialist herbivore, because the production of allylglucosinolate might attract more specialists. Two specialists *Pieris rapae* and *Phyllotreta cruciferae* and one generalist *Trichoplusia ni* were each applied to 44 *Brassica nigra* seedlings at the four leaf stage. We recorded herbivory and removed the herbivores after 12 hours. Plants were later harvested after reaching 8, 10, 12, or 14 leaves (n_ per plant developmental stage). *Pieris rapae* triggered a doubling of trichome density in subsequent leaves, whereas neither *Trichoplusia ni* nor *Phyllotreta cruciferae* had a significant effect on trichome density. The increase in leaf trichome density was the result of more trichomes being produced, rather than a smaller leaf area. Allylglucosinolate concentration was not induced by the three herbivores. The specificity of the trichome induction to *Pieris rapae* suggests that the plant receives a signal more specific than damage alone, perhaps including some constituent of the saliva.

**Chromosome Localization and Genetic Mapping of Russian Wheat Aphid Resistance Genes *Dn1*, *Dn2*, and *Dn5i* in Wheat Using Molecular Markers,** Xuming Liu and C. Michael Smith, Department of Entomology; Bikram S. Gill,
Department of Plant Pathology, Kansas State University, Manhattan, KS 66506, USA; and Vicki Tolmay, Small Grain Institute, Private Bag, Bethlehem, Republic of South Africa

The Russian wheat aphid (RWA), *Diuraphis noxia* Mordvilko, is a serious economic pest of wheat and barley in the western United States and South Africa. Aphid resistant cultivars have proven to be a viable tactic for RWA management. Several dominant resistance genes have been identified in wheat, *Triticum aestivum*, germplasm, including *Dn1* in PI 137739, *Dn2* in PI 262660, and at least two resistance genes (*Dn5i*) in PI 294994. To determine the chromosome locations of these genes, genomic DNA of several near isogenic lines (BC 5+), as well as segregating $F_2$ populations from crosses between the resistant PIs and four susceptible wheat cultivars, was amplified via PCR with molecular markers of known chromosome location. Results revealed that the locus for wheat microsatellite (WMS) 111, located on wheat chromosome 7DS (short arm), was tightly linked to *Dn1*, *Dn2*, and *Dn5a*. These results confirm that *Dn1*, *Dn2*, and *Dn5a* are tightly linked to each other, and provide new information about their location being 7DS, near the centromere, instead of as previously reported on chromosome 7DL (long arm). WMS 635 (near the distal end of 7DS) clearly marked the location of the previously suggested resistance gene *Dn5b*, and WMS 642 (located on 1DL) marked and identified a new gene *Dn5c*, which is located in a defense gene-rich region of wheat chromosome 1DL. Based on analyses of isogenic line data, the genetic distance between the *Dn* genes and their respectively linked WMS markers was estimated to be <3.2 cM [$1 \times 100 / 2^5$]. Exact genetic linkage distances are being determined using $F_2$ populations. These markers will prove very useful for the further study of RWA resistance genes and in marker-assisted breeding for aphid resistant wheat.

Key words: Russian wheat aphid, wheat, molecular marker, *Dn* resistance genes

**Isolation of the Nucleotide Binding Site Family of Resistance Gene Analogs from Alfalfa, J.C. Cordero and D.Z. Skinner,** Kansas State University & USDA-ARS

Many disease resistance genes from different plant genera that confer strong resistance against a wide range of pathogens have been found to share sequence homology at specific regions. Furthermore, the NBS region of homology from the NBS-LRR group of R genes share conserved motifs – P-loop, Kinase-2, Kinase 3-a, and a putative membrane-spanning domain. The objective of this study was to isolate the NBS regions from *Medicago sativa* in order to evaluate the variability and to facilitate the future cloning of complete disease resistance genes.

PCR with degenerate primers designed from the P-Loop and the putative membrane-spanning domains was used to amplify a 500 bp fragment. The 500 bp product was cloned and sequence diversity was analyzed. Sequence analysis from 94 individual clones showed that fifteen significantly different types of NBS regions exist in alfalfa. Each possessed the conserved domains Kinase-2 and Kinase-3a, characteristic of the NBS region. The fifteen sequences were compared to the most similar NBS genes found with a BLAST search of the GenBank database.

Dendrogram analysis showed that three major clusters of families exist in alfalfa that seem to have different evolutionary origins. This suggests that further research evaluating the evolution of disease resistance genes in alfalfa is possible. Additionally, the confirmed existence of such a wide family of NBS regions in alfalfa might make it possible to clone R genes using this approach in combination with Serial Analysis of Gene Expression (SAGE) or differential display.

## IDAHO

**Department of Plant, Soil and Entomological Sciences[1]**
**University of Idaho**
**Moscow, ID 83844-2339**

**Daniel E. Cervantes, Nilsa A. Bosque-Perez and Sanford D. Eigenbrode**

### Hessian fly oviposition preference on winter wheats varying in surface waxes

Damage due to the Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), has been increasing in northern Idaho for the last decade. The use of resistant varieties has been a principal control measure for this pest. Resistance to Hessian fly in wheat has relied on antibiosis, but in other parts of the USA this has resulted in the evolution of Hessian fly biotypes capable of overcoming resistance. Antixenosis, which focuses on non-preference by the ovipositing female, has the potential to reduce selection for new biotypes.

Free choice tests were conducted in the greenhouse to evaluate winter wheats for possible antixenosis to Hessian fly. Comparisons were made between Avalon and Avalon reduced wax, and in a separate experiment, between Virtue and Virtue reduced wax. Genotypes were tested separately at the seedling stage and the flag–leaf stage. There were no significant differences in number of eggs laid per female when the genotypes were tested at the seedling stage.

Significant differences in mean number of Hessian fly eggs were detected between the wheat genotypes when plants were tested at the flag–leaf stage. Female Hessian flies preferred reduced wax genotypes for oviposition compared to normal wax genotypes. Scanning electron microscopy of the winter wheats showed less crystal density on reduced wax compared to normal wheat genotypes. Gas chromatography was performed on the surface waxes in order to characterize the genotypes. Differences in surface wax components between normal and reduced wax genotypes were evident only at the flag–leaf stage. Nonacosane, hentriacontane, and octacosanol were greater in percentage of total constituents in the reduced wax genotypes, whereas these components were considerably lower in percentage in the normal wax genotypes. Some of the constituents identified may have influenced oviposition preference by the Hessian fly.

## IOWA

**USDA-ARS North Central Regional
Plant Introduction Station
Ames, IA**

**Richard L. Wilson and Sharon G. McClurg**

During 1999, we evaluated 500 maize accessions (introductions) for resistance to leaf feeding by European corn borer (*Ostrinia nubilalis* (Hübner)). A 1 - 9 visual rating scale (1=no damage, 9=heavy damage) was used to evaluate the accessions in the field. Four accessions rated 3 or less (resistant). We also evaluated 509 accessions during 2000 and found 13 accessions to be resistant.

In 1999, we evaluated 189 maize accessions for resistance to stalk boring by European corn borer. Data were obtained by splitting stalks and measuring length of feeding tunnels. These data were compared to a resistant check inbred, B52. Fourteen accessions were as good as, or better than the resistant check. Data for 2000 are not available at this writing.

The *Brassica* collection is being field evaluated for cabbage aphid (*Brevicoryne brassicae* (L.)) resistance at Hermiston, Oregon (Gary Reed, Oregon State University, is cooperating on this project). A 1 - 5 visual rating scale (1=no damage, 5=heavy damage) was used to evaluate the accessions. During 1999, 24 of 500 accessions tested rated 2 or less (resistant) and in 2000, 31 of 581 accessions tested rated resistant.

Data from these evaluations will be made available to the public via the Germplasm Resources Information Network (GRIN). The web site to view this data is http://www.ars-grin.gov/npgs/ or you may contact our station directly via our web site, http://www.ars-grin.gov/nc7/.

Recent publications dealing with plant resistance to insects:

1 Wilson, R. L. and S. G. McClurg. 1999. Evaluation of sunflower germplasm for resistance to sunflower moth. Abs. Submitted Papers, N. Cent. Br., Entomol. Soc. Am. 54, 16.

2 Binder, B. F., J. C. Robbins, R. L. Wilson, C. A. Abel, and P. N. Hinz. 1999. Effects of Peruvian maize extracts on growth, development, and fecundity of the European corn borer. J. Chem. Ecol. 25, 1281-1294.

3. Wilson, R. L. 1999. Acquisition and Maintenance of Resistant Germplasm. In: Handbook of Pest Management. (Ed: Ruberson, J. R.) Marcel Dekker, Inc., New York, 239-262.

4. Abel, C. A. and R. L. Wilson. 1999. Evaluation of 11 maize populations from Peru for mechanisms of resistance to leaf feeding by European corn borer. J. Kan. Entomol. Soc. 72, 149-159.

5. Abel, C. A., R. L. Wilson, B. R. Wiseman, W. H. White, and F. M. Davis. 2000. Conventional resistance of experimentalmaize lines to corn earworm (Lepidoptera: Noctuidae), fall armyworm (Lepidoptera: Noctuidae), southwestern corn borer (Lepidoptera: Crambidae), and sugarcane borer (Lepidoptera: Crambidae). J. Econ.

Entomol. 93, 982-988.

**KANSAS**

**USGMRL/ARS-USDA**
**1515 College Avenue**
**Manhattan, KS 66502**

**K.J. Kramer, T.D. Morgan, J.E. Throne, M. Bailey and J.A. Howard**

Results of collaborative research between ARS-USDA (Manhattan, KS) and ProdiGene, Inc. (College Station, TX) demonstrated that a new type of transgenic corn (maize) is insect-resistant. This corn contains the protein avidin, which results in kernels that have nutritional resistance to
many stored-product insects because avidin binds the essential vitamin biotin. Insects feeding on this corn develop a biotin deficiency that leads to delayed development and toxicity. Avidin is a rather unique biopesticide because it is a protein found in one of nature's most nutritious creations,
the chicken egg. Avidin occurs in the transgenic grain at only a fraction of the level present in eggs. This is one of the very few new ideas for use of transgenic plant biotechnology for insect pest management and has exciting possibilities.

Kramer, K. J., Morgan, T. D., Throne, J. E., Bailey, M. and Howard, J. A. 2000. Transgenic maize expressing avidin is resistant to storage pests. Nature Biotech. 18, 670-674.

**KANSAS**

**Department of Entomology**
**Kansas State University**
**Manhattan, KS 66506**

## Sorghum Tolerance to Greenbug Feeding Damage

**John C. Reese, G. R. Reeck, Ken Kofoid, Nandi Nagaraj, Leslie R. Campbell, Runlin Z. Ma, and Melaku Girma, Yu Zhang**

In order to decrease any possible selection pressure for yet more virulent biotypes of the greenbug, *Schizaphis graminum* (Rondani), we have focused our efforts on the development of sorghum germplasm that exhibits tolerance to greenbug feeding damage, rather than antibiosis or antixenosis. We have emphasized the reduction of chlorophyll loss due to greenbug feeding damage. A chlorophyll meter was utilized to nondestructively measure chlorophyll of areas fed upon four days by greenbugs. Four accessions that showed only low levels of resistance to biotype I were utilized in a recurrent selection scheme to make a large number of crosses. Selections were screened for tolerance and many promising ones were returned to the scheme, thus the label recurrent selection.

We are continuing to screen a group of 1,017 selections for tolerance to biotype I greenbugs, and then screen those tolerant selections for tolerance to biotype K. We have completed screening a total of 315 selections for tolerance to biotype K. Sixty-one selections from the most recent group lost significantly less chlorophyll than the susceptible check.

The damage response elicited by feeding greenbugs appears to be caused mainly by pectinases such as polygalacturonase via a two-step process involving the release of cell wall fragments. Pectinases from various sources, including greenbugs, caused significant chlorophyll losses in susceptible sorghum plants. Cell wall fragments released by the actions of pectinases on pectin from various sources, including sorghum, also caused significant reductions in chlorophyll.

In the area of molecular genetics of pectinases, Yu Zhang is completing his M. S. thesis, Comparative Studies on Pectin Methylesterases of *Sitophilus oryzae*, *S. zeamais*, and *S. granarius*.

We are just starting a project on the relationships between chlorophyll loss and photosynthetic capabilities. Preliminary experiments suggest that greenbug feeding activities actually elicit a very rapid and dramatic drop in photosynthetic rates.

Recent Publications:

Barbehenn, R. V., J. C. Reese, and K. S. Hagen. 1999. The food of insects. In, Ecological Entomology (Second Edition). C. B. Huffaker and A. P. Gutierrez (eds.). John Wiley and Sons. New York. Pp. 83-121.

Girma, M., K. D. Kofoid, and J. C. Reese. 1998. Sorghum germplasm tolerant to greenbug (Homoptera: Aphididae) feeding damage as measured by reduced chlorophyll loss. J. Kansas Entomol. Soc. 71: 108-115.

Ma, R. Z., J. C. Reese, W. C. Black IV, and P. Bramel-Cox. 1998. Chlorophyll loss in a greenbug-susceptible sorghum due to pectinases and pectin fragments. J. Kansas Entomol. Soc. 71: 51-60.

Reese, J. C., W. F. Tjallingii, M. van Helden, and E. Prado. 2000. Waveform comparisons among AC and DC electronic monitoring systems for aphid (Homoptera: Aphididae) feeding behavior. In, Principles and Applications of Electronic Monitoring and Other Techniques in the Study of Homopteran Feeding Behavior. G. P. Walker and E. A. Backus (eds.). Thomas Say Publ. In Entomol.: Proceedings. Entomol. Soc. Am. Pp. 71-101.

**KANSAS**

**[1]Department of Entomology**
**[2]Department of Plant Pathology**
**[3]USDA/ARS & Department of Agronomy**
**Kansas State University, Manhattan, KS 66506**
**[4]Department of Entomology, Kansas State University,**
**Agricultural Research Center – Hays, Hays, KS 67601**
**[5]Small Grain Institute, Bethlehem, Republic of South Africa**
**[6] Czech Research Institute of Crop Protection, Prague, Czech Republic**

**Michael Flinn[1], C. Michael Smith[1], Renu Malik[1], Xuming Liu[1], Tom Harvey[4], Sharon Starkey[1], Bikram Gill,[2] Gina Brown-Gudeira[3], Vicki Tolmay[5] Helena Havlickova[6], and Vojtech Holubec[6]**

## Microsatellite Markers Linked to Six Russian Wheat Aphid Resistance Genes in Wheat

**Xuming Liu, C. Michael Smith, Bikram Gill and Vicki Tolmay**

The Russian wheat aphid (RWA), *Diuraphis noxia* Mordvilko, is a serious economic pest of wheat and barley in North America, South America, and South Africa. Using aphid resistant cultivars has proven to be a viable tactic for RWA management. Several dominant resistance genes have been identified in wheat, *Triticum aestivum*, including *Dn1* in PI 137739, *Dn2* in PI 262660, and at least three resistance genes (*Dn5+*) in PI 294994. The identification of RWA-resistant genes and the development of resistant cultivars may be accelerated through the use of molecular markers. DNA of wheat from near isogenic lines and segregating $F_2$ populations was amplified with microsatellite primers via PCR.

Results revealed that the locus for wheat microsatellite GWM111 (*Xgwm111*), located on wheat chromosome 7DS (short arm), is tightly linked to *Dn1*, *Dn2*, and *Dn5*, as well as *Dnx* in PI 220127. Segregation data indicate RWA resistance in wheat PI 220127 is also conferred by a single dominant resistance gene (*Dnx*). These results confirm that *Dn1*, *Dn2*, and *Dn5* are tightly linked to each other, and provide new information about their location being 7DS, near the centromere, instead of as previously reported on 7DL. *Xgwm635* (near the distal end of 7DS) clearly marked the location of the previously suggested resistance gene in PI 294994, here designated as *Dn8*. *Xgwm642* (located on 1DL) marked and identified another new gene *Dn9*, which is located in a defense gene-rich region of wheat chromosome 1DL. The locations of markers and the genes linked to them were confirmed by ditelosomic and nulli-tetrasomic analyses. Genetic linkage maps of the above RWA resistance genes and markers have been constructed for wheat chromosomes 1D and 7D.

## Molecular Markers Linked to a New Gene for Wheat Curl Mite Resistance in Wheat

**Renu Malik, C. Michael Smith, Tom Harvey, Sharon Starkey, and Gina Brown-Gudeira**

Over 200 molecular markers have been evaluated to map the location of the gene(s) in the WGRC40 germplasm responsible for resistance to the wheat curl mite, *Aceria toschilla* Keifer. Initial phenotypic evaluations indicated that this resistance is expressed by a dominant gene. However, preliminary genotypic results indicate that resistance is expressed by the previously identified *Cmc1* resistance gene from *Aegilops tauschii*, as well as a new gene, also from *Ae. tauschii*. Both appear to be located on the short arm of chromosome 6D.

## Molecular Markers in Wheat Linked to Tolerance to Greenbug Feeding Damage

**C. Michael Smith, Sharon Starkey, John Reese and Gina Brown-Gudeira**

Plants containing the greenbug resistance genes *Gb3, Gb4, Gb5,* and *Gb6* were evaluated for tolerance to chlorophyll loss from greenbug feeding in SPAD index experiments. The SPAD indices of wheats containing the *Gb3, Gb5,* and *Gb6* genes were significantly less than those of the susceptible cultivar 'Thunderbird'. SPAD indices of two uncharacterized biotype I resistance sources from *Aegilops tauschii* , WGRC 04 and KSU94U306, were intermediate in phenotypic response. The resistance of these sources appears to be controlled by genes expressing a category of resistance other than tolerance.

DNA isolated from 'Amigo' (*Gb3)* and 'Thunderbird' (*Gb0*) was amplified with wheat microsatellite (WMS) primers with loci on chromosome 7D and evaluated for putative polymorphisms. Preliminary results of these experiments indicated that WMS primers 44 & 111 (7DS) and 130 (7AS) all differentially amplified 'Amigo' and 'Thunderbird' DNA in such a way to reveal putative polymorphisms. WMS primers with loci on chromosome 1A, specific to rye, were evaluated for putative polymorphisms between DNA containing 'GRS 1201' (*Gb6)* and 'Thunderbird'. Preliminary results of these experiments indicate that WMS primers 33 and 136 each differentially amplify the DNA of resistant and susceptible cultivars in such a way to reveal putative polymorphisms.

## Evaluation of *Aegilops* Germplasm with Multiple Aphid Resistance in Wheat

**C. Michael Smith, Bikram Gill, Helena Havlickova, and Vojtech Holubec**

Afterwards, 20 *Aegilops* species from the Gene Bank Collection of RICP, all possessing some level of resistance the bird cherry-oat aphid or the English grain aphid were evaluated for resistance to the Russian wheat aphid and the greenbug (biotype I) at KSU. *Aegilops tauschii* accession 7096 was similar in level of greenbug resistance to *A. tauschii* 1675, a standard greenbug resistant control in aphid evaluations at KSU. Both *A. tauschii* accessions were significantly less damaged than the susceptible variety 'Wichita'. Two *Aegilops cylindrica* accessions (4059 & 4062) and an *Aegilops markgrafi* accession were highly susceptible and similar to 'Wichita' in response to greenbug feeding. *A. neglecta* accession (8052) was moderately resistant to Russian wheat aphid and greenbug. Sixty-seven pest-resistant *Aegilops* accessions from the KSU Wheat Genetic Resource Center were evaluated for resistance to bird cherry-oat aphid and accessions TA36, TA4, and TA 168 were highly resistant.

## M. S. Thesis

**A Molecular Marker Linked to Tolerance in *Aegilops tauschii* Accession 1675 to Greenbug, (Homoptera: Aphididae). Michael B. Flinn, Kansas State University, Manhattan, Kansas. 2000.**

The greenbug is a serious aphid pest of wheat and sorghum throughout the world. Its ability to overcome both resistant plant cultivars and insecticides make it a serious problem to crop producers. Nevertheless, traditional plant breeding techniques to produce insect resistant cultivars are an economical and environmentally sound way of managing greenbugs in sorghum production.

The categories of resistance to greenbug, *Schizaphis graminum* (Rondani), biotype I, were determined in *Aegilops tauschii* (goatgrass) accession #1675 (*Ae. tauschii* 1675) (resistant donor parent), 'Wichita' (susceptible wheat parent), and an *Ae. tauschii* derived resistant offspring, line 97-85-3 ('A97-85-3'). Antibiosis was determined using the intrinsic rate of increase of populations of aphids confined to each of the three wheats. Neither parent nor the resistant progeny expressed antibiosis. Antixenosis was determined by allowing aphids a choice to feed on plants of each of the three wheats. *Ae. tauschii* 1675 exhibited antixenosis, but this resistance was not inherited and expressed in 'A97-85-3'. Comparisons of SPAD meter readings and proportional dry plant weight loss were used to determine tolerance to greenbug feeding. *Ae. tauschii* 1675 and 'A97-85-3' were highly tolerant compared to 'Wichita'. DNA from segregating $F_2$ populations from the cross [*Ae. tauschii* accession 1675 x 'Wichita'] was isolated and amplified using all known wheat microsatellite PCR primers and other degenerate primers for the D genome of wheat. Segregation analyses showed that microsatellite marker XGWM44 was linked to the *Ae. tauschii* 1675 greenbug resistance gene(s). The location of XGWM44 was confirmed as being on the short arm of wheat chromosome 7D. A genetic linkage map was constructed for XGWM44

**Recent Publications**


Smith, C. M. 1998. Plant Resistance to Insects. In: Rechcigl, J. E. and Rechcigl, N. A. (Eds.) *Biological and Biotechnological Control of Insects Pests*. CRC Press LLC., Boca Raton, FL. pgs. 171-208.

Dhaliwal, G. S. , V. K. Dilwari, and C. M. Smith. 1999. Host Plant Defense Against Insects. In: Dhaliwal, G. S., and Arora, R. (Eds.). *Environmental Stress in Crop Plants*. Commonwealth Publishers, New Delhi. pp. 172-210.

Oppert, B., K. Hartzer, and C. M. Smith. 2000. Characterization of the digestive proteinases of *Hypera postica* Gyllenhal (Coleoptera: Curculionidae). *Trans. Kansas Acad. Sci.* (In Press).

Lui, X. M. , C. M. Smith, B. S. Gill, and V. Tolmay. 2000. Microsatellite markers linked to six Russian wheat aphid resistance genes in wheat. *Theor. Appl. Genet.* 98: (In Press).

## OKLAHOMA

**ARS, USDA**
**Stillwater, OK**

On August 3, 2000, after 32 years of service, Dr. James A. Webster will retire from the USDA-ARS, Plant Science and Water Conservation Research Laboratory, Stillwater, Oklahoma.

Jim received his B.S. in Zoology and M.S. in Entomology from the University of Kentucky, and then went on to earn a Ph.D. in Entomology from Kansas State University in 1968. He immediately came to work for ARS in East Lansing, Michigan, working on the cereal leaf beetle plant resistance program. After the successful development and release of CLB-resistant wheat and barley germplasm lines, the ARS phase of the program was discontinued, and in 1981 Jim transferred to Stillwater to work primarily on plant resistance to cereal aphids in the Wheat and Other Cereal Crops Research Unit. From 1993 to 1999 he served as Research Leader for that Unit, as well as Laboratory Director for the Plant Science and Water Conservation Research Laboratory.

Jim is best known for his leadership role during the initial detection of the Russian wheat aphid in the United States. His background knowledge on the insect allowed ARS to immediately distribute information to U.S. researchers and extension personnel. It is estimated that this advance information cut a year off the time required to develop management strategies for this new pest. For this work, Jim was awarded the Entomological Society of America Recognition in Entomology Award for Outstanding Contributions to Agriculture for 1996.

Jim is an active member in the Entomological Society of America, and has held numerous offices and committee chair positions in the Southwestern Branch. He is also a member of the American Society of Agronomy, the Kansas (Central States) Entomological Society, and the Southwestern Entomological Society. He participates in activities of the International Plant Resistance to Insects group, the Hard Red Winter Wheat Improvement Committee, and the Western Coordinating Committee for "Integrated Management of Russian Wheat Aphid and Other Cereal Aphids." He was the ARS co-organizer for an international ARS/Oklahoma State University aphid symposium held in Stillwater in 1990. He also was invited to serve as an outside reviewer of the South African Russian Wheat Aphid Research Program by the South African Department of Agriculture. During his career he authored or co-authored over 150 articles and book chapters, and he co-edited the 1999 Thomas Say Publications in Entomology book "Economic, Environmental, and Social Benefits of Resistance in Field Crops."

Because many of the people who have worked with Jim over the years will be attending this year's ESA annual meeting in Montreal in December, plans are in the works for a nice reception there. Information on that can be obtained from Dave Porter (dporter@pswcrl.ars.usda.gov). As part of that event, we will present him with a book of congratulatory and memory letters. These can be sent to Ruth Treat, USDA-ARS, 1301 N. Western Road, Stillwater, OK 74075, by November 15.

A small, informal reception by the Stillwater group is also planned for Jim's last day, August 3. Any of Jim's coworkers who happen to be in the vicinity that afternoon are certainly welcome to stop by for coffee and cake.

## OKLAHOMA

**Plant Science Research Laboratory, USDA-ARS**
**1301 N. Western St.,**
**Stillwater, OK 74075-2714, USA**

**http://www.pswcrl.ars.usda.gov**

**C.A. Baker, J.D. Burd, N.C. Elliot, M.H. Greenstone, S.D. Kindler, D.W. Mornhinweg, D.R. Porter, K.A. Shufran, J.A. Webster, and Y. Chen.**

### Russian wheat aphid, *Diuraphis noxia* (Mordvilko)

### Wheat

Efforts are ongoing to develop Russian wheat aphid (RWA)-resistant wheat germplasm. Advanced wheat lines derived from 13 different RWA resistance sources were planted for seed increase, evaluation, and purification in preparation for germplasm release; these include 61 hard white winter lines, 87 hard red winter lines, 36 hard red spring lines, 63 soft white spring lines, and 42 hard white spring lines. Topcrossed seed was screened for resistance to RWA, and resistant plants were transplanted to the greenhouse for increase and progeny testing. Homozygous RWA-resistant lines will be selected for germplasm release. Field evaluations of winter RWA-resistant wheat lines continue to be made in Stillwater.

Durum wheats maintained by USDA –ARS GRIN have been evaluated for resistance to RWA. Resistant plants were identified, rescued, and grown for seed increase. Purified selections will be reintroduced to the GRIN collection, and crosses will be made with agronomically acceptable durum wheats.

Development of resistant X resistant populations continued in order to study genetic diversity of RWA resistance in wheat. Genetic diversity studies are ongoing for all resistant lines to determine if these lines carry different genes for resistance to RWA.

### Barley

Efforts continue to develop adapted RWA-resistant germplasm lines for all barley producing areas of the U.S. 2,500 spring and 450 winter BC3F3/F4 barley observation lines were evaluated in Aberdeen, ID with the cooperation of Phil Bregitzer and Darrell Wesenberg, USDA-ARS, Aberdeen, ID and head/row selections made for further analysis in 2001 headrows/preliminary yield trials. These lines include 20 susceptible backgrounds and 25 resistant sources. Seventy lines were evaluated in preliminary yield trials and selections earmarked for advanced replicated yield trials in 2001. These lines included 7 susceptible backgrounds and 24 resistant sources. Approximately 16 lines were evaluated in replicated advanced yield trials in several locations Idaho and Colorado for potential release as adapted germplasm lines. These lines include 3 susceptible backgrounds and 3 resistant sources. Other lines developed in conjunction with Phil Bregitzer were also evaluated in advanced yield nurseries at several locations in Idaho, Colorado and Nebraska. Crossing still continued to bring more resistant sources into adapted barley backgrounds.

Development of genetic populations to study genetic diversity among all 109 RWA-resistant barley lines identified and selected at Stillwater continued.

Data analysis is ongoing from a study conducted in 1998 and 1999 in Idaho and Colorado, with the cooperation of Phil Bregitzer and Frank Peairs, to determine the affect of early and late RWA feeding on malting quality of malting barley cultivars and adapted RWA-resistant barley lines.

**Greenbug, *Schizaphis graminum* (Rondani)**

Greenbugs were a serious pest on winter wheat in the central Oklahoma wheat growing area (north of I-40) in autumn of 1999. Intensity of infestations appeared to increase as one headed north towards the Kansas border. Early planted fields appeared to suffer less damage than later-planted fields, suggesting that fields were colonized by greenbugs primarily from mid-September through mid-October. Seriously damaged fields first became evident in late-October. Autumn weather was mild and dry, making conditions ideal for greenbug population growth. The majority of winter wheat fields in central Oklahoma were treated with insecticide in autumn of 1999 (mostly during November). Greenbug populations in untreated fields in central Oklahoma declined during winter, primarily due to the activity of parasitoids. Parasitism levels by L. testaceipes exceeded 90% in some fields. Most such fields had probably already suffered economic damage.

Wheat fields in the Oklahoma panhandle also developed serious greenbug infestations, but they developed later than in central Oklahoma, peaking in January or February. This was the result of low parasitism levels and mild weather. Much of the wheat acreage in the panhandle was treated with insecticide during January and February, but we believe that a smaller proportion of fields were treated than in central Oklahoma. Parasitism levels increased from late January through February and greenbug populations in untreated fields eventually crashed as the result; however not before economic damage occurred. Greenbugs were sparse in southwestern Oklahoma (south of I-40). The bird cherry-oat aphid was present in fields throughout the state, but generally occurred at low levels.

A regional field study to assess the overwintering ability and the success of the greenbug to undergo sexual reproduction is now in its third year. Research locations include Brookings, SD, Hays and Manhattan, KS, Stillwater, OK, and Bushland, TX. Greenbugs have produced sexual morphs at all locations, and except for the Bushland site, eggs have been collected and successfully hatched. Future plans include studies to optimize the process of artificially generating the greenbug holocycle and improving egg-hatch success.

A molecular phylogenetic analysis based on the cytochrome oxidase I mitochondrial gene was conducted on all greenbug biotypes found in the United States (B, C, E, F, G, H, I, J and K). In addition, three unique isolates, one from a New York colony (NY) that has been in culture since 1959, another that was collected from Canada wild rye (CWR) in Oklahoma, and an isolate from Germany (EUR) were used in the analysis. Genetic distances among greenbug biotypes ranged from 0.08% to 6.17% difference in nucleotide substitutions. Phylogenetic analyses produced dendrograms revealing three clades; clade 1 contained the 'agricultural biotypes' commonly found on sorghum and wheat (C, E, I, K, plus J), clade 2 contained F, G, and NY, and clade 3 contained B, CWR, and EUR, which are rarely found on crops. Biotype H fell outside these clades and may represent another *Schizaphis* species. Greenbug biotypes are a mixture of genotypes belonging to three clades and likely have diverged as host-adapted races on wild grasses as opposed to resistant crop cultivars. Biotype, as defined for the greenbug, does not appear to have any evolutionary or taxonomic status.

Information was developed that sheds new light on a theory of breeding plants with resistance to insects. Older, classical concepts of resistance breeding have dictated that "pyramiding" genes (combining more than one resistance gene) into a single wheat plant provided durable protection to insect pests and thwarted the development of new damaging biotypes. Experimental wheat germplasms were developed using various combinations of resistance genes

and subsequently tested with an array of greenbug biotypes. Results of these experiments clearly show that pyramiding resistance genes in wheat does not provide additional protection against greenbug biotypes.

**Rice root aphid, *Rhopalosiphum rufiabdominalis (Sasaki)***

An obscure aphid found on wheat in Oklahoma was identified as the rice root aphid. Rather high numbers of this aphid were found on wheat beginning in October and continued through the middle of January. During October this was the most numerous aphid found on wheat. The aphid feeds at the base of the wheat plant. It is believed the aphid can cause economic damage to wheat, although losses have apparently never been quantified. The rice root aphid may be a particularly important pest of cereals in the southern Great Plains (Susan Halbert personal communication), where in addition to direct feeding damage, it can also transmit barley yellow dwarf disease. Interspecies similarities between the bird cherry-oat aphid and the rice root aphid often lead to visual misidentification, and damage to cereals often attributed to the bird cherry-oat aphid may sometimes be caused by the rice root aphid. A key distinguishing feature is that the bird cherry-oat aphid has six antennal segments whereas the rice root aphid only has five antennal segments. Other, non-diagnostic characteristics can often be used to separate the species, including presence of dense setae on the antennal segments, and the slight differences in coloration.

**Personnel**

James Anstead (Cambridge, UK) has completed his MS degree at Oklahoma State University (Thesis: Genotypic and Biotypic Diversity of Greenbug, *Schizaphis graminum* (Rondani), on Non-cultivated Hosts).

**Publications**

Hays, D.B., D.R. Porter, J.A. Webster, and B.F. Carver. 1999. Feeding behavior of biotypes E and H greenbug (Homoptera: Aphididae) on previously infested near-isolines of barley. J. Econ. Entomol. 92:1223-1229.

Lukaszewski, A.J., D.R. Porter, E.F. Antonelli, and J. Dubcovsky. 2000. Registration of UCRBW98-1 and UCRBW98-2 wheat germplasms with leaf rust and greenbug resistance genes. Crop Sci. 40:590.

Porter, D.R. and J.A. Webster. 2000. Russian wheat aphid-induced protein alteration in wheat. Euphytica 111:199-203.

Porter, D.R., J.D. Burd, K.A. Shufran, and J.A. Webster. 2000. Efficacy of pyramiding greenbug (Homoptera: Aphididae) resistance genes in wheat. J. Econ. Entomol. (in press).

Webster, J.A. and D.R. Porter. 2000. Reactions of four aphid species on a Russian wheat aphid resistant wheat. Southwest. Entomol. (in press)

Webster, J.A. and D.R. Porter. 2000. Plant resistance components of two greenbug (Homoptera: Aphididae) resistant wheats. J. Econ. Entomol. 93:1000-1004.

Shufran, K.A., Burd, J.D., Anstead, J.A., and Lushai, G. 2000. Mitochondrial DNA sequence divergence among greenbug (Homoptera: Aphididae) biotypes: evidence for host-adapted races. Insect Molecular Biology 9:179-184.

**Thesis Abstract**

Name: James Anstead Date of Degree: July, 2000

Institution: Oklahoma State University Location: Stillwater, Oklahoma

Title of Study: Genetic And Biotypic Diversity of Greenbug *Schizaphis Graminum* (Rondani) Populations on Non-Cultivated Hosts

Pages in Study: 103 Candidate for the Degree of Master of Science

Major Field: Entomology

Scope and Method of Study: The purpose of this study was to determine the biotypic and genetic diversity of *Schizaphis graminum* on non-cultivated hosts. Collections made from non-cultivated hosts were screened against resistant crop lines to determine their biotype. A 1043 base pair region of the mitochondrial DNA, cytochrome oxidase I gene was sequenced to measure genetic diversity. The evolutionary and taxonomic status of biotype was also investigated.

Findings and Conclusions: There was significant biotypic diversity on non-cultivated grasses. We found biotypes E, I and K on non-cultivated grasses but we also found biotype G at higher than previously recorded densities. An isolate with a unique virulence profile was also found (i.e. a new biotype). Our study indicates non-cultivated grasses are a reservoir of biotypic diversity. This study supports previous conclusions that biotype formation was not driven by the development of resistant crop varieties. Biotypes, as defined in the greenbug (by virulence against resistant hosts) do not appear to have any evolutionary and taxonomic status. Rather this study confirms the presence of three genetically distinct clades in *S. graminum.* The distances between clades indicate one to two million years have passed since they had shared a common mitochondrial ancestor. These clades are likely to represent host-adapted races, with only one of the three containing greenbugs commonly found on crop hosts.

## SOUTH DAKOTA

**U.S. Department of Agriculture**
**Northern Grain Insects Research Laboratory**
**Crops and Entomology Research Unit**
**2923 Medary Avenue**
**Brookings, SD 57006**

### Nutrient Solution Nitrogen Form and Bird Cherry-Oat Aphid Resistance in Wheat

**Walter E. Riedell and Louis S. Hesler**

Bird cherry-oat aphids (*Rhopalosiphum padi* L.) are common insect pests of wheat *(Triticum aestivum* L.) in the northern Great Plains. Heavy spring infestations of seedling spring wheat can reduce yield by about 80 % while fall infestations in winter wheat can reduce yield from 20 to 75 %. The nutritional status of wheat crops modifies cereal aphid biology and life cycle and plays an important role in allowing plants to compensate for insect damage. Fungal, bacterial, and viral disease infestation severity and crop disease symptom intensity were shown to be strongly influenced by the form of N ($NH_4$-N or $NO_3$-N) provided to plants. It is not known if differences in fertilizer N form provided to wheat would impact plant resistance to bird cherry-oat aphids. The availability of specialized fertilizer products and the development of nitrification inhibitors that block the conversion of $NH_3$ to $NO_3$ in the soil provides reasons for reexamination of the relative merits of $NH_4$ and $NO_3$ nutrition especially with respect to potentially improving aphid resistance in small grains.

The research reported here examined the impact of nutrient solutions with different forms of N (either all $NO_3$-N or all $NH_4$-N) on aphid population growth and plant growth in wheat. The objectives of our growth chamber experiments were to determine if the form of nitrogen provided in plant nutrient solutions affected aphid population growth parameters or the ability of wheat to withstand infestation. Aphid population growth characteristics (development time, number of aphids produced, and intrinsic rate of increase) were not significantly affected by nutrient solution N form treatments. Plants grown with $NH_4$-N nutrient solutions had significantly less shoot fresh weight. Aphid infestation also significantly reduced shoot fresh weight. There were no significant interactions between nutrient solution N form and aphid treatments for shoot fresh weight. Aphid treatment did not reduce root fresh weight in plants given $NO_3$-N nutrient solution, but did in plants given $NH_4$-N nutrient solution. Thus, while N form given to wheat plants had no effect on aphid population growth characteristics, plants given $NH_4$-N nutrient solution showed less root growth than plants given the $NO_3$-N nutrient solutions. The results of this study suggest that use of $NH_4$-containing fertilizer and soil nitrification inhibitors likely would not improve wheat resistance to aphids.

**Publication:**

Riedell, W.E. and L.S. Hesler. 2000. Nutrient solution nitrogen form and bird cherry-oat Aphid resistance in wheat. Cereal Res. Commun. Accepted for publication 19 April 2000

## TEXAS

**Texas A&M University Research & Extension Center**
**17360 Coit Road**
**Dallas, TX 75252-6599**
**Ph: 972/231-5362 FAX: 972/952-9216**
**j-reinert@tamu.edu**

**Lantana Lace Bug, *Teleonemia scrupulosa* Stal, resistance among Lantana Cultivars for the Landscape – James A. Reinert, Steve W. George, Wayne A. Mackay, Erin Smith & Tim D. Davis**. Lantana lace bug, *Teleonemia scrupulosa* Stal, (Hemiptera: Tingidae) is a primary insect pest of lantana, a tender perennial landscape plant that is commonly grown across the Southern United States for its heat and drought tolerance. Most of the literature on *T. scrupulosa* refers to its potential use worldwide as a biocontrol agent for several *Lantana* spp. that were introduced as ornamental plants from their native North and South America and had become major weed pests. Twenty-eight cultivars of three lantana species [*Lantana montevidensis* (K. Spreng.) Briq., *L. camara* L. and *L. hybrida*] were evaluated for resistance to the lantana lace bug in replicated field plantings exposed to natural infestations. Lace bug populations began to develop in mid July 1996, and were dispersed across the replicates within 30 days. Populations of nymphs and adults were sampled bi-weekly from Sep. - Nov. 1996 (5 sample dates). Highest mean populations for the 5 sample dates were present on 'Patriot Desert Sunset' (40.3 nymphs and adults/3-leaf sample/plant), 'Pink Frolic' (20.6) and 'Patriot Sunburst' (19.4), with 19 of the cultivars exceeding 4 lace bugs per 3-leaf sample. Plants of 'Weeping White', 'White Lightning' and 'Weeping Lavender' were never observed to have any lace bugs on them throughout the test period and 'Imperial Purple', 'Patriot Rainbow' and 'Denholm Dwarf White' had means of 0.1 total lace bugs per sample and never exceeded more than 0.7 per sample. The Resistance Performance Index shows that the aforementioned cultivars and additionally, 'Radiation', 'Dallas Red', 'Gold Mound', 'New Gold' and 'Lemon Swirl' occurred either 9 or 10 (out of 10) times in the top statistical groupings. When cultivars are grouped and analyzed by species, *L. montevidensis* (four cultivars with a mean of 0.02 lace bugs/3 leaf sample) is highly resistant whereas, *L. camara* and *L. hybrida* (6.73 and 9.54, respectively) are susceptible to the lantana lace bug. All of the *L. montevidensis* have flower color of either white or purple. Cultivars were also separated by flower color for analysis. Cultivars with purple or white flower color (primarily *L. montevidensis*) had far fewer lantana lace bugs (means of 0.03 and 1.73, respectively) developing on them than did cultivars with other flower colors. Additionally, cultivars with either gold or red flowers and the aforementioned purple- or white-flowered cultivars had far fewer lace bugs than did cultivars with either orange/red, yellow or a bicolor of yellow with another color. It appears that cultivars with either yellow or yellow bicolor flowers are among the most susceptible to the lantana lace bug. These results indicate that within most flower colors or bicolors, there exists a range of resistance among the cultivars.

**Host Resistance to White Grubs (*Phyllophaga* spp.) among Genotypes of *Poa arachnifera* X *P. pratensis* Hybrids – James A. Reinert & James C. Read.** White grubs are annual pests of both the cool- and warm season turfgrasses in the U.S. A 3-yr-old replicated planting of two genotypes of Texas bluegrass, *Poa arachnifera* Torr., and five of its hybrids with Kentucky bluegrass, *P. pratensis* L., was evaluated for resistance to white grub damage. A field population of *Phyllophaga* spp. (prob. *P. congrua* LeConte) had established and was causing significant damage across the replicated plots. On 31 May 1996, a visual rating (scale of 1-9 (turf damage, 9 = most damage with loss of stand, yellowing and loss of root anchoring; 1 = no damage or loss of turf quality) of white grub damage to the grass in each turf plot was taken. Grass in each plot was visually examined for wilting and loss of stand and the leaves of 4 to 5 randomly selected plants within the plot were pinched and pulled to indicate potential root damage and loss of anchoring. Based upon these results from randomized planting in field plots exposed to natural *Phyllophaga* adult selection, it appears that the two Texas bluegrass selections, Syn1 and Syn2, and three Texas bluegrass X Kentucky bluegrass hybrids, TXKY-90-13-16, TXKY-90-13-8 and 'Reveille' (evaluated as TXKY-90-16-1), have considerable resistance to white grub damage. TXKY-90-15-6 and TXKY-92-35-1 are susceptible and sustained significant damage (ca. 4 ranking) and loss of stand.

**Host Resistance to Tawny Mole Cricket, *Scapteriscus vicinus*, in Bermudagrass, *Cynodon* spp. – James A. Reinert & Philip Busey.** Three species of *Scapteriscus* mole crickets were introduced to the southeastern USA and have become major pests of turfgrasses, especially bermudagrass, *Cynodon* spp. The objective of the study was to evaluate genetic resistance among vegetatively propagated *Cynodon* genotypes to damage by tawny mole cricket, *S. vicinus* Scudder (Orthoptera: Gryllotalpidae). Genotypes of bermudagrass, including commercial cultivars, were evaluated for their response to the tawny mole cricket, in field screen cages. Adult tawny mole crickets were introduced into replicated cages in which bermudagrass plants were planted. Cage sidewalls extended below the soil line and extended with a soil erosion fabric to a depth of 75 cm, to prevent migration of the highly mobile mole crickets. Damage estimates were based on visual ratings and relative reduction in clippings mass of harvested plants in inoculated cages compared with the same genotypes in adjacent noninfested cages. The four cage pairs, mole-cricket-infested and noninfested, thus represented the main plots of a split-plot experiment in four replications. Differences were observed ($P < 0.05$) in tawny mole cricket damage among 26 genotypes evaluated across two experiments. 'Tifdwarf', 'Tifgreen', 'Sunturf', 'Texturf-10' and 'Texturf-1F' were the most susceptible and sustained more tunneling and feeding damage than any of the other genotypes. All bermudagrass selections tested were damaged, but 'Ormond', FL-2400, PI-290659 and PI-291586 showed the least overall damage. Resistance scores (83 to 99) were high for each of these genotypes. 'Tifway' and 'FLoraTeX', were common to both studies, and each received similar intermediate damage and growth reduction ratings. Whereas, conflicting results were produced with Tifgreen and Sunturf, which were also common to both experiments. The field screen cages provided an excellent environment to evaluate plant materials against a highly mobile soil insect such as the tawny mole cricket.

**Resistance in Zoysiagrass, *Zoysia spp.*, to the Tropical Sod Webworm, *Herpetogramma phaeopteralis*, Guenee – James A. Reinert & M. C. Engelke.** The tropical sod webworm, *Herpetogramma phaeopteralis* Guenee (Lepidoptera: Pyralidae) is a primary pest of turfgrass especially in the southern states of the USA and many islands of the Caribbean Archipelago. Twenty cultivars and genotypes of zoysiagrass, *Zoysia* spp., were evaluated for resistance to tropical sod webworm adult preference for oviposition and larval feeding. Adults expressed a preference among the zoysiagrass genotypes for egg deposition as expressed by the resulting larval feeding. 'Cavalier', DALZ8501 and JZ-1 exhibited high resistance (rankings < 7) with low feeding damage while 'Meyer' and DALZ8516 (ranking >1.5) sustained near complete defoliation. When neonate larvae were allowed to develop on each zoysiagrass in a no-choice experiment, a similar ranking was produced. Cavalier, DALZ8501, 'Korean Common' and 'El Toro' exhibited high resistance in the form of much smaller larvae (6.3-7.5 mg) at the 15-day evaluation. Conversely, larvae developing on 'Diamond', Meyer and DALZ8516 were significantly larger (36.4 to 41.0 mg). Additionally, larvae developing on the resistant Cavalier, Korean Common, El Toro and DALZ8501 required more than a week longer to reach pupation compared to larvae feeding on Diamond, Meyer and DALZ8516, which required only 19.1-19.7 days. Compared to the industry standard, Meyer (19 days), Cavalier required 12 days longer to pupation. During this period, larvae were much smaller, eating far less and they would be more vulnerable to predation. The highest mortality was recorded on Cavalier. In contrast, larvae feeding on the three most susceptible genotypes had an accumulated mortality of 6.7 to 13.4% at adult emergence.

**Cultivar releases by Texas Agric. Exp. Stn.**

Engelke, M. C., V. G. Lehman, K. B. Marcum, P. F. Colbaugh, J. A. Reinert, B. A. Ruemmele, & R. H. White. 1996. Release of 'Mariner' (Reg. No. CV-8, PI 599032) a creeping bentgrass with good salt tolerance.

Engelke, M. C., P. F. Colbaugh, J. A. Reinert, K. Marcum, R. H. White, B. A. Ruemmele & S. J. Morton. 1996. Release of 'Diamond' or DALZ8502 a dwarf type zoysiagrass.

Engelke, M. C., J. A. Reinert, P. F. Colbaugh, R. H. White, B. A. Ruemmele, K. Marcum & S. J. Morton. 1996. Release of 'Cavalier' or DALZ8507 a zoysiagrass with good water stress tolerance and good insect and disease resistance.

Engelke, M. C., R. H. White, P. F. Colbaugh, J. A. Reinert, K. Marcum, B. A. Ruemmele & S. J. Morton. 1996. Release of 'Crowne' or DALZ8512 a zoysiagrass with excellent water stress tolerance and good insect and disease resistance.

Engelke, M. C., R. H. White, P. F. Colbaugh, J. A. Reinert, K. Marcum, B. A. Ruemmele & S. J. Morton. 1996. Release of 'Palisades' or DALZ8514 a zoysiagrass with excellent water stress tolerance and good insect and disease resistance.

Read, J. C., J. A. Reinert, P. F. Colbaugh & W. B. Knoop. 1999. Release of 'Reveille' bluegrass.

## GLOBAL CONTRIBUTIONS

## CANADA

Agriculture and Agri-Food Canada
Potato Research Centre, P.O. Box 20280
Fredericton, New Brunswick, Canada, E3B 4Z7

Y. Pelletier & G. C. C. TAI

Accessions from seven wild *Solanum* species were evaluated in the field for their resistance to the Colorado potato beetle (*Leptinotarsa decemlineata* (Say)). The multivariate insect population density data were analysed using factorial analysis. The factors extracted corresponded to relevant phases of the life cycle of the insect and provided information on the mode of resistance (antixenosis and antibiosis) of the plant species. *S. berthaultii*, *S. capsicibaccatum*, *S. jamesii*, *S. pinnatisectum* and *S. trifidum* demonstrated both antixenosis and antibiosis but had different level of resistance. The mode of resistance of *S. polyadenium* seems to be caused by an antibiotic effect and the resistance of *S. tarijense* by an antixenotic effect. Genetic variability and heritability of insect resistance trait within accession was trivial or inconsistent for all Solanum species studied.

**INDIA**

**Annamalai University**
**Tamilnadu 608 002**
**India**

**V. Selvanarayanan**
**Lecturer In Entomology**
**Faculty of Agriculture**

Dear Members,

Greetings from India. I am new member to the PRP group and I wish to thank all the members for their patience to go through this mail. I am a Lecturer in Agricultural Entomology working at Annamalai University, Tamilnadu situated in the southern peninsula of India.

I have just completed my doctoral research on Host Plant Resistance in Tomato against fruit borer, Helicoverpa armigera. In the process, I have collected and screened around 320 exotic and indigenous/ native /tribal tomatoes and isolated five accessions which are resistant to the borer both under field and glasshouse conditions. I am planning to work on those selected accessions in depth and many other wild accessions, I hold, with reference to their mechanisms of resistance, future scope in breeding programmes and other related areas.

I wish to pursue my post-doctoral research in this venture and if any of the distinguished member is willing to utilize my services, I will much thankful to him. I request all the learned members to mail me their suggestions and help in this regard.

Hope to receive fruitful information from the members.

## INDIA

**Tamil Nadu Rice Research Institute**
**Aduthurai - 612 101**
**Tamil Nadu**
**India**

### Screening Rice Entries of AICRIP in ADVANCED Yield Trial for Resistance to Insect Pests of Rice

**V. Balasubramani, S. Sadakathulla, M. Subramanian and S. Ramanathan**

Under all India Co-ordinated Rice Improvement Programme (AICRIP), 183 and 178 advanced yield trial entries of rice were screened during 1997-98 and 1998-99 respectively, for their reaction to insect pests under natural conditions. Damage score was recorded as per Standard Evaluation System (SES) of IRRI, Philippines and AICRIP protocol. In 1997-98, out of 183 entries fourteen entries viz., IET 14829, IET 14833, IET 14834, IET 14806, IET 14807, IET 14867, IET 14350, IET 14359, EIT 14584, IET 14935, IET 14955, IET 14956, IET 14657, and IET 14338 were found to be resistant against gall midge (*Orseolia oryzae*) throughout the crop stand. In 1998-99, out of 178 entries, IET 15177, IET 15178 and IET 15179 against gall midge, IET 15742 and IET 15072 against yellow stem borer (*Scirpophaga incertulus*) and IET 16120 against rice leaf folder (*Cnaphalocrosis medinalis*) were found to be moderately resistant.

### Varying Level of Natural Incidence of Rice Leaf Folder

**V. Balasubramani, P. Muthukrishnan, S. Sadakathulla, M. Subramanian and S. Ramanathan**

*Cnaphalocrosis medinalis* Guenee was observed in Tamil Nadu Rice Research Institute, Aduthurai, India during August-September 1999. Variation among different medium duration varieties was found with respect to leaf folder damage. Damage score was recorded as per Standard Evaluation System (SES) of IRRI, Philippines in 0-9 scale. Among the 24 medium duration varieties/cultures screened, seven (ADT 38, ADT 39, ADT 40, Improved white Ponni, AD 95319, Bhavani and TPS 3) were found to be resistant, seven (AD 94010, AD 92215, CO 46, MDU 4, IR 20, TRY-1 and Paiyur 1) scored moderately resistant reaction, three (AD 94016, ASD 19, MDU 3) were found to be moderately susceptible and seven (AD 90072, CO 43, CO 45, MDU 2, PY-1, Red Ponni and PTS 2) were found to be susceptible.

### Reaction of Short and Medium Duration Rice Varieties Entries to Tetranychid mite *Oligonychus oryzae*

**V. Balasubramani, P. Muthukrishnan, S. Sadakathulla, M. Subramanian and S. Ramanathan**

Twenty-five short duration and twenty-four medium duration rice varieties and cultures under advanced stage of yield trials were screened for their reaction to rice mite *Oligonychus oryzae* under in vivo condition during Kuruvai 1999 season (June-July sowing). Mite damage score was done on 0-9 scale as per Sridharan et al., 1992 (APRINL 18:66). When the natural incidence was high, out of 25 short duration rice, three varieties (ADT 41, ASD 8 and IR 50) recorded score 1, nineteen (ADT 36, ADT 37, ADT 42, AD 95010, AD 95078, AD 95104, AD 95106, ADTRH 1, DRRH 1, Pro Agro 6201, PHB 71, ASD 16, ASD 17, ASD 18, IR 36, IR 64, IR 72, TKM 9, and MDU 5) recorded score 3 and three varieties (ADT 43, ASD 20, and IR 66) recorded score 5. Among the medium duration varieties, ten (Improved white Ponni, AD 95319, AD 94016, ASD 19, CO 43, Red Ponni, Bhavani, Paiyur 1, TPS 2 and TPS 3) recorded score 1, tweleve (ADT 38, ADT 39, ADT 40, AD 90072, AD 92215, CO 45, CO46, MDU 2, MDU 3, MDU 4, IR 20, and PY 1) recordedd score ‘3' and two (AD 94010 and TRY 1) recorded score 5, showing their resistant, moderately resistant and moderately susceptible nature respectively.

**Reaction of Popular Varieties of Medium Duration Rice in Nursery to Rice Thrips*Stenchaetothrips biformis***

**V. Balasubramani, P. Muthukrishnan, S. Sadakathulla, M. Subramanian and S. Ramanathan**

Twenty-six medium duration rice varieties/cultures were screened under natural conditions, 20 days after sowing in the nursery during Thaladi season 1999 (Sept-Oct sowing). Reaction score of 0-9 scale was adopted as per Standard Evaluation System (SES) or IRRI, Philippines. Three varieties viz., ADT 39, ADT 40, and Improved white Ponni recorded 1 (resistant), three cultures (AD 92215, AD 90072, and AD 94016) and two varieties (Pondy 1 and Red Ponni) recorded score 3 (moderately resistant), six varieties (ADT 38, CO 43, CO46, MDU2, TRY1, and ASD 19) recorded score 5 (moderately susceptible), Bhavani and AD 94010 recorded score 7 (Susceptible) and nine varieties (CO 45, MDU3, MDU 4, IR 20, Paiyur 1, TPS 2, TPS 3, BPT 5204 and ADRH 8) and a culture (AD 95319) recorded score 9 (highly suscpetible).

**Scoring of Medium Duration Rice Varieties Against Yellow Stem Borer *Scirpophaga incertulus* (Walker) Attack**

**V. Balasubramani, P. Muthukrishnan, S. Sadakathulla, M. Subramanian and S. Ramanathan**

Twenty-one varieties and five cultures of medium duration rice were screened for their reaction against the yellow stem borer *Scripophaga incertulus* (Walker) under natural conditions, based on dead heart counts on 30, 50 DAT (Days After Transplanting) and white ear counts on 80 DAT, during Thaladi season 1999 (Sept-Oct sowing). Based on the mean score (0-9 scale as per SES of IRRI, Philippines) nine varieties and two cultures (ADT 38, ADT 40, CO 43, CO 45, MDU 3, Pondy 1, ASD 19, Red ponni, Bhavani, AD 95319 and AD 92215) were found to be resistant with score 1. Twelve of the total varieties/cultures (Improved white ponni, AD90072, AD94010, CO 46, MDU 2, MDU 4, IR 20, Trichy 1, Paiyur 1, TPS 2, TPS 3 and ADRH 8) stored score 3 revealing their moderately resistant reaction. Only there viz. ADT 39, AD94016, and BPT 5204 were found to be moderately susceptible with score ‘5'.

**Screening Banana Germplasm for Resistance to Lacewing Bug *Stephanitis typicus***

**V. Balasubramani, P. Sundararaju and H.P. Singh**

A total of 278 accessions from the banana germplasm maintained at National Research Centre on Banana (NRCB), Tiruchirappalli were screened for their reaction to lacewing bug *Stephanitis typicus* under natural condition, 7-8 months after planting. Of them five accessions viz., Kalibale (0286), Malaivazhai (0290), Dole (0459), Gandevi (0370) and Chakkarakel (0093) were found to be free from the incidence of *S. typicus*. The remaining 273 accessions had infestation of *S. typicus* which ranged from 10-40 percent infested leaves.

## UNITED KINGDOM

**Horticulture Research International,**
**Wellesbourne,**
**Warwick, CV35 9EF,**
**United Kingdom**

**P.R.Ellis and N.B. Kift**

Editor's Note:

Studies continued on the high levels of resistance to the cabbage aphid, *Brevicoryne brassicae* discovered in certain lines of *Brassica fruticulosa* (n=8). F1 and F2 families have been produced from crosses between selected individual plants representing the extremes of the range of resistance. These families have been evaluated in a controlled environment. Resistance was found to be quantitative, with no mendelian segregation ratios observed.

In an earlier report, the results of evaluating about 400 *Brassica* accessions against *B. brassicae* were presented. The most promising gene pool was found to be the kales. Four of the kale accessions were selected for breeding work. In order to study the genetics of resistance these kales were crossed with a double haploid line derived from the calabrese 'Marathon' and with the Brussels sprouts 'Oliver', which had been used a susceptible standard in all field, glasshouse and laboratory experiments. One of the objectives of the project was to 'bank' genes for resistance in a rapid cycling brassica genotype so that they could be exploited in future breeding programmes with different horticultural brassica crops. The rapid cycling *Brassica oleracea* CRGC 121 has been shown to be highly susceptible to *B. brassicae* and was considered to be a suitable recipient of genes for resistance. The four kales were therefore crossed with this rapid cycling accession. F1 and F2 families were produced in 1997 and 1998 from crosses between all four kales and the different brassicas described above. Progeny from three of the crosses were evaluated in 1999. The results indicated that resistance was multigenic, the response to selection was poor, the susceptible brassica genetic background significantly influenced resistant phenotype and environmental affects influenced the expression of resistance. Microspore culture will be used to produce double haploid lines which can be assessed more thoroughly in replicated experiments. This should make it possible to partition environmental and genetic components of resistance and to identify true-breeding resistant lines.

A project has begun to search for resistance in *Arabidopsis thaliana* to three important aphid pests, *B. brassicae*, cabbage aphid, *Lipaphis erysimi*, the mustard aphid and *Myzus persicae*, the peach-potato aphid. About 110 different *Arabidopsis* accessions have been obtained and a series of experiments designed to evaluate material. For both *B. brassicae* and *M. persicae* several different clones of aphid have been collected and used in preliminary experiments to identify the most vigorous ones for use in subsequent screening work. Antibiosis resistance has been identified to *B. brassicae* in 2 accessions, with some putative resistance to *L. erysimi* also being identified in a separate accession.

A UK MAFF-funded project on lettuce continued in 2000 to investigate the resistance to *Myzus persicae* in the lettuce variety 'Iceberg', a Batavian type of lettuce. Six clones of the aphid collected from different locations in the UK have been established at Wellesbourne. The performance of these clones on a susceptible lettuce variety, 'Saladin' has been compared. Antixenosis and antibiosis screening techniques have been developed for the evaluation of resistance. Preliminary laboratory experiments have confirmed that the Batavian 'Iceberg' variety possesses moderate levels of antibiosis resistance to aphid attack. It is planned to investigate the biological and genetical basis of this resistance and to determine the performance of inbreds produced in a single seed descent programme bred from a cross between susceptible and resistant lettuce material.

A review has been written on the resistance of carrot to carrot fly, *Psila rosae* (see below). The team continues to offer seed companies and other organisations a service for screening breeding lines for resistance to carrot fly, *Psila rosae*. A new carrot fly-resistant variety, 'Resistafly', was released by A.L. Tozer (seed company) in the spring of 2000 as a result of the collaboration with Horticulture Research International.

**Publications**

**Refereed papers**

**ELLIS, P.R.** (1999). The identification and exploitation of resistance in carrots and wild Umbelliferae to the carrot fly, *Psila rosae* (F.). *Integrated Pest Management Reviews* **4**, 256-268.

**ELLIS, P.R.,** PINK, D.A.C., BARBER, N.E., & MEAD, A. (1999). Identification of high levels of resistance to cabbage root fly, *Delia radicum*, in wild Brassica species. *Euphytica* **110**, 207-214.

**ELLIS, P.R.,** KIFT, N.B., PINK, D.A.C., JUKES, P.L., LYNN, J. & TATCHELL, G.M. (2000). Variation in resistance to the cabbage aphid (*Brevicoryne brassicae*) between and within wild and cultivated *Brassica* species. *Genetic Resources and Crop Evolution* **47**, 395-401.

**ELLIS, P.R.**, PINK, D.A.C., McCLEMENT, S.J., SAW, P.L. PHELPS, K., VICE, W.E. & KIFT, N.B. (2000). Identification of sources of resistance in lettuce to the lettuce root aphid, *Pemphigus bursarius*. *Euphytica*. (Submitted)

KIFT, N.B., PINK, D.A.C., **ELLIS, P.R.** & TATCHELL, G.M. (2000). The influence of genetic background on the use and manipulation of resistance to the cabbage aphid (*Brevicoryne brassicae*) in kale (*Brassica oleracea* var. *acephala*). *Annals of Applied Biology (In press)*

**Non-refereed papers**

**ELLIS, P.R.** (1999). Breeding the fly-free carrot. *Grower* **131 (12)**, pp. 18 & 20.

COLLIER, R.H., TATCHELL, G.M., **ELLIS, P.R.**, & PARKER, W.E. (1999). Strategies for the control of aphid pests of lettuce. *IOBC/WPRS Bulletin* **22**, (5), 25-35.

**ELLIS, P.R.** & ESTER, A. (1999). Possible reasons for the decline in carrot fly (*Psila rosae* (F.) infestations in western Europe. *IOBC/WPRS Bulletin* **22**, (5), 83-87.

KIFT, N.B., **ELLIS, P.R.** & SINGH, R. (1999). Interpretation of aphid performance data in quantifying resistance. *IOBC/WPRS Bulletin* **22**, (10), 65-70.

**ELLIS, P.R.** (1999). Exploiting the resistance in carrots and wild umbelliferae to the carrot fly, *Psila rosae* (F.). *IOBC/WPRS Bulletin* **22**, (10), 45-52.

**ELLIS, P.R.** & KIFT, N.B. (2000). The exploitation of plant resistance in controlling insect pests of vegetable crops. *IOBC/WPRS Bulletin*. (Submitted).

**Other publications**

***ELLIS, P.R.*** *& DERRIDJ, S. (1999) (Editors).* Breeding for Resistance to Insects and Mites. IOBC

## UNITED KINGDOM

**Ecotoxicology Research Group**
**Department of Agricultural and Environmental Science**
**Newcastle University, Newcastle upon Tyne**
**NE1 7RU, UK**

**R.M. Wilkins, (**Richard.Wilkins@ncl.ac.uk) **Senior Lecturer & Supervisor; Fazalluah M. Bughio (**Fazallullah.Bughio@newcastle.ac.uk); **Miss A.S. Petrova (A.S.** Petrova@ncl.ac.uk); **Ovais S. Pathan (**O.S.Pathan@ncl.ac.uk) **Ecotoxicology Group, Department of Agricultural & Environmental Science, University of Newcastle, Newcastle upon Tyne, NE1 7RU, UK.**

### Inhibition of gut proteolytic enzymes of *Tribolium castaneum* (Hbst.) (Coleoptera: Tenebrionidae) by albumin proteins isolated from insect-resistant and susceptible rice flours.

**Fazalullah M. Bughio and Richard M. Wilkins**

Seeds, especially those of cereals contain large quantities of protein and are major source of dietary protein. However, some are extremely toxic to animals and insects. Albumin protein was extracted from two forms of rice grain (brown and milled) of Dawn and DR82 cultivars, which are resistant and susceptible respectively to the stored product insect *Tribolium castaneum.* The aqueous extract of each grain form was divided and part was heat-treated for 10 min at 80°C. The concentrations of both heat-treated and untreated proteins of Dawn cultivar were significantly higher than DR82 in brown and milled forms except in the unheated brown form of the cultivars. The heat-treated proteins of both forms of the grains were the most effective in inhibiting the proteolytic activity of the insect gut. The effects of the heat-treated and untreated proteins of the two forms of Dawn cultivar on the proteolytic activity of *Tribolium castaneum* were significantly higher than the forms and treatments of DR82 cultivar.

### Brown planthopper *Nilaparvata lugens* as a stress factor in rice plants

**Adelina Petrova and Richard M. Wilkins**

Phloem sugars and free amino acids are known to influence the feeding behaviour of many phloem feeding homopteran pests. Brown planthopper (BPH) also has the ability to modify plant nutritional physiology. Heavy infestations of BPH on rice plants induce proteolysis and a 30-fold increase in levels of several amino acids (arginine, asparagine, lysine, proline, and tryptophan), whereas free sugars and moisture content decrease (Sogawa, 1971; Cagampang *et al.*, 1974).

Three rice varieties have been chosen on the basis of resistance to the BPH, Rathu Heenati (resistant), Bg300 (medium), TN1 (susceptible), and they have been grown under two nitrogen regimes. The total amount of amino acids of 8- and 6-week old plants infested with BPH have been measured and compared to that of the control plants. The ninhydrin method has been used for the determination of the amino acids.

### Mechanisms of plant resistance in crops to the leafworm *Spodoptera littoralis*: role of gut detoxifying enzymes

**Ovais Safdar Pathan and Richard M. Wilkins**

The cotton leafworm, *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) is an important polyphagous insect pest attacking a wide variety of crops in tropical and temperate areas of Africa, Asia and Europe. The choice and combination of the methods for control depend on the pest complex, infestation and the costs of implementation. Much control is achieved through integrated pest management including insecticides and mating disruption.
In contrast to monophagous pests, it is difficult to develop varietal resistance for polyphagous pests in the crops attacked. However, an understanding of the reasons for susceptibility of the various crops to attack may help in the development of resistant varieties. In the case of *S. littoralis*, dicotyledonous crops are preferred to monocots. An understanding of the mechanisms that contribute to this preference could have a role in improving crop resistance and biological control.

The objectives of this study were to compare feeding on selected crops (maize, wheat, sunflower and cabbage) and the consequential response from the insect in terms of detoxification activities. Larvae were reared on the crops until the last instar and their weight gains, food intake and cytochrome P450 enzymes (CYP1A1 and CYP2B1) activities measured. Food consumption and CYP1A1 activity was low on wheat and maize. In sunflower and cabbage both enzyme activities were significantly increased. The role of these enzymes in the insect's response to the crops will be discussed in terms of the food utilisation and in the comparison of the four crops.

**Publications**

**Bughio, F. M., and R. M. Wilkins. 1997.** Effect of rough rice cultivars on larval period and $F_1$ emergence time of the red flour beetle *Tribolium castaneum* (Hbst.) and confused flour beetle *Tribolium confusum* (Duv.). International Plant Resistance to Insects Newsletter. 23: 55-56.

**Bughio, F. M. and R. M. Wilkins. 1998.** Influence of various types of flour of resistant and susceptible rice cultivars on biology of *Tribolium* species. International Plant Resistance to Insects Newsletter. 24: 11-12

**Bughio, F. M., and R. M. Wilkins. 1998.** Response of insecticide-resistant and susceptible strains of *Tribolium castaneum* to various types of grains flour of rice cultivars, pp. 4B-048. *In* Proceedings: 9th International Congress: Pesticide Chemistry, 2-7 August 1998, London. Royal Society of Chemistry, Cambridge, UK.

**Bughio F. M., and R. M. Wilkins. 1999.** Post-harvest pest management: resistant rice varieties in control of stored product insect pests, pp. 221-225. *In* Proceedings: 5$^{th}$ International Conference on Plant Protection in the Tropics, 15-18 March 1999, Kuala Lumpur, Malaysia. Malaysian Plant Protection Society (MAPPS).

**Bughio F. M., and R. M. Wilkins. 2000.** Influence of Malathion Resistance Status on Survival and Growth of *Tribolium* spp. (Coleoptera: Tenebrionidae), when Fed on Flour from Resistant and Susceptible Rice Cultivars. J. Econ. Entomol. In press.

**Rauf, A., F. M. Bughio, and R. M. Wilkins.** 1997. Insecticide resistance in *Tribolium castaneum* Herbst and *Sitophilus granarius* L.: comparing residual film and topical application methods. Tribolium Information Bull. 37: 163-169.

## YUGOSLAVIA

**Fruit and Grape Research Centre**
**32 000 Cacak**
**Yugoslavia**

### Strawberry Resistance to the Aphid *Chaetosiphon Fragaefolii* (Cockerell) (Homoptera, Aphididae)

**Slobodan Milenkovic**

The paper presents the results of the studies on the resistance of the strawberry *Fragaria x ananassa* Duchesne and 652 hybrids of *Fragaria ananassa x Fragaria chiloensis* clone Del Norte. Moderately resistant hybrids from the cross Senga Fructarina x Del Norte (zf/1/94/96 and 2/11/95/97) and Dana x Del Norte (da/17/94/96) were singled out on the basis of testing in the glasshouse and in the field. Fifteen strawberry genotypes were used for studying survival and fertility (a five-day test), longevity, fertility and production of honeydew on filter paper with bromine cresol green in apterous parthenogenetic females. Significant differences were recorded in all the evaluated parameters by genotypes, with the lowest values obtained on the moderately resistant hybrids and Del Norte. The population density of *Chaetosiphon fragaefolii* in the field on the standard cultivars and moderately resistant hybrids shows year-to-year variations. However, on the moderately resistant hybrids it does not exceed 20% of the density recorded on the sensitive cultivars. Strawberry genotype affects morphometric characters of parthenogenetic apterous females. The smallest dimensions of the body and the apical segment of the rostrum were observed in the females reared on Del Norte and moderately resistant hybrids. Dimethoate and delthametrine are more toxic to the individuals from the *Ch. fragaefolii* population reared on the moderately resistant hybrid zf/1/94/96 compared to the population reared on the highly sensitive selection ^a~anska Rana, particularly at $LC_{90}$ level. The cross-section of the leaf blade and leaf petiole in strawberry genotypes showing different resistance to *Ch. fragaefolii* was studied by the paraffin method and by staining it with safranine, crystal violet and light green SF. In more resistant genotypes, besides thicker cell walls of the primary bark collenchyma and a greater share of the collenchyma in relation to the parenchyma in the primary bark, the main vascular bundles are encircled by a ring of more intensely stained lignified cells forming a mechanical ring. This stained reaction of cells to safranine and crystal violet also occurs in smaller-sized vascular bundles, as well as in the leaf palisade tissue. The tissue cross-sections in the sensitive genotypes reveal the predominance of the green colour on the cellulose cell walls and protoplasts due to the reaction to light green SF, whereas the stained reactions to safranine and crystal violet are absent.

**Key words:** *Chaetosiphon fragaefolii, Fragaria ananassa, Fragaria chiloensis,* resistance, fertility, longevity, honeydew, morphometric ch