Program & Abstracts

University of Vermont

Second International Conference on Sunn Pest

ICARDA, Aleppo, Syria
July 19-22, 2004

Edited by
M. El-Bouhssini, B. Parker, M. Skinner, W. Reid and S. Kumari

International Center for Agricultural Research in the Dry Areas

About ICARDA and the CGIAR

Established in 1977, the International Center for Agricultural Research in the Dry Areas (ICARDA) is governed by an independent Board of Trustees. Based in Aleppo, Syria, it is one of 16 centers supported by the Consultative Group on International Agricultural Research (CGIAR).

ICARDA serves the entire developing world for the improvement of lentil, barley and faba bean; all dry-area developing countries for the improvement of on-farm water-use efficiency, rangeland, and small-ruminant production; and the Central and West Asia and North Africa region for the improvement of bread and durum wheats, chickpea, and farming systems. ICARDA's research provides global benefits of poverty alleviation through productivity improvements integrated with sustainable natural-resource management practices. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national agricultural research and development systems.

The results of research are transferred through ICARDA's cooperation with national and regional research institutions, with universities and ministries of agriculture, and through the technical assistance and training that the Center provides. A range of training programs is offered, from residential courses for groups to advanced research opportunities for individuals. These efforts are supported by seminars, publications, and specialized information services.

CGIAR

The CGIAR is an international group of representatives of donor agencies, eminent agricultural scientists, and institutional administrators from developed and developing countries who guide and support its work. The CGIAR receives support from many country and institutional members worldwide. Since its foundation in 1971, it has brought together many of the world's leading scientists and agricultural researchers in a unique South–North partnership to reduce poverty and hunger.

The mission of the CGIAR is to promote sustainable agriculture to alleviate poverty and hunger and achieve food security in developing countries. The CGIAR conducts strategic and applied research, with its products being international public goods, and focuses its research agenda on problem-solving through interdisciplinary programs implemented by one or more of its international centers, in collaboration with a full range of partners. Such programs concentrate on increasing productivity, protecting the environment, saving biodiversity, improving policies, and contributing to the strengthening of agricultural research in developing countries.

The World Bank, the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), and the International Fund for Agricultural Development (IFAD) are cosponsors of the CGIAR. The World Bank provides the CGIAR System with a Secretariat in Washington, DC. A Science Council, with its Secretariat at FAO in Rome, assists the System in the development of its research program.

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International Center for Agricultural Research in the Dry Areas

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Conference Organizing Institutions

- International Center for Agricultural Research in the Dry Areas, Aleppo, Syria
- University of Vermont, USA
- Arab Society for Plant Protection, Lebanon

Conference Supporting Institutions

- United States Agency for International Development (USAID), USA
- United States Department of Agriculture (USDA), USA
- Food and Agriculture Organization of the United Nations (FAO)
- Islamic Development Bank (IDB)

Conference Committees

Conference Coordinators
Dr Mustapha El-Bouhssini, ICARDA, Syria
Dr Bruce Parker, University of Vermont, USA
Dr Margaret Skinner, University of Vermont, USA

International Organizing Committee
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Dr Safaa Kumari (Chairperson)
Dr Mustapha El-Bouhssini
Dr Samir El-Sebae Ahmed
Mr Bill Reid
Mr Fadel Afandi
Mr Ahmed Shahbandar

Conference Program

Sunday, 18 July 2004

19:30-22:00 Cocktail & Registration, at ICARDA office I, Aleppo city

Monday, 19 July 2004

08:00 Transport to Tel Hadya (ICARDA Headquarters)

08:00-9:00 Registration

9:00-9:30 **Opening Statements**

University of Vermont, *by Prof. Dr. Bruce L. Parker*
Arab Society for Plant Protection, *by Dr. Wafa Khoury*
ICARDA, *by Prof. Dr. Adel El-Beltagy - Director General*

9:30-10:00 **Coffee Break and Group Photo**

10:00-11:30 **KEYNOTE PRESENTATIONS**
Chairperson: *Dr. William Erskine, ICARDA, Syria*

10:00-10:45 **IPM in the CGIAR,** *by Khaled Makkouk, Al-Manar University of Tripoli, Lebanon*

10:45-11:30 **Lessons Learned from IPM Programmes: Ecology, Policy, and Community Empowerment,** *by Peter Kenmore, FAO, Italy*

11:30-15:00 **SESSION 1: SOCIOECONOMICS OF SUNN PEST**
Chairperson: *Dr. Majd Jamal, GCSAR, Syria*

11:30-11:45 **The basic role of extension, farmer grouping and participation in Sunn Pest management,** *by Gholam Abbas Abdollahi, PPDRI, Iran*

11:45-12:00 **Analysis of policies on Integrated Pest Management on Sunn Pest in Iran, Syria and Turkey,** *by Aden Aw-Hassan, ICARDA, Syria*

12:00-12:15 **Shifting from aerial to ground spraying in Sunn Pest control in the Trace region of Turkey: Farmers' perception and problems,** *by Aykut Gul, University of Cukurova, Turkey*

12:15-12:30 **Positive effects of commodity exchange in Sunn Pest control in Turkey in recent years,** *by Aykut Gul, University of Cukurova, Turkey*

12:30-12:45 **The role of Socio-economic characteristics in the holding of farmer field school and acceptance of participation in IPM of Sunn Pest,** *by Majid Hassani Moghaddam, PPDRI, Iran*

12:45-13:00 **A Socio-economic study of integrated pest management of Sunn Pest on wheat in Syria,** *by Hamoud Haj Hamoud, Aleppo University, Syria*

13:00-14:00 Lunch

SESSION 1 (Continued)

14:00-14:15 **The loss assessment and economic levels for Sunn Pest, *Eurygaster integriceps* Puton, through cost-benefit methods in Qazvin province of Iran,** *by Hossein Noori, Qazvin Agricultural and Natural Research Center, Iran*

14:15-14:30 **Determination and comparison of allocative, technical and economic efficiency in outside and inside of integrated Sunn Pest management pilot sites in Iran,** *by Majid Hassani Moghaddam, PPDRI, Iran*

14:30-14:45 **Evaluating Sunn Pest management in Turkey in terms of food security, human health, environmental conservation and economic returns,** *by Hasan Akca, Gaziosmanpasa University, Turkey*

14:45-15:00 **Modified Farmers' Field Schools as a new option in IPM of Sunn Pest *Eurygaster itegriceps* Puton (Hemiptera: Scutelleridae),** *by Mohammed Abdulhai, GCSAR, Syria*

15:00-18:30 SESSION 2: SUNN PEST BIOLOGY AND ECOLOGY
***Chairperson**: Dr. Gholam Abbas Abdollahi, PPDRI, Iran*

15:00-15:15 **Sunn Pest population distribution in overwintering sites in Iran,** *by Bruce L. Parker, University of Vermont, USA*

15:15-15:30 **Damage loss assessment of Sunn Pest, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae) on wheat in Turkey,** *by Ramazan Canhilal, Adana Plant Protection Research Institute, Turkey*

15:30-15:45 **Investigation of mechanisms of mate-finding in Sunn Pest,** *by David Hall, University of Greenwich, UK*

15:45-16:15 **Coffee Break**

SESSION 2 (Continued)

16:15-16:30 **Mitochondrial DNA variations in Iranian geographic populations of Sunn Pest, *Eurygaster integriceps* Puton,** *by Alimorad Sarafrazi, PPDRI, Iran*

16:30-16:45 **Morphometric studies on Iranian geographic populations of Sunn Pest, *Eurygaster integriceps* Puton,** *by Alimorad Sarafrazi, PPDRI, Iran*

16:45-17:00 **The role of biocontrol agents in decreasing the population of Sunn Insect *Eurygaster integriceps* Puton in wheat fields in the north of Iraq,** *by Mohammed A. J. Al-Izzi, AOAD, Sudan*

17:00-17:15 **Entomophilous and entomopathogenic fungi associated with Sunn Pest in overwintering sites,** *by W. Reid, ICARDA, Syria*

17:15-17:30 **Sunn Pest, *Eurygaster integriceps* Puton, status in Iraq,** *by Nazar N. Hama, SBAR, Iraq*

17:30-17:45 **The impact of Sunn Pest density in wheat fields on grain and flour quality,** *by Fouad Jaby El-Haramein, ICARDA, Syria*

17:45-18:00 **A new technique for monitoring of the Sunn Pest, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae),** *by Heidar Adldoost, Agricultural Research Center of West Azarbaijan, Iran*

18:00-18:15 **Life history and reproductive table of *Eurygaster maura* L. (Het.: Scutelleridae) in the laboratory,** *by Jafar Mohaghegh, PPDRI, Iran*

18:15-18:30 **Investigation on damage of overwintered Sunn Pest (*Eurygaster integriceps* Puton) and their nymphs in rainfed wheat fields of Kermanshah province, Iran,** *by Farshid Karkoodi, Agricultural Jahad Organization of Kermanshah, Iran*

18:30 **Transportation to hotels in Aleppo**

Tuesday, 20 July 2004

08:00 Transport to Tel Hadya (ICARDA Headquarters)

08:30-10:00 KEYNOTE PRESENTATIONS
Chairperson: *Dr. Lukas Brader, Netherlands*

08:30-09:15 **Green Muscle, from isolate to commercial product,** *by Christiaan Kooyman, IITA, Republic of Benin*

09:15-10:00 **Biorational Insecticides Use in integrated pest management,** *by Charles Vincent, Agriculture and Agri-Food Canada, Canada*

10:00-10:30 Coffee Break

10:30-12:30 SESSION 3: SUNN PEST BIOLOGY AND ECOLOGY
Chairperson*: Dr. David Hall, University of Greenwich, UK*

10:30-10:45 **Host plant-associated variation and sexual dimorphism in size and shape in Iranian geographic populations of Sunn Pest, *Eurygaster integriceps* Puton,** *by Alimorad Sarafrazi, PPDRI, Iran*

10:45-11:00 **Biological parameters of Sunn Pest, *Eurygaster integriceps* Puton, in wheat fields in the north of Iraq,** *by Abdul-Bassit M. Amin, University of Baghdad, Iraq*

11:00-11:15 **Population density of Sunn Pest, *Eurygaster integriceps* Puton, during hibernation and aestivation in the North of Iraq,** *by Mohammed Al-Izzi, AOAD, Sudan*

11:15-11:30 **Survey of egg parasitoids of Sunn Pest in Northern Syria,** *by A. N. Trissi, Aleppo University, Syria*

11:30-11:45 **Survey of Sunn Pest adult parasitoids in Syria,** *by Mohammed Abdulhai, GCSAR, Syria*

11:45-12:00 **Observations on important wheat pests in Tajikistan,** *by Munira Otambekova, Tajikistan*

12:00-12:15 **Regional degree-day model for predicting developmental stages of Sunn Pest, *Eurygaster integriceps* Puton, in the field under variable temperatures,** *by Naser Moeeny Naghadeh, Razi University, Iran*

12:15-12:30 **Temperature thresholds and degree-day requirements of embryonic development of Sunn Pest, *Eurygaster integriceps* (Hemiptera: Scutelleridae), at constant temperatures,** *by Naser Moeeny Naghadeh, Razi University, Iran*

12:30-13:30 **Lunch**

13:30-15:30 **TOUR OF ICARDA**

15:30-16:45 **SESSION 4: IPM: CHEMICAL CONTROL**
Chairperson: *Dr. Ramazan Canhilal, GDPC, Turkey*

15:30-15:45 **Timing as a tactic of ecological selectivity for chemical control of Sunn Pest, *Eurygaster integriceps* Puton,** *by A. Sheikhi Garjan, PPDRI, Iran*

15:45-16:00 **The influence of insecticide residues on the foraging behaviour of the Sunn Pest egg parasitoid (*Trissolcus grandis*) in the laboratory,** *by A. Sheikhi Garjan, PPDRI, Iran*

16:00-16:15 **Effects of conventional insecticides on Sunn Pest egg parasitoids *Trissolcus grandis* and *T. semistriatus* (Hymenoptera: Scelionidae),** *by Moosa Saber, Maragheh College of Agriculture, Iran*

16:15-16:30 **Chemical control of Sunn Pest with pesticides (ULV) applicable for emulsion in water by using ground spraying system,** *by Nassir A. Al-Gamali, State Board of Plant Protection, Iraq*

16:30-16:45 **The effects of application methods in chemical treatments for Sunn Pest control in Turkey,** *by Arzu Erman, Plant Protection Central Research Institute, Turkey*

16:45-18:15 **Coffee Break &**
POSTERS SESSION I: IPM

1. **Outbreaks of cereal Sunn Pests and solutions for sustainable control,** *by M. Javahery, Macdonald Campus of McGill University, Canada*
2. **The effect of temperature on the development, reproductive potentials, and longevity of *Trissolcus semistriatus* Nees (Hymenoptera: Scelionidae) under constant temperatures,** *by S. Tarla, University of Mustafa Kemal, Turkey*
3. **Binomial and sequential sampling of adult Sunn Pest, *Eurygaster integriceps* Puton (Heteroptera: Scutelleridae),** *by M. Amir-Maafi, PPDRI, Iran*

4. **Effects of indoxacarb to a predacious mirid and two species of predatory mites found in orchards,** *by Charles Vincent, Agriculture and Agri-Food Canada, Canada*
5. **UDA-245: a botanical insecticide/acaricide for worldwide horticultural uses,** *by Charles Vincent, Agriculture and Agri-Food Canada, Canada*
6. **Evaluation of wheat cultivars and advanced lines for resistance to Sunn Pest (*Eurygaster integriceps* Puton) in Iran,** *by A. R. Haghshenas, Isfahan Agricultural and Natural Resources Research Center, Iran*
7. **Study on predatory and parasite mite associated with overwintering sites of sunn pest in western Iran,** *by Mohammad Khanjani, Faculty of Agriculture, Hamada, Iran*
8. **The present situation of some alternative hosts (*Dolycoris baccarum* L., *Piezodorus lituratus* F.) on the natural enemies of Sunn Pest (*Eurygaster integriceps* Puton) in the Southeastern Anatolian region of Turkey,** *by Ayse Akkaya, Plant Protection Research Institute, Diyarbakır, Turkey*
9. **Screening of some wheat varieties to Sunn Pest in Nineveh province, Iraq,** *by Suaad Irdeny Abdullah, Mosul University, Iraq*
10. **Temperature and Rainfall: Factors for fungal success in Sunn Pest overwintering sites,** *by Margaret Skinner, University of Vermont, USA*
11. **Comparative study of the properties and regulation of the activity of cholinesterases and carboxylesterases of Sunn Pest, *Eurygaster integriceps* Puton,** *by Habib H. Kushiev, Gulistan State University, Uzbekistan*

18:15 **Transportation to hotels in Aleppo**

20:00 **Dinner Reception**

Wednesday, 21 July 2004

08:00 Transport to Tel Hadya (ICARDA Headquarters)

08:30-10:00 KEYNOTE PRESENTATIONS
***Chairperson**: Dr. Bruce L. Parker, University of Vermont, USA*

08:30-09:15 **Miracle Economics and IPM: Success in developing countries,** *by Douglas Gollin, Williams College, USA*

09:15-10:00 **How can scientists and scientific programmes connect with public and private enterprises to further the cause of IPM,** *by Lukas Brader, Herent, Belgium*

10:00-10:30 Coffee Break

10:30-12:45 SESSION 5: IPM: BIOLOGICAL CONTROL / IPM: GENERAL TOPICS
***Chairperson**: Dr. Charles Vincent, Agriculture and Agri-Food Canada*

10:30-10:45 **Cereal Sunn Pests and sustainable management in the 21st century,** *by M. Javahery, Macdonald Campus of McGill University, Canada*

10:45-11:00 **Sunn Pest management in Romania,** *by Felicia Mureşanu, Agricultural Research and Development Station Turda, Romania*

11:00-11:15 **Entomopathogenic fungi for management of Sunn Pest: efficacy trials in overwintering Sites,** *by Margaret Skinner, University of Vermont, USA*

11:15-11:30 **The development of a mycoinsecticide for the biological control of Sunn Pest,** *by Dave Moore, CABI Bioscience, UK*

11:30-11:45 **Mass production of entomopathogenic fungi used for the biological control of insect pests,** *by Dave Moore, CABI Bioscience, UK*

11:45-12:00 **Initial studies on the potential use of an entomopathogenic fungal granular formulation along the edges of wheat fields,** *by W. Reid, ICARDA, Syria*

12:00-12:15 **Studies on the egg parasitoid (*Trissolcus* spp., Hymenoptera: Scelionidae) of Sunn Pest (*Eurygaster* spp., Hemiptera: Scutelleridae) in Turkey,** *by Erhan Koçak, Central Plant Protection Research Institute, Turkey*

15:30-15:45 **Resistance to Sunn Pest (*Eurygaster integriceps* Puton) in advanced lines of durum and bread wheat,** *by Tohid Najafi Mirak, Seed and Plant Improvement Institute, Iran*

15:45-17:15 Coffee Break &
POSTERS SESSION II: BIOLOGY AND ECOLOGY

1. **The investigation of α-amylase activity in hibernating Sunn Pest (*Eurygaster integriceps* Puton),** *by Majid Kazzazi, University of Tehran, Iran*
2. **Relation between weed grasses and life cycle of Sunn Pest in the Setif high plains (North-East of Algeria),** *by Mohamed Fenni, University Ferhat Abbes, Algeria*
3. **Biology, ecology and chemical control of Sunn Pest, *Aelia germari* Kuster (Heteroptera: Pentatomidae), in the Setifian high plains (North-East of Algeria),** *by Mustapha Bounechada, University Ferhat Abbes, Algeria*
4. **A study of the Sunn Pest species on cereal crops in the Setifian High Plains (North-East of Algeria),** *by Adel Nadjib Chaker, University Ferhat Abbes, Algeria*
5. **Prediction of Sunn Pest life cycle using environmental data over the North-East of the I.R. of Iran,** *by A. Movaghar Moghaddam, Climatologic Research Institute, Iran*
6. **Morphometric analysis of two populations of *Eurygaster maura* L. (Heteroptera Scutelleridae) from Iran,** *by Jafar Mohaghegh, PPDRI, Iran*
7. **Studies on the determination of the fat rate of Sunn Pest, *Eurygaster integriceps* Puton, (Heteroptera: Scutelleridae) to forecast Sunn Pest populations in fields in the South East Anatolia Region of Turkey,** *by Abdullah Demir, Diyarbakir Plant Protection Research Institute, Turkey*
8. **Ecological Principles of Sunn Pest Monitoring in Kazakhstan,** *by Amangeldy Sarbaev, Research and Production Center for Agriculture and Plant Growing, Kazakhstan*
9. **Studies on Sunn Pest overwintering sites, parasitoids and effects of Sunn Pest on Cereal Lines and varieties in Konya province, Turkey,** *by A. Faik Yildirim, Anatolian Agricultural Research Institute, Turkey*
10. **Harmfulness of Sunn Pest in grain crops of Azerbaijan,** *by Sardar Ibragimov, Azerbaijan Research Institute of Agriculture, Azerbaijan*

11. **Sunn Pest population under different plant species in overwintering sites in Iran,** *by Bruce L. Parker, University of Vermont, USA*
12. **Investigations on the mass production and storage possibilities of the egg parasitoid, *Trissolcus grandis* (Thomson) (Hymenoptera: Scelionidae),** *by Münevver Kodan, Central Plant Protection Research Institute, Turkey*

17:15-18:30 **CLOSING SESSION**
Chairperson: Dr. William Erskine

Wrap-up comments- *by Dr. Lukas Brader*
Closing - *by Prof. Dr. Adel El-Beltagy*

18:30 **Transportation to hotels in Aleppo**

Thursday, 22 July 2004

Touristic Trip

07:30	Departure to Aleppo Citadel
08:00-09:15	Citadel visit
09:30	Departure to Carpet Workshop
10:30-11:45	Carpet workshop visit
11:45-12:30	Visit to Ain Dara Temple
13:00-14:00	Visit to Qalaat Seman (St. Simeon)
14:00-16:00	Lunch (st. Someon restaurant)
16:30	Visit the Roman Road
17:30	Arrival to Aleppo
18:30-20:30	Visit the old Souk (traditional shopping area)

12:15-12:30 **Infectivity of two isolates of *Steinernema feltiae* (Rhabditida: Steinernematidae) in relation to *Eurygaster maura* L. (Heteroptera: Scutelleridae) adults,** *by Erhan Koçak, Plant Protection Central Research Institute, Turkey*

12:30-12:45 **Initial studies on the efficacy of entomopathogenic nematodes against Sunn Pest and survey of Syrian soils for locally adapted isolates,** *by Mohammed Abdulhai, General Commission for Scientific Agricultural Research, Syria*

12:45-13:45 Lunch

13:45-16:45 SESSION 6: IPM HOST PLANT RESISTANCE / IPM GENERAL TOPICS

***Chairperson**: Dr. Khaled Makkouk, MUT, Lebanon*

13:45-14:00 **Evaluation of wheat and its wild relatives for resistance to Sunn pest under artificial infestation,** *by M. El-Bouhssini, ICARDA, Syria*

14:00-14:15 **Comparison of resistance to Sunn Pest (*Eurygaster integriceps* Puton) in some bread and durum wheat lines,** *by Manouchehr Rezabeigi, PPDRI, Iran*

14:15-14:30 **Effect of different cereals (Wheat and Barley) on the population of Sunn Pest, *Eurygaster integriceps* Puton (Heteroptera: Scutelleridae), in the South East Anatolia region of Turkey,** *by Vedat Karaca, Diyarbakir Plant Protection Research Institute, Turkey*

14:30-14:45 **Host-plant preference and performance by different developmental stages of Sunn Pest, *Eurygaster integriceps* Puton, on wheat cultivars,** *by A. Arzani, Isfahan University of Technology, Iran*

14:45-15:00 **The effect of the starch granule sizes of grain endosperm on the resistance of wheat cultivars to Sunn Pest (*Eurygaster integriceps* Puton),** *by Manouchehr Rezabeigi, PPDRI, Iran*

15:00-15:15 **Development of an efficient wheat genetic transformation system for the creation of the transgenic wheat resistant to the Sunn Pest (*Eurygaster integriceps* Puton),** *by A. K. Gaponenko, "Bioengineering" RAS, Russian Federation*

15-15-15:30 **The Sunn Pest in former USSR countries: history and current status,** *by Galia Zharmukhamedova, Institute for Plant Protection, Kazakhstan*

Table of Contents

KEYNOTE PRESENTATIONS

IPM AT THE CGIAR. Khaled Makkouk, Al-Manar University of Tripoli, P.O. Box 676, Tripoli, Lebanon, Phone: (00961-6) 426800/1/2; Fax: (00961-6) 426803; E-mail: K.Makkouk@mut.edu.lb

In response to the need for a different IPM approach and to Agenda 21-the action plan developed by the UN Conference on Environment and Development, the CGIAR launched in 1995 a system-wide program on IPM to promote IPM as a key element of sustainable agricultural production within the CG centers. This initiative was put to action in 1996 when an Inter-Centers Working Group (ICWG) on IPM was established as a global network of CG and other International Agricultural Research Centers with the FAO/World Bank Global IPM facility, IPM Forum, Pesticide Action Network representing the CGIAR NGO Committee and Crop Life, representing private crop protection industry. Beneficiaries of the program are farmers, national and International research organizations, extension programs and NGOs. Since 1996, the ICWG meets annually to identify problems for which inter-institutional effort could make a difference, in order to review progress, discuss and agree on priorities, policy, contractual obligations and allocation of resources to strengthen collaboration, promote networking and increase impact. The ICWG has a coordinating secretariat which catalyses and facilitates execution of approved activities, mobilizes/disseminates technical and material resources, develops information and publicity materials to promote IPM learning and advocacy, serves as the contact point to promote linkage with partners and seek funding. The Secretariat is housed until present at IITA. My presentation in the conference will highlight the SP-IPM activities conducted over the last eight years, and the achievements made.

LESSONS LEARNED FROM IPM PROGRAMMES: ECOLOGY, POLICY, AND COMMUNITY EMPOWERMENT. Peter Kenmore, FAO, Rome, Italy. E-mail: Peter.Kenmore@fao.org

"Abstract Not Submitted"

GREEN MUSCLE, FROM ISOLATE TO COMMERCIAL PRODUCT. Christiaan Kooyman, IITA Biological Control Centre for Africa, 08 B.P. 0932 Tri Postal, Cotonou, Republic of Benin, Phone: +229 350188, Fax: +229 350556, e-mail: C.Kooyman@cgiar.org

Locusts and grasshoppers are still mainly controlled by means of chemical insecticides. However, progress has been made over the last 15 years to develop alternative means of control. A biological product based on the entomopathogenic

fungus *Metarhizium anisopliae* var. *acridum* has been developed over a period of 12 years by the LUBILOSA programme, a French acronym meaning biological control of locusts and grasshoppers. The programme was executed by CABI, IITA, AGRHYMET and GTZ with funding from the international development agencies of Canada, the Netherlands, Switzerland and the United Kingdom. The programme brought together a group of researchers with a wide diversity of expertise to be able to go through all the necessary steps for the development of an effective and easy-to-use product. These steps included the search for isolates, bioassays to select the best isolates, field testing, (eco)toxicology testing, mass production and storage studies, formulation, application and commercialisation. One isolate was selected on the basis of its efficacy and ease of production. A licensing agreement was signed with the South African company Biological Control Products, which registered the product under the name Green Muscle®. Though the product is now on the market, full acceptance is still some way off. One important hurdle is registration, which has not yet been achieved in the majority of affected countries. Acceptance by the locust control establishment is also still problematic, which primarily has to do with the product's slow speed of kill. Lessons learned in the LUBILOSA programme and possible ways forward will be discussed.

BIORATIONAL INSECTICIDES USE IN INTEGRATED PEST MANAGEMENT. Charles Vincent, Horticultural Research and Development Center, Agriculture and Agri-Food Canada, 430 Gouin Blvd., Saint-Jean-sur-Richelieu, Qc, Canada J3B 3E6, Phone (450) 346-4494, ext 202; Fax (450) 346-7740; e-mail: vincentch@agr.gc.ca

In theory, Integrated Pest Management programs should blend an array of tactics to provide optimal damage control while being sustainable, ecologically sound and economically viable. In practice, pesticides are actually the leading management technologies on an economic basis. Alternatives to pesticides are strongly knowledge-based, as exemplified with the success of a program to manage the plum curculio, *Conotrachelus nenuphar* Herbst (Curculionidae). The development and implementation of biorational insecticides as alternatives will be discussed in the context of horticultural protection in Canada. Several examples will be discussed, notably the commercial development of a granulosis virus against the codling moth, *Cydia pomonella* L. (Tortricidae), and a Btk-based formulation against the oblique banded leafroller, *Choristoneura pomonella* Harris (Tortricidae). Research on kaolin, a white, non-abrasive aluminosilicate clay particle formulation, used pure or in mixtures with granulosis virus or Btk formulations will be discussed in the context of management of the oblique banded leafroller and the codling moth, and the blueberry maggot, *Rhagoletis pomonella* Walsh (Tephritidae). Other case histories will concern the development and use of botanicals in pre- (Canada) and post-harvest (Africa) situations.

MIRACLE ECONOMICS AND IPM: SUCCESS IN DEVELOPING COUNTRIES. Douglas Gollin, Department of Economics, Williams College, Fernald House, Williamstown, Massachusetts USA 01267, Phone: (203) 432-3608; Fax: (203) 432-3635; e-mail: dgollin@williams.edu

Agricultural research over the past forty years has succeeded in generating enormous benefits to consumers and producers around the world, although its contributions have often gone under-appreciated. Recent research demonstrates the large and persistent social and economic benefits that have resulted from improvements in agricultural technology. Indeed, some recent research suggests that improvements in agricultural technology play a role in generating economy-wide growth. Improved farm-level management of pests can represent an important ingredient of agricultural technology change. In areas where pest impacts are large and unpredictable, effective management of pests can remove an important constraint to farmers' investments in land and equipment, as well as to their use of fertilizers and other inputs. Past experience suggests that there are large potential payoffs to successful research on pest management.

HOW CAN SCIENTISTS AND SCIENTIFIC PROGRAMMES CONNECT WITH PUBLIC AND PRIVATE ENTERPRISES TO FURTHER THE CAUSE OF IPM. Lukas Brader, Herent, Belgium, Phone: 0032 16 228688; e-mail: brader.lukas @skynet.be

The IPM research and development activities over the last 20 years have clearly shown the heterogeneity of the agricultural production systems. Thus, no standard solutions can be offered to address the plant health needs of the individual farmers. Extension staff can offer a set of tools, but the farmers themselves must be able to decide on how these tools can be used most effectively. The traditional extension methods of offering standard solutions are not suitable anymore. Plant health research has increasingly moved in this direction, but the extension services have not. An exception is the Farmer Field School approach that has proven its effectiveness. The lack of appropriate extension approaches is further exacerbated by the registration requirements for plant protection products. IPM researchers have not facilitated the necessary transformation towards more effective farmer support systems. For example, the IPM definition keeps changing because of the evolving understanding of the key elements needed for producing a healthy crop. It is high time to define in broadly understandable terms what IPM is. The goal is to produce a healthy crop with minimum use of synthetic pesticides. On this basis closer collaboration has to be established with extension and regulatory agencies to finally arrive at a joint and appropriate approach. Changes have to take place in a system that is still dominated by strong interest groups with outdated ideas. A real lobbying exercise will have to be undertaken. The IPM research community has little capacity to do this well. It will need effective partners that require clear facts showing what can be gained by growing healthier crops.

ORAL PRESENTATIONS

I. SOCIOECONOMICS OF SUNN PEST

THE BASIC ROLE OF EXTENSION, FARMER GROUPING AND PARTICIPATION IN SUNN PEST MANAGEMENT. Gholam Abbas Abdollahi, Plant Pests & Disease Research Institute, P.O. Box 19395-1454, Tehran, Iran, Phone: (+98-21) 2401242; Fax: (+98-21) 2403691; e-mail: abbasmo2001@yahoo.com

Sunn Pest is the most important and economic pest of wheat and barley in the Near East as well as in the Eastern European countries. In Iran, due to climatic conditions, the farming systems, the increase of lands under wheat cultivation, the favorable hibernation sites and insufficient chemical control, populations of the pest have increased dramatically. During the last 50 years a centralized governmental system has been applied to control the pest through heavy applications of pesticides, mainly by aerial application. In the paper, results and achievements of new control systems and changes in the Sunn Pest management strategies in Iran are discussed. The definition of, and approaches to Sunn Pest management and wheat IPM is also discussed. The basic role of farmer participation and training through Farmer Field Schools, and also their role in pest management are highlighted. A practical model of a monitoring network, in which the government and farmers work together, and the role of farmers in the active implementation of Sunn Pest management in their fields are discussed.

ANALYSIS OF POLICIES ON INTEGRATED PEST MANAGEMENT ON SUNN PEST IN IRAN, SYRIA AND TURKEY. Aden Aw-Hassan[1], Ahmed Mazid[1], Aykut Gul[2], Majid Hasani Moghaddam[3] Hamoud Haj Hamoud[4] and Mustapha El-Bouhssini[1]. (1) ICARDA, P.O. Box 5466, Aleppo, Syria; Phone: (+963-21) 2213433; Fax: (+963-21) 2213490; e-mail: A.Aw-Hassan@cgiar.org; (2) University of Cukarova, Adana, Turkey; (3) PPDRI, P.O. Box 19395-1454, Tehran, Iran; (4) Department of Agricultural Economic, Faculty of Agriculture, Aleppo University, Syria.

Wheat is a crop with important economic and political (food security) values in Iran, Syria and Turkey. The three countries have total wheat areas of 6.5, 1.7 and 9.4 million ha, with a production of 12.9, 4.9 and, 19.0 million metric tons in 2003, respectively. Because of this, there have always been policies supporting wheat production through price support and input subsidies in all three countries. One particular insect that is important in all three countries is Sunn Pest. When it infests at the grain-filling stage, it renders the harvest worthless for baking at infestation levels as low as 5%. Annual losses of such infestation could reach millions of dollars with impact on food security and rural income. The infestation depends on environmental conditions and insect populations. All three governments take this insect pest seriously and consider it as a national "public" insect, for which

the state has to take charge of its control. This attitude is now changing and there are indications of policy shift from central state control of this insect to farmer management. The application by farmers of IPM through the combination of different measures including chemical, biological and mechanical control and the use of tolerant crop varieties are considered as more efficient and environmentally sound pest control practices. The success of farmers adoption of IPM, however, depends on changes in government polices. This paper analyses the policies towards wheat Sunn Pest control, compares the results of recent experiences in pilot cases and examines the implications of policy changes on Sunn Pest management.

SHIFTING FROM AERIAL TO GROUND SPRAYING IN SUNN PEST CONTROL IN THE TRACE REGION OF TURKEY: FARMERS' PERCEPTION AND PROBLEMS. Aykut Gul[1], Aden Aw-Hassan[2], Halil Kutuk[3], Ahmed Mazid[2], Majid Hasani Moghaddam[4], Hamoud Haj Hamoud[5] and Mustapha El Bouhssini[2]. (1) University of Cukurova, Adana, Turkey, Phone: (+90-322) 338 7056; e-mail: aykutgul@cukurova.edu.tr; (2) International Center For Agricultural Research in the Dry Areas (ICARDA), P.O. Box 5466, Aleppo, Syria; (3) Plant Protection Research Institute, Adana, Turkey, (4) PPDRI, P.O. Box 19395-1454, Tehran, Iran; (5) Faculty of Agriculture, Aleppo University, Syria.

Wheat is the major source of food for human beings and Sunn Pest is the major damaging insect of wheat. That is why governments of wheat producing countries in West and Central Asia, where Sunn Pest causes economic damage, take serious precautions to control the insect and have high quality grain yield. Cereals are grown in approximately 14 million ha in Turkey and 45 % of the cereal growing areas are under the threat of Sunn Pest. If no control methods are conducted against Sunn Pest, it could cause damage up to 100% on wheat quality. The Turkish government has conducted Sunn Pest management, mainly based on chemical control since 1927. Neither farmers nor technical consultants have been satisfied with the Sunn Pest management programme conducted by the government. The Turkish government has been changing its Sunn Pest control policy by shifting aerial spraying to ground spraying. The Trace Region, as a major cereal growing area, has an important contribution in increasing the share of ground sprayed area. In 2002 and 2003 no aerial spraying was applied in the Trace Region. The purpose of this study was to investigate the impact of this policy change in the region in terms of wheat production and grain quality and farmers' perception. To achieve this goal a survey with farmers was done and results were evaluated and are presented.

POSITIVE EFFECTS OF COMMODITY EXCHANGE IN SUNN PEST CONTROL IN TURKEY IN RECENT YEARS. Aykut Gul[1], Aden Aw-Hassan[2], Hilal Isik[1], Ramazan Canhilal[3], Ali Duran Kanat[4], Ahmed Mazid[2] and Mustapha El-Bouhssini[2]. (1) University of Cukurova, Adana, Turkey, Phone: (+90-322) 338 7056; e-mail: aykutgul@cukurova.edu.tr; (2) International Center For Agricultural Research in the Dry Areas (ICARDA), P.O. Box 5466, Aleppo, Syria; (3) General Directorate of Plant Protection, Ankara, Turkey; (4) Plant Protection Research Institute, Adana, Turkey.

Wheat is a very strategic and basic food for Turkey and Sunn Pest is the major damaging insect. Sunn Pest management has been conducted mainly based on chemical control in Turkey since 1927. In recent years there have been changes in the control policy of Sunn Pest by shifting aerial spraying to ground spraying. In 2003, the Central Anatolia and Trace Regions were excluded from aerial spraying and only spraying with ground equipments was applied. Konya and Edirne Commodity Exchanges are the two major Commodity Exchanges in Turkey in terms of wheat marketing. A study was conducted to determine the effect of Sunn Pest damage on the wheat market and also to understand the positive effect of commodity exchanges on Sunn Pest management by farmers. In this context a survey was carried out with merchants in Konya Commodity Exchange, and it was also investigated how these two commodity exchanges operated.

THE ROLE OF SOCIO-ECONOMIC CHARACTERISTICS IN THE HOLDING OF FARMER FIELD SCHOOL AND ACCEPTANCE OF PARTICIPATION IN IPM OF SUNN PEST. Majid Hassani Moghaddam[1], A.R. Haghshenas[2], F.Karkoodi[3]. (1) PPDRI, P.O. Box 19395-1454, Tehran, Iran; Phone: (+98-21) 2413406; Fax: (+98-21) 2403691; e-mail: hasanimoghaddam@yahoo.com; (2) Center of Agricultural and Natural resources Research in Esfahan Province, Iran; (3) Plant Protection Organization in Kermanshah Province, Iran.

One of the most important principles of IPM is the change of the pest control concept to that of the pest management. In this method socio economic and technical factors are not separable in the management framework and the farmer as the farm manager plays a special role. Without paying attention to his abilities, needs and opinions, even other possibilities being available development would not proceed and acceptance terminated. Farmer Field School (FFS) is a new method of interaction among researchers, extension specialists and farmers, with an axial role of the latter, leading to farmer awareness and consequently acceptance of IPM as the new method of pest management that guarantees the availability of useful techniques based on sound principles of ecology and economy. In the present study we attempt to determine the effects of quantitative and qualitative factors on participation in FFS and acceptance of participation in Sunn Pest IPM using a logit probability model based on information collected from 64 farmers. In this model the dependent variable is the acceptance of participation in IPM via participation in FFS

and the independent variables are education, total planted areas, number of plots, confidence in the facilitator, familiarity with different life stages of Sunn Pest and the connection of the farmer with research and extention centers were significant at the 5 and 10% levels. Other variables such as family size, form of ownership, age and non-farm revenue were not significant, furthermore the elasticity of participation under the effect of the change in any independent variable has been calculated. Finally, upon descriptive examination of important variables and comparison of the means in the FFS, non-FFS and control villages have been analyzed.

A SOCIO-ECONOMIC STUDY OF INTEGRATED PEST MANAGEMENT OF SUNN PEST ON WHEAT IN SYRIA. Hamoud Haj Hamoud[1], Nour Eddin Mona[1], Aden Aw Hassan[2] and Ahmed Mazid[2]. (1) Department of Agricultural Economic, Faculty of Agriculture, Aleppo University, Syria; Phone: (+963-21) 456220; e-mail: hamoud-h@scs-net.org; (2) ICARDA, P.O. Box 5466, Aleppo, Syria.

This study analyzes the production constrains and the economic, social, and environmental effects of chemical control of Sunn Pest on wheat in Syria. The study analyzes the economic feasibility and farmers' acceptance of integrated pest management for Sunn Pest. The analysis is based on survey data collected from the main provinces infested by the insect, mainly Idleb and Aleppo provinces. Farmers reported the main pests to be Sunn Pest, field mice, diseases and bacteria, each causing significant damage. The cost per hectare of chemical spraying is 500 S.L. Farmers knowledge of Sunn Pest was analyzed. Farmers recognize adult Sunn Pest very well, while 80% do not know the lifecycle and have no clear idea of the levels of damage caused by the insect. The main information sources are neighbors, relatives and friends, which shows strong information transfer between farmers themselves. This apparently lends relevance and effectiveness to the farmer field school as a method to transfer agricultural techniques to participant farmers. About 67% of the surveyed farmers were not satisfied with the Ministry of Agriculture's practice of spraying, mainly because of late spraying, lack of spraying, and ineffectiveness of pesticides.

THE LOSS ASSESSMENT AND ECONOMIC LEVELS FOR SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, THROUGH COST- BENEFIT METHOD IN QAZVIN PROVINCE OF IRAN. Hossein Noori, Qazvin Agricultural and Natural Research Center, P.O. Box 34185-618, Sahid Beheshti Ave. No.118 Qazvin, I.R.Iran, Phone: +98-281-3348490; Fax:+98-281-3337840; e-mail: drhn55@yahoo.com

The Sunn Pest, *Eurygaster integriceps* Puton, is considered the most destructive and damaging pest of wheat throughout the country. Sunn Pest causes a great reduction in yield and quality of the wheat. Therefore, management of this pest

is perceived to be the most important plant protection programme of the government and private sector. Recently, great effort has been initiated to develop a comprehensive IPM strategy for the pest. The quantitative damage of the overwintered Sunn Pest was studied in 1998 and 1999. A factorial experiment was used with two factors based on a randomized complete block design (RCBD) with five replications. In each plot, the yield loss was estimated using the following equations (Reza-Beigi, 2000): I_t $(I_S+I_h)/N_S$ and $D_s=I_t \times Y_s$. Using the data acquired, the economic injury level and economic threshold of the pest were estimated using formula proposed by Pedigo (1989): EIL= GT/b ET= EIL × 0.75. The economic thresholds of adult Sunn Pest in aerial and ground chemical control for cv. "Zarrin" were 8.7 and 11.1 adults per square meter, respectively and for cv. "Alvand", the EILs were 10.57 and 13.5 adults per square meter for aerial and ground chemical control, respectively.

DETERMINATION AND COMPARISON OF ALLOCATIVE, TECHNICAL AND ECONOMIC EFFICIENCY IN OUTSIDE AND INSIDE OF INTEGRATED SUNN PEST MANAGEMENT PILOT SITES IN IRAN. Majid Hassani Moghaddam and G.A. Abdollahi, PPDRI, P.O. Box 19395-1454, Tehran, Iran; Phone: (+98-21) 2413406; Fax: (+98-21) 2403691; e-mail: hasanimoghaddam@yahoo.com

The concepts of efficiency, measurement and comparison are very important. The main aim of this research is to study the effect of whole policies applied in pilot sites on their degree of efficiency and also recognition of the farmers' ability and potential in the pilot site and in two side pilot sites. In this study Technical, Allocative and Economic efficiency of farmers outside and inside pilot sites were estimated for their production function with the use of the ordinary least squares (OLS) method and the frontier production probability estimated with the use of the maximum likelihood method (M.L.E) with front.4, software. The necessary information was collected by a two-stage sampling method. The results of the efficiency of fertilizer, pesticide, seed and machinery work inputs were calculated and compared on an average basis. In the base, Allocative, Technical and Economic efficiency were 0.824, 0.763, and 0.629 respectively for inside the pilot site and 0.751, 0.691 and 0.52 respectively for outside of the pilot site. This shows in inside the pilot site the gap between farmers' efficiency was limited because they carried out positive activities within the sites. The results of this study show that the effective factors on non-efficiency on the number of plots has negative effects, and education, the level of planted areas, observance of crop rotation and familiarity to different life stages of the Sunn Pest inside pilot sites have positive effects on the technical efficiency. Finally due to the desirable conditions inside pilot sites versus outside pilot sites the range of Technical efficiency (distance between most skilled and non-skilled) in outside area was high showing that due to the extension of

management characteristics, especially in case of Sunn Pest from efficient fields to other fields can reduce the damage caused by this insect.

EVALUATING SUNN PEST MANAGEMENT IN TURKEY IN TERMS OF FOOD SECURITY, HUMAN HEALTH, ENVIRONMENTAL CONSERVATION AND ECONOMIC RETURNS. Hasan Akca, Murat Sayili, Aydin Basarir, (1) Gaziosmanpasa University, Faculty of Agriculture, Department of Agricultural Economics, 60240, Tokat, Turkey, Phone: (+90 356) 2521616; Fax: (+90 356) 2521488; e-mail: akcahasan@yahoo.com

Turkey occupies a total area of 78 million hectares and has 28 million hectares of cultivated area. The total amount of arable land suitable for wheat production is more than 4 million hectares. Wheat constitutes about two-thirds of the cereal value. Turkey is one of the largest wheat producing and consuming countries in the world. The majority of farms are engaged in wheat production. Also wheat is the staple food item for Turkish consumers at 220 kg/year per person. It is a fact that quality is an important factor in trading wheat in domestic and international markets. The Sunn Pest, *Eurygaster integriceps* Puton, is a very damaging insect pest of wheat and barley in Turkey. Sunn Pest has direct effects on wheat production and indirect effects on baking quality of dough. Sunn Pest affects the majority of the wheat-cultivated land in 35 provinces of Turkey. Therefore, the Turkish government has spent large sums of money for the management of Sunn Pest. In recent years, multi-dimensional integrated pest management approach has started gaining importance instead of the use of chemical insecticides in the control of Sunn Pest. The study has four sections. First section gives information about the importance of wheat production, and policies related to agricultural production, food security and the environment followed by the government. The second section discusses different Sunn Pest control approaches. The third section explains the economic benefits of Sunn Pest management for wheat producers and the Turkish economy using an empirical model.

MODIFIED FARMERS' FIELD SCHOOLS AS A NEW OPTION IN IPM OF SUNN PEST *EURYGASTER ITEGRICEPS* PUTON (HEMIPTERA; SCUTELLERIDAE). Mohammed Abdulhai[1] and Joumaa Ebrahim[2]. (1) General Commission for Scientific Agricultural Research (GCSAR), Aleppo Centre, Aleppo, Syria; Phone: (+963-21) 4647200; Fax: (+963-21) 4644600; e-mail: mah70@scs-net.org; Mohamad_abdulhai@yahoo.com; (2) Faculty of Agriculture, Aleppo University, Aleppo, Syria

Modified Farmers' Field Schools (MFFS) were applied in Syria in 2003-2004 by the Sunn Pest IPM Project as a new model of extension of Integrated Pest Management (IPM) options by the Ministry of Agriculture, Aleppo University, researchers, and farmers. The MFFS approach was used as an extension methodology in two provinces in Syria; Aleppo and Idlib. One village in each

province was chosen. MFFS were established in Azaz area for rainfed wheat, and in Bennish for irrigated wheat. The MFFS activities included meetings at an extension building in Binnish and at the home of a local leader in Azaz and in the field throughout the whole growing season with a group of 25 – 30 farmers. Farmers learned technical IPM options for pest control and improved cultural practices at the field level. The MFFS approach include integrations between farmers/ extensionists/ researchers by training extensionists from three provinces to improve their interaction with farmers, followed by training of farmers using a participatory approach, informing scientists about the farmers' problems, using the field as a meeting place where farmers interacted with researchers and extensionists, and increasing the awareness of farmers to environmental knowledge, food security and natural enemy issues.

II. SUNN PEST BIOLOGY AND ECOLOGY

SUNN PEST POPULATION DISTRIBUTION IN OVERWINTERING SITES IN IRAN. Bruce L. Parker[1], Masood Amir-Maafi[2], Margaret Skinner[1], Mustapha El-Bouhssini[3], and Scott D. Costa[1] (1) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont 05405-0105, USA, Phone: 802-656-5440, Fax: 802-658-7710, e-mail: bparker@zoo.uvm.edu; (2) Sunn Pest Research Department, Plant Pests & Diseases Research Institute, 719/33715, Varamin, Iran; (3) ICARDA, P.O. Box 5466, Aleppo, Syria.

Historically identified Sunn Pest overwintering sites in Iran were studied to determine patterns of population distribution. The study was conducted on two scales, initially a small design and later an expanded one. At each location an arbitrary Sunn Pest population center was selected and then concentric circles at fixed distances from this center delineated. In the small area design, ten bushes were randomly chosen along each circle and the number of live Sunn Pest beneath either *Astragalus* sp. or *Artemesia* sp. counted. Circles were 5 m apart to a distance of 30 m from the population center. To evaluate distribution over a larger area, an arbitrary population center was selected and sampling lines from it were established at each of the four cardinal directions to a distance of 5 km. Sampling sites were chosen at 500 m intervals along each of the sampling lines. At each sampling location, 5 bushes were randomly selected and Sunn Pest populations beneath each bush counted over time. Sunn Pest populations in these overwintering sites were not uniformly distributed. They increased in numbers under bushes with elevation. There was a pronounced increase in numbers of Sunn Pest from south to north followed by a decline as elevation decreased. Data indicated that a foci of Sunn Pest population density is present in the overwintering sites in Esfahan and Varamin. Implications for management are drawn.

DAMAGE LOSS ASSESSMENT OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON (HEMIPTERA; SCUTELLERIDAE) ON WHEAT IN TURKEY. Ramazan Canhilal, Halil Kutuk, Mahmut Islamoglu and A. Duran Kanat, Adana Plant Protection Research Institute, P.K: 21 01321, Turkey, Phone: (+90-322) 3219581; Fax: (+90-322) 322 48 20; e-mail: h_kutuk@hotmail.com

Studies were conducted in cages to determine the damage of adults and nymphs of Sunn Pest to wheat in two different locations in 2002 and 2003. The released adult densities in the cages were 1, 2, 3, 5 and 10 adults per m^2. The released nymph densities were 5, 10, 15 and 20 nymphs per m^2. Spike damage caused by adults depended upon the number of Sunn Pest released into cages and ranged from 0.072 - 0.878% in 2002 and from 0.000 - 0.256% in 2003. The total grain yield ranged from 956.00 - 1150.00g and 308.75 – 1165.00g per $2m^2$ in 2002 and 2003, respectively. While differences between the spike damage rates were

statistically significant in 2002, it was not in 2003. In both years there was no difference between the total yield harvested from cages. Kernel damage caused by nymph feeding was dependent on the number of nymphs released into cages and varied from 0.287 to 0.625 % in 2003.

INVESTIGATION OF MECHANISMS OF MATE-FINDING IN SUNN PEST.

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Sunn Pest, *Eurygaster integriceps*, is a serious pest of wheat in West Asia. At the beginning of the season adults move from overwintering sites into fields where they mate and lay eggs. Feeding by the next generation of nymphs and adults then causes extensive yield loss and reduction in baking quality of the wheat due to enzymes in the saliva of the pest. It would thus seem likely that the overwintered bugs have efficient mechanisms for locating the opposite sex, possibly involving semiochemicals and/or vibratory signals. Various chemicals have been reported previously by other authors as potential pheromones, but no biological activity has been demonstrated for these. We have re-investigated mate-finding behaviour of Sunn Pest. We have confirmed that mature males produce large amounts of a homobisabolene with bisabolene and vanillin as minor components, and shown that production of these chemicals seems to be associated with mate-finding. Both males and females produce a blend of "defensive" chemicals when disturbed. Extensive bioassays of behaviour towards live insects, naturally-produced chemicals or synthetic chemicals have been carried out using a windtunnel or a linear-track olfactometer. Some weak attraction of females to collections of the male-produced volatiles has been demonstrated, and weak repulsion by the "defensive" chemical blend. Male Sunn Pest vibrate their abdomens and the signal is transmitted through their legs to the plant stem. These signals have been recorded and characterised. Approaching males produce an agonistic signal and approaching females produce another characteristic "song". Attraction of males to signals from either male or female insects has been found, and, in some experiments attraction of females to signals from males or recording of the male song was found. However, as with the responses to semiochemicals, these responses are weak and difficult to replicate. The results will be discussed in relation to results with related bugs.

MITOCHONDRIAL DNA VARIATIONS IN IRANIAN GEOGRAPHIC POPULATIONS OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON

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Levels of intraspecific variation within a 4-kb region of mitochondrial DNA (mtDNA), was investigated in 198 individuals of Sunn Pest populations from 6 distant geographic sites (>200 km apart). Digestion with Alu I, Dde I, and Mbo I endonucleases yielded 26 haplotypes in combination. All populations contained individuals with ancestral and novel mtDNA haplotypes. The haplotypic diversity ranged from 0.49 to 0.82 among the populations with an average of 0.68 for all populations. The digestion detected a widely distributed composite haplotype, AAC, with a frequency of 16-69% among the populations. Populations from Lorestan, Moghan, and Isfahan provinces had the least frequency of the ancestral mtDNA haplotype. An analysis of molecular variance (AMOVA) in six populations showed that the among population variance component was 27.74%, with 72.26% of the variation attributable to the within population variability. The study revealed significant mtDNA heterogeneity among the six populations, possibility of ancestral haplotype, and lack of correlation between genetic and geographic parameters. The results are discussed in the light of the literature concerning the population biology of the other insect pests.

MORPHOMETRIC STUDIES ON IRANIAN GEOGRAPHIC POPULATIONS OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON

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Analysis of morphological variation within and among populations and correlation between morphological and geographic distances of the Sunn Pest, *Eurygaster integriceps* Puton, a key pest on wheat and barley in Iran, were studied using morphometrics. A canonical variate analysis on 14 variables measured in 3558 adult Sunn Pest, collected from 16 different localities, separated the populations to seven distinct clusters. Thoracic variables were the best discriminators. Little morphological heterogeneity was observed within each population based on principal component analysis of the same variables

THE ROLE OF BIOCONTROL AGENTS IN DECREASING THE POPULATION OF SUNN INSECT *EURYGASTER INTEGRICEPS* PUTON IN WHEAT FIELDS IN THE NORTH OF IRAQ. Mohammed A. J. Al-Izzi[1], Abdul-Bassit M. Amin[2] and Hassan S. Al-Assadi[2]. (1) Entomology Department, IAEC, Ministry of Science and Technology, Iraq (Present address: AOAD, P.O. Box 474-1111, Khartoum, Sudan, Phone: 249912131692; Fax: 249-183-471402; e-mail: mohamedalizzi@hotmail.com; mohamedalizzi@yahoo.com; aoad@sudanmail.net); (2) College of Education, Ibn-Al-Haithum, University of Baghdad, Iraq.

The infection of Sunn Pest population, *Eurygaster integriceps* Puton by the fungus *Beauveria bassiana*, egg parasites *Trissolcus spp.* and *Ooencyrtus* sp., adult parasite *Phasia* sp and predators were recorded in the top, mid and foot-hill of the mountains in Erbile city. Fungus infection in the top of Safin mountain was recorded in July, August, September, October, November, December of 1999, it was 58.78%, 44.19%, 20.82%, 38.96%, 14.89% and 40.48%, respectively. During January, February and March of 2000, the ratios of infection were 32.26%, 31.58% and 2.16%, respectively. However, on the mid of mountain were 52.94%, 17.86% and 2.5%, respectively and on the foot- hill they were 49.15%, 16.33% and 13.04%, respectively. The infections of Sunn Pest eggs by the parasites *Trissolcus spp.* and *Ooencyrtus sp.* were recorded in the mountains of Koshtapa, Ashkawsaka, Koysinjak during April and Smak-shereen and Erbil during May. The ratio of infections was 100%, 76.92%, 85.71%, 100% and 100%, respectively. Sunn Pest adults killed by the parasite *Phasia sp.* were recorded in Safin mountain. The dead adults per 10 m^2 were observed during July, August, September, October, November and December of 1999. The percentage was 8, 21, 67, 43, 2 and 6. However, the percentage decreased to 1 in March of 2000. Number of predators (*Calosoma, Carabid, Coccinella septempunctata,* spiders, and birds were observed feeding on different developmental stages of Sunn Pest.

ENTOMOPHILOUS AND ENTOMOPATHOGENIC FUNGI ASSOCIATED WITH SUNN PEST IN OVERWINTERING SITES. W. Reid[1], M. El-Bouhssini[1], S. Gouli[2], V.V. Gouli[2], B.L. Parker[2] and M. Skinner[2]. (1) ICARDA, P.O. Box 5466, Aleppo, Syria, Phone: (+963-21) 2213433; Fax: (+963-21) 2213490; e-mail: b.reid@cgiar.org; (2) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont , USA 05405-0105.

Fungal genera associated with Sunn Pest and other insects collected in overwintering sites from 1998 to 2002 were identified. Sites were located in Syria, Iran, Turkey, Kyrgyz Republic, Kazakhstan, Uzbekistan and Russia. Twenty fungal genera were found associated with Sunn Pest. The most common entomophilic fungi were *Alternaria*, *Mucor* and *Scopulariopsis*; the most common entomopathogenic were *Beauveria* and *Paecilomyces*. In Iran, sufficient numbers of Sunn Pest were available in each site to measure interactions between the fungal genera. A significant negative linear trend of *Trichoderma* spp. associated with *Eurygaster*

integriceps cadavers was detected. No association between increased *Beauveria* and the level of *Trichoderma* was detected among other cadavers recovered, suggesting that *Beauveria* spp. isolated from the overwintering sites may possess an adaptation that allows them to be competitive with the mycoflora in the overwintering sites. This factor is important in the persistence of the fungus. Levels of the second most commonly isolated pathogen *Paecilomyces farinosus* were consistent throughout the sites and were not found to be associated with other fungal genera.

SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, STATUS IN IRAQ. Nazar N. Hama, Zuhair A. Stephan, Mohammed A. Ali and Muzhir L. Aboud, State Board for Agric. Res. (SBAR) Ministry of Agric. Abu- Ghrabe, Baghdad, Iraq. E-mail: nazar_sbar@hotmail.com; zuhairstephan@yahoo.com

Since 1989 Sunn Pest, *E. integriceps*, has been considered as an economic pest on wheat and barely grown in rainfed regions in the northern governorates. During the nineties of the past century a number of new wheat varieties (Mexiback, Abu-Ghrab, IPA90, 95 & Al-Guaid) were introduced to a large area in the central and southern governorates as a part of a national plan to reach food self-sufficiency. Consequently, the pest infestation map had changed dramatically by Sunn Pest invading most wheat and barely grown on irrigated areas in most central and middle Euphrates and southern governorates, but in different densities. Thousands of donums of wheat were sprayed 2-3x / season in Dywania and Najef governorates between 2002-2004 due to the severity of the infestation. Field observations and research data confirmed the hibernation of Sunn Pest under date palm leaf bases, blade weeds and rice hay during the winter and early spring. This paper will discuss relevant postulates as an attempt to explain this new situation.

THE IMPACT OF SUNN PEST DENSITY IN WHEAT FIELDS ON GRAIN AND FLOUR QUALITY. Fouad Jaby El-Haramein[1], Mustapha El-Bouhssini[1], Masood Amir Mafi[2], Ramazan Canhilal[3] and Halil Kutuk[3]. (1) ICARDA, P.O. Box 5466, Aleppo, Syria, Phone: (963-21) 2213433; Fax: (963-21) 2213490, e-mail: f.el-haramein@cgiar.org; (2) P.O. Box 719-3375, Varamin, Iran; (3) PPRI, P.K. 21 01321, Adana, Turkey.

Wheat grain and flour quality deterioration caused by Sunn Pest (*Eurygaster integriceps* Puton) is a major concern for wheat growers and processors. A total of 44 natural infested wheat fields selected in Iran and Turkey were sampled during wheat head development. Sunn Pest density ranged from 1.0 to 57.1 nymph/m^2 which gave 0.3-49% damaged kernels. Wheat samples were collected from the observed fields for grain and flour quality testing. In Iran and Turkey, wheat fields with density less than 7 and 10 nymph/m^2, respectively, had no significant damage on flour gluten strength as measured by sedimentation and farinograph tests. The results need to be taken into consideration in determining the economic threshold for Sunn Pest control.

HOST PLANT-ASSOCIATED VARIATION AND SEXUAL DIMORPHISM IN SIZE AND SHAPE IN IRANIAN GEOGRAPHIC POPULATIONS OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON Alimorad Sarafrazi[1], Hugh D. Loxdale[2], Janet Hemingway[3], G. Abdollahi[1] and Darren A. Murrray[2]. (1) Plant Pests & Disease Research Institute, P.O. Box 19395-1454, Tehran, Iran, Phone: (+98-21) 2403022; Fax: (+98-21) 2403691; email: sarafrazi@ppdri.ac.ir; (2) IACR – Rothamsted, Harpenden, Hertfordshire, AL5 2JQ, UK; (3) Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK

The Sunn Pest, whose diet consists mostly of Graminae, shows different patterns of size variation on its host plants. Sexual dimorphism and morphological variation between Sunn Pest populations on wheat and barley and the variables that contribute to discrimination between populations from two of its main alternative hosts were investigated using canonical variate analyses (CVA). There was a high degree of congruence in the majority of morphometric analyses carried out on most of the morphological structures in host-plant associated population variation tests. Shape analyses revealed overlap between populations from the two host plants, suggesting that most of observed variation might be host plant induced. The analyses demonstrated different patterns of sexual dimorphism between pest populations from wheat and barley. Sexual dimorphism within populations from wheat was significant while males and females from barley did not show any significant difference in both shape and size tests. Trans-plant experiments are required to confirm the observed variation.

A NEW TECHNIQUE FOR MONITORING OF THE SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON (HEMIPTERA: SCUTELLERIDAE). Heidar Adldoost, Agricultural Research Center of West Azarbaijan, Iran, Phone: (0098-441) 2776313; Fax: (0098-441) 2771253; e-mail: Adldoost@yahoo.com

The Sunn Pest, *Eurygaster integriceps* Puton, is the most significant pest of wheat in Iran. The primary method for its control is chemical spraying conducted on all fields where Sunn Pest densities exceed the economic threshold. Chemical treatments against overwintering adults should be carried out during the recommended period, not lasting to oviposition onset across the entire treatment area. This will stop Sunn Pest damage while protecting oophagous parasitoids. Accurate monitoring is the basis for effective biological control. It governs the timing of parasitoid releases and thereby increases their efficacy. Some techniques have already been tested on cereals, other techniques could be tested. The eggs of Sunn Pest are laid on weed plants. Some weed plants maintain good protection for eggs or early immature stage from direct sunlight. During 1999 – 2001 the oviposition of the insect was investigated on weeds of wheat fields in 28 fields of West Azarbaijan. Ten samples including wheat and weeds were collected from each field using a one-m^2 sampling frame, then transported to the laboratory in plastic

bags. The results showed that the maximum egg number was 30 and the mean was 4.96 batches per m^2 of wheat field. The number of eggs on the weed plant, *Conringia orientalis* (L) Dumort was as high as 73% of the total per m^2. *C. orientalis* is a shiny, smooth and slightly succulent plant. Its presence in an area is considered to be an indicator of loamy soils and mainly is associated with wheat and distinct between grasses.

INVESTIGATION ON DAMAGE OF OVERWINTERED SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON) AND THEIR NYMPHS IN RAINFED WHEAT FIELDS OF KERMANSHAH PROVINCE, IRAN. Farshid Karkoodi, Keshavarz street, Agricultural Jahad Organization of Kermanshah, Kermanshah, Iran, Phone: (+98-831) 8363208; Fax: (+98-831) 8358150; e-mail: farshid32@lycos.com

Sunn Pest, *Eurygaster integriceps* Puton, is the most important insect pest on wheat and barley in Kermanshah province. Studies were carried out in Talandasht during 1996 and 1997 to measure Sunn Pest damage. For evaluating injury and damage of overwintered adults and nymphs of Sunn Pest, 4 rainfed wheat fields were selected. All selected fields were divided into three parts: (1) for damage by overwintered Sunn Pest, (2) for damage by overwintered adults and nymphs, and (3) as a control that was sprayed by insecticide. The density of adults and nymphs, the number of damaged leaves, shoot and spikes, the percentage of damaged kernels and finally the yield of fields were measured. The number of overwintered adults was 1.9 per m^2 and the number of damaged leaves shoots and spikes were 15.2, 16 and 6.75 respectively in infested fields. The density of nymphs was 4.5 per m^2 and average percentage of damaged kernels was 4.5%. As a result the rate of crop loss by one overwintered adult was 121.66 kg/ha. The rate of damaged kernels was 1% by one nymph per m^2. The calculated data were used for analyzing economic injury level (EIL) of this pest.

BIOLOGICAL PARAMETERS OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, IN WHEAT FIELDS IN THE NORTH OF IRAQ. Abdul-Bassit M. Amin[1], Hassan S. Al-Assadi[1] and Mohammed A.J. Al-Izzi[2]. (1) College of Education, Ibn-Al-Haithum, University of Baghdad, Iraq; (2) Entomology Department, IAEC, Ministry of Science and Technology, Iraq (Present address: AOAD, P.O. Box 474-1111, Khartoum, Sudan, Phone: 249912131692; Fax: 249-183-471402; e-mail: mohamedalizzi@hotmail.com; mohamedalizzi@yahoo.com; aoad@sudanmail.net

The appearance of Sunn Pest, *Eurygaster integriceps,* was studied in wheat and barley fields in the north of Iraq within the Erbil district. Field cages were used for biological studies of Sunn Pest in wheat and barely fields; twenty cages (100 X 100 X 100 cm and 30 X 30 X 60 cm) were used either to cover the wheat plants, or contain pots planted with wheat plants. One pair of Sunn Pest adults (male and

female) were left inside each cage for oviposition, and newly emerged nymphs complete their growth and development inside the cages. Incubation period, nymph development and adult life span were measured. Pre-oviposition period ranged from 9-11 days and the oviposition period was 33.5 days. Meanwhile the post-oviposition period ranged from 1-5 days. Longevity of the hibernated offspring of both adult males and females were 53 and 48 days, respectively. Females lay their eggs in form of 5-16 batches; each disc contains 8-14 eggs and the whole number of eggs for each female was between 68-183 eggs. The incubation period ranged from 6 to 14 days with an average 84% egg hatching. The longevity of first, second, third, fourth and fifth nymphs were 3.42, 5.32, 4.4, 5.5 and 8.41 days, respectively. The percentage existence of male and female differs according to the seasons, the sex ratio ranged from 1 to 9 females per 1 male.

POPULATION DENSITY OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, DURING HIBERNATION AND AESTIVATION IN THE NORTH OF IRAQ. Hassan S. Al-Assadi[1], Abdul-Bassit M. Amin[1] and Mohammed A.J. Al-Izzi[2]. (1) College of Education, Ibn-Al-Haithum, University of Baghdad, Iraq; (2) Entomology Department, IAEC, Ministry of Science and Technology, Iraq (Present address: AOAD, P.O. Box 474-1111, Khartoum, Sudan, Phone: 249912131692; Fax: 249-183-471402; e-mail: mohamedalizzi@hotmail.com; mohamedalizzi@yahoo.com; aoad@sudanmail.net)

The seasonal appearance of Sunn Pest was studied in the North of Iraq. It was found that the hibernated insects begin their activity in the first half of March within the years 1998, 1999 and 2000, while the newly emerged adults appeared in the second half of April and the first week of June. The population density of hibernated adults ranged between 0.58-11.83 adults / $10m^2$ throughout the three years. Females laid eggs during April and the number of egg masses in the fields ranged from 1-39, 1- 10 and 1-11 during 1998, 1999 and 2000 respectively. Nymph population density ranged from 3.08 to 119.26 nymphs / 10 m^2 during the three years while the newly emerged adults was 1.33-99.41 adults / 10 m^2 The population density of adults in the mountains; Hassan Beg, Hindrin, Kalander, Shereen, Baradost, Zozic, Korec, Kearan and Safin was 916, 100, 1458, 720, 943, 25, 1095, 766, and 295 adults/$10m^2$, respectively. These numbers were different than those recorded in 2000, in which Hassan Beg, Shereen, Bradost, Korec, Pearan and Safin was: 76, 146, 308, 373, 692 and 117 adults/10 m^2. During hibernation and aestivation, the Sunn Pest goes to their host plants, which are *Prunus argentia* (Lam.) Rehd. *Astragalus russelii, Thymbra vulgaris* (Thyme), *Euphorbia peplus, Quercus infectoria, Quercus aegiliops, Pistacia atlantica, Crxpis paraoiflora, Platanus orientalis* L. *Teucrium chamaevrys* L. Subsp, *Sinuatum* (Celak.) Rech, *Telephium oligospermum* Boiss, *Nepeta* sp., *Silene ampulata* Boiss, *S. stenobotrys* Boiss and Onosma *albo-roseum* Fisch. et Mey. The movement of the insects within the different regions of the mountain was observed during the first half of October

and the highest population density in the top of the mountain was 97.75 adults/10m^2 in November 1999 and 15.33 adults/10m^2 in March 2000 and in mid of the mountain was 20.75 in October 1999 and 13.33 in March 2000, while in the foot-hills, it was 11.75 in October 1999 and 25.3 in March during 2000.

SURVEY OF EGG PARASITOIDS OF SUNN PEST IN NORTHERN SYRIA. A. N. Trissi[1], M. El-Bouhssini[2], J. Ibrahem[1], M. Abdulhai[3] and W. Reid[2]. (1) Department of Plant Protection, Faculty of Agriculture, Aleppo University, Aleppo, Syria Phone: (093) 484300; Fax: (+963-21) 2213490; E-mail: n-trissi@scs-net.org; (2) International Center for Agricultural Research in the Dry Areas (ICARDA), P.O. Box 5466, Aleppo, Syria, e-mail: M.Bohssini@cgiar.org; (3) General Commission for Scientific Agricultural Research, Aleppo, Syria.

Surveys of Sunn Pest eggs and egg parasitoids were made in three northern provinces of Syria, Idleb, Aleppo and Al Hassakeh in the 2003 field season. Egg laying occurred from 7 April until 30 May, with parasitized eggs present within the first week of egg observance and continuing throughout the season. Parasitoids were recovered from all provinces and sites, with the exception of one site that had been aerially treated with Decis for Sunn Pest management. Species abundance was significantly correlated (r=0.90) with total percent parasitism. In total, five species were recovered, *Trissolcus grandis, T. semistriatus, T. vassilevi, T. festivae and Ooencyrtus fecundus*. This is the first record of *T. semistriatus*, and *T. festivae* in Syria. The most abundant species were *T. semistriatus* which occurred in all provinces and 62% of all sites, and *T. vasselivi* which occurred in Aleppo and Al Hassakeh provinces and 37% of all sites. *O. fecundus* was recovered only from Idleb, *T. festivae* from Idleb and Aleppo provinces and *T. grandis* from Aleppo and Al Hassakeh provinces. All species of *Trissolcus* were recovered throughout the season with the exception of *T. grandis*, which was first observed 8 May, four weeks post first egg observation. Overall parasitism rates reached 58% at the end of the season. Rates within the first month of egg observance ranged from 10 to 25% where *T. vasselivi* was present, and 6 to 20% in areas with *T. semistriatus*.

SURVEY OF SUNN PEST ADULT PARASITOIDS IN SYRIA. Mohammed Abdulhai[1], Ramazan Canhilal[2], Mustapha El-Bouhssini[2], W. Reid[2] and Fawzi Rihawi[2]. (1) General Commission for Scientific Agricultural Research (GCSAR), Aleppo, Syria; Phone: (+963-21) 4647200; Fax: (+963-21) 4644600; e-mail: mah70@scs-net.org; Mohamad_abdulhai@yahoo.com; (2) International Center for Agricultural Research in the Dry Areas, P.O. Box 5466, Aleppo, Syria.

A survey of adult parasitoids of Sunn Pest, *Eurygaster integriceps* Puton, was conducted in Syria in 2003 and 2004. Five species of Phasiine flies were found: *Phasia subcoleoptrata* L., *Heliozeta helluo* F., *Ectophasia crassipennis* F., *Heliozeta lateralis* and *Elomyia lateralis* Meigen. In 2003, parasitism rates in all of the sampled overwintering sites were negligible. In-wheat-field rates in the early spring

were 1.3% in Hamaa, 2.7% in Swedaa and not detected in the other areas. Towards the end of the spring, the percent in-wheat-field parasitism rates increased dramatically and were 6.47, 4.0, 5.85 and 13.25% in Azaz, Idlib, Al Kamishly and Al Swidaa respectively. In 2004, the levels of parasitism in the overwintering sites were again negligible, except in Azaz (1% parasitism). In-wheat-field rates in the early spring reached 1.9% in Al Malkia and were not detected in the other areas. Late-spring parasitism rates reached 5.88% in Al Kamishly and 12.45% in Al Malkia.

OBSERVATIONS ON IMPORTANT WHEAT PESTS IN TAJIKISTAN. Munira Otambekova, Bernd Pett and Hafiz Muminijanov, Behzod 1, Aprt 7, Dushanbe city, Tajikistan 734025, Phone: +992-372 234796, Fax: +992-372-248705, e-mail: omunira01@yahoo.com

During the last two years, investigations have been undertaken to determine the most important wheat pests in several locations of Tajikistan. These pests and their symptoms of damage were photographed and collected in a computer-based catalogue. The investigations do not include nematodes. The incidence of Sunn bugs (*Eurgaster integriceps*) and other pest species has been astonishingly low (less than 1%, related to all pests found), although this insect group is known to be very harmful in other countries. The economical threshold of more than 2 bugs or 5-10 nymphs/m^2 was not reached in 2003. However, Sunn Pests and their damage symptoms could be found regularly on wheat plants. Therefore, these insects should be observed carefully in the next years. Finally, it should be assumed that pest populations vary from year to year. Their incidence and possible outbreaks depend on many environmental conditions, therefore, the occurrence of pests has to be observed carefully and, if the situation should arise, they should be controlled. Regular observations are the solid basis for application of a successful Integrated Pest Management program. The authors will present, at their presentation, "Dangerous wheat pests", published in 2004, where recommendations on control measures have been described.

LIFE HISTORY AND REPRODUCTIVE TABLE OF *EURYGASTER MAURA* L. (HET.: SCUTELLERIDAE) IN THE LABORATORY. Jafar Mohaghegh, Plant Pest & Disease Research Institute, P.O. Box 1454, 19395 Tehran, Iran, Phone: (+98-21) 240 36 92; Fax: (+98-21) 240 36 91, E-mail: jmohaghegh@lycos.com

Eurygaster maura is a prevailing species of the genus *Eurygaster* in the wheat fields of the northeast of Iran (Golestan province). An experiment was carried out to determine its life history and demographic parameters under laboratory conditions (T=26±1°C; R.H.=50-60%; L:D=16:8h) using individuals collected from overwintering sites. Developmental periods of immature stages (egg and five nymphal instars) were: 5.94 ± 0.01, 3.51 ± 0.02, 5.71 ± 0.03, 5.26 ± 0.03, 5.75 ± 0.02 and 9.13 ± 0.04 days, respectively. There was no difference between female

(35.54 ± 0.18 days) and male (35.12 ± 0.17 days) total developmental times. Preoviposition period was 11 days. Demographic parameters of R_0, r_m, λ, T and DT were 30.54, 0.0577, 1.059, 59.29 and 12, respectively. Comparing with its close and well-known species *Eurygaster integriceps*, *E. maura* seems to have less reproductive potential under laboratory conditions.

TEMPERATURE THRESHOLDS AND DEGREE-DAY REQUIREMENTS OF EMBRYONIC DEVELOPMENT OF SUNN PEST, *EURYGASTER INTEGRICEPS* (HEMIPTERA: SCUTELLERIDAE), AT CONSTANT TEMPERATURES. Naser Moeeny Naghadeh[1] and Ahad Sahragard[2]. (1) Razi University, Kermanshah, Iran, e-mail: chamran1360@yahoo.com; (2) Gilan University, Rashat, Iran.

In this study, the development of five embryouic stages of Sunn Pest was studied at six constant temperatures, 12, 15, 20, 25, 27.5 and 30°C under laboratory conditions. Single-cohort stage-frequency data for each temperature was obtained and analyzed with PlF software with Bellows and Birley's (1981) model. Means and standard deviations of durations for each stage at each temperature were estimated and compared with predictions of the model. Durations at 12 and 15°C were 37.11±7.9 and 25.95±3.7 days respectively. Durations decreased at higher temperatures. At 20, 25 and 27.5°C durations were 12.68±2.5, 5.65±1.11 and 5.43±1.11 days respectively. It increased at 30 to 6.46±1.11. Mortality percent like durations decreased with temperature until 27.5 °C then increased at 30°C, the mortality percent at 12 to 30°C were 100, 97.3, 29.2, 21.3, 16.7, and 27.7 respectively. Observations were compared to the predicted model. Regression equations were used to estimate the lower thresholds and degree-days for each embryonic stage. Upper temperature threshold of total embryonic stage was 27.5°C. Lower temperature thresholds estimated for the five stages and total embryonic development were 3.43, 14.59, 12.82, 9.73, 12.60, and 12.26°C, respectively. Degree-days needed for each developmental stage and total embryonic developments were 64.52, 4.75, 9.17, 12.53, 14.62, and 76.92 DD, respectively.

REGIONAL DEGREE-DAY MODEL FOR PREDICTING DEVELOPMENTAL STAGES OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, IN THE FIELD UNDER VARIABLE TEMPERATURES. Naser Moeeny Naghadeh[1], and G. A. Abdollahi[2]. (1) Razi University, Kremanshah, Iran, e-mail: chamran1360@yahoo.com; (2) Plant Pest and Diseases Research Institute, Tehran, Iran

Sunn Pest, *Eurygaster integriceps* Puton, is the most important pest of wheat in Iran and the Near East. The ability to predict accurately the occurrence of different developmental stages of this pest may facilitate and improve population control measures. Field studies were conducted two consecutive years (1988 & 1999). Date of migration of first observed individuals from overwintering habitats to

wheat fields was determined by accumulation of degree-days (Biofix). Data was collected with a stratified random sampling program. Multi-stage frequency data were analyzed with Bellows & Birley (1981) model of P1f software with an ordinary time scale and a physiological time scale (degree-days) to estimate the mean durations and standard deviations of the developmental stages of Sunn Pest. Degree-days were calculated using the double sine wave method with an intermediate cut off at the upper threshold with DDU software. Mean degree-days needed for observing the peak of populations at overwintering adults, eggs, five nymphal stages and new generation adults for two years observed at 74, 123, 145.5, 170, 214.5, 172.5, 317.5, 376.5 degree-days respectively.

III. IPM TACTICS FOR MANAGEMENT OF SUNN PEST

III. 1. CHEMICAL CONTROL

COMPARATIVE STUDY OF THE PROPERTIES AND REGULATION OF THE ACTIVITY OF CHOLINESTERASES AND CARBOXYLESTERASES OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON. Habib H. Kushiev, S. Ernazarova, A. Abdurakhimov and B. Kholmurodov, Gulistan State University, 707000 Mustakillik street, Gulistan, Uzbekistan, Phone: (+3672) 250275/ 254189; Fax: (+3672) 254042/254509; E-mail: kushiev@mail.ru

The increase in activity of metabolic enzymes plays an essential role in the mechanism of resistance in the insects, isopods and nippers. There are multiple esters in chemical compounds, which can be inactivated by hydrolysis under the action of nonspecific esterases: carboxylesterases, phosphatases and oxidases. The enzymatic properties of cholinesterases (ChE) and carboxylesterases (CE) of *Eurygaster integriceps* Puton, by methods of fermentative kinetics in various organs, and throughout the ontogeny of insect development, was studied. Enzymatic activity depends on the age of the insect, location of enzyme isolation, temperature and pH of the reaction medium. In the body of the insects two types of ChE were discovered. They differ by their ability to hydrolyze cholinesters of carbonic acids, and also by the sensitivity to the action of the series of phosphororganic compounds (PhOC). As the experiments showed, CE hydolyses S-alkyl esters, unlike the ChE, CE activity, and are not limited by high concentration of substrates. The concentration of PhOC causes a decrease in CE activity, while the catalytic properties of CE are inhibited by PhOC, in the structure of which the cationic group is absent. The presence of PhOC is important for ChE activity control. On the basis of the obtained results the conclusion of the structural peculiarities of the catalytic centers of these enzymes was made.

TIMING AS A TACTIC OF ECOLOGICAL SELECTIVITY FOR CHEMICAL CONTROL OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON. A. Sheikhi Garjan, A. Mohammadipour, Gh.Radjabi, Gh. Sabahi. Plant Pests and Diseases Research Institute, P.O. Box 1454/19395, Tehran, Iran; Phone: (+98-21) 2403692; Fax: (+98-21) 2403691; e-mail: a_sheikhigarjan@yahoo.com

Sunn Pest is the most important pest of barley and wheat in the Near East. Yearly sprays with insecticides are currently conducted on about 1,200,000 ha at two stages including overwintered adults and nymphs in Iran. In this experiment nine insecticides were tested in infested wheat fields in two–RCBD for both chemical control stages. Two year-studies showed that spraying against

overwintered adults had no significant effects on reducing the punctured and damaged kernel rate (>2%) or the new generation density (>10 nymphs and young adults/m^2) relative to their economic importance. The date and quantity of rainfall and movement of overwintered adults among the fields were effective factors in low efficacy of spraying against overwintered adults. These applications also had a high risk for natural enemies because of a lack of refugia for them. Results showed that trichlorphon was the only selective insecticide in chemical control of overwintered adults in an emergency status. It is better to be applied after the earring stage of wheat for reducing adverse effect on beneficial arthropods. Lambda-cyhalotrin, deltamethrin, esfenvalerate as synthetic pyrethroids and trichlorphon as organophosphorus insecticides were found to be more efficient than other *insecticides* in control of nymphal stages. Application against Sunn Pest nymphs at the third instar reduced punctured and damaged kernels (>2%) economically and conserved the reproductive activity of natural enemies. Application against overwintered adults of Sunn Pest had efficacy less than that obtained against the new generation.

THE EFFECTS OF APPLICATION METHODS IN CHEMICAL TREATMENTS FOR SUNN PEST CONTROL IN TURKEY. Arzu Erman, Yasemin Sabahoğlu and Numan Babaroğlu, Plant Protection Central Research Institute, Bağdat Caddesi No:250, P.O. Box 49 06172, Yenimahalle, Ankara, Turkey; Phone: (+90-312) 3445994; Fax: (+90-312) 3151531; e-mail: erman@agri.ankara.edu.tr

In Turkey, wheat and barley represent crops with the largest cultivated land area at 13 030 000 ha. Cereals are the most important food for internal consumption and also export for Turkey. Chemical treatment is a common method for plant protection against Sunn Pest. Commonly, liquid pesticides have been applied using aerial application conducted by the government. This is highly inefficient with spray failing to reach the target area of the crop. The wasted pesticide covers non-targeted parts of the plant, or drifts outside the crop by wind or suspends in the air or drops into sources of water and reaches the ground. As a result of this, environment pollution takes place. With a new approach, in 2005, farmers will start to spray their areas using ground application equipmment. It is aimed to increase the biological efficiency and to reduce the spray costs and environment pollution.. In this study, for more effective spraying and less non-target contamination, advantages and disadvantages of aerial spraying and ground spraying are compared for Turkey.

THE INFLUENCE OF INSECTICIDE RESIDUES ON THE FORAGING BEHAVIOR OF THE SUNN PEST EGG PARASITOID (*TRISSOLCUS GRANDIS*) IN THE LABORATORY. A. Sheikhi Garjan, A. Mohammadipour, M. Amir-Maafi and S. Asgari, Plant Pests and Diseases Research Institute, P.O. Box 1454/19395, Tehran, Iran; Phone: (+98-21) 2403692; Fax: (+98-21) 2403691; e-mail: a_sheikhigarjan@yahoo.com

The behavior of *Trissolcus grandis* was recorded in laboratory bioassays in the presence of nine insecticide residues on one-day-old eggs of Sunn Pest. Insecticide concentrations were provided at field recommended rates. Batches of 14-eggs were dipped in insecticide solutions. Treated batches were offered to female parasitoids. Parasitoids exposed to treated eggs died with exposure to organophosphorus compounds (OPs), and carbamate insecticides, however they did not die following exposure to synthetic pyrethroid (SPs) insecticides because of departure from the treated eggs. The parasitoids had abnormal types of behavior in SPs insecticide treatments in comparison with control. Parasitoids exposed to eggs treated with SPs insecticide residues were observed to spend shorter visit time and to rest far away from treated eggs. The results indicated that parasitoids had significant behavioral difference in preference and visiting between non-treated and SPs insecticide-treated eggs especially lambda-cyhalothrin and deltamethrin meanwhile they had the same preference and visiting between non-treated and OPs-treated eggs. Sex ratio was not significantly different between control and OPs insecticides. The results are discussed in terms of the repellency of SPs insecticides and the implications for integrated pest management of differing sub lethal insecticide effects on parasitoid behavior. This character can help in the selection of insecticides favorable for chemical control of overwintered adults and the new generation.

EFFECTS OF CONVENTIONAL INSECTICIDES ON SUNN PEST EGG PARASITOIDS *TRISSOLCUS GRANDIS* AND *T. SEMISTRIATUS* (HYMENOPTERA: SCELIONIDAE). Moosa Saber, Department of Plant Protection, Maragheh College of Agriculture, Maragheh, Iran, Phone: (0098-421) 2249740; Fax: (0098-421) 2249742; e-mail: saber@tabrizu.ac.ir

Sunn Pest, *Eurygaster integriceps* Puton, is the most important pest of wheat and barley in Iran. Effects of fenitrothion and deltamethrin, the most commonly used insecticides in Iran for controlling the pest, were assessed on the Sunn Pest egg parasitoids *Trissolcus grandis* Thomson and *T. semistriatus* Nees. The field recommended concentrations of the insecticides caused 100% mortality on the adult wasps within 24 hrs. LC_{50} values of fenitrothion and deltamethrin for *T. grandis* and *T. semistriatus* were 16.2, 7.9 and 155 and 145.6 ppm, respectively. Life table parameters of adult females exposed to LC_{50s} of the insecticides within the first 24 hrs after emergence were evaluated. Longevity and reproductive capacity of emerged females were not significantly affected for both species. The sex ratio of the progeny of both parasitoids was not affected significantly but was male biased.

The intrinsic rates of increase of *T. grandis* were 0.298, 0.289 and 0.286 and for *T. semistriatus* were 0.297, 0.293 and 0.295 female offspring per female per day in control, fenitrothion and deltamethrin, respectively.

CHEMICAL CONTROL OF SUNN PEST WITH PESTICIDES (ULV) APPLICABLE FOR EMULSION IN WATER BY USING GROUND SPRAYING SYSTEM. Abdul-Satar A.Al-Kafaji[1] and Nassir A.Al-Gamali[2]. (1) State Board of Agricultural Research, Baghdad, Iraq; (2) State Board of Plant Protection, Baghdad, Iraq, Phone: 5559644, E-mail: plant-protection75@hotmail.com

A study was carried out in wheat fields in the Al-Qush region (Mousl Province) using new pesticides called Beticol 20% SL, Trebon 7.5% ULV, Ofunack 25% ULV, Cyperlod 7.5 % ULV, using a concentration of 0.25 ml/L. All were referenced to the common insecticide Sumialpha 2.5% EC at a concentration of 1 ml/L. Results showed that all pesticides were highly effective against the Sunn Pest (Eurygaster integriceps Puton), with mortality reaching (72.95-77.56%), (86.33-91.59%) and (96.54-98.52%) after 1, 3 and 7 days, respectively postapplication.

III. 2. BIOLOGICAL CONTROL

ENTOMOPATHOGENIC FUNGI FOR MANAGEMENT OF SUNN PEST: EFFICACY TRIALS IN OVERWINTERING SITES. Margaret Skinner[1], Bruce L. Parker[1], William Reid[2], Mustapha El Bouhssini[2], and Masood Amir-Maafi[3] (1) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont 05405-0105, USA, Phone: 802-656-5440, Fax: 802-658-7710, e-mail: m.skinner@uvm.edu; (2) ICARDA, P.O. Box 5466, Aleppo, Syria; (3) Sunn Pest Research Department, Plant Pests & Diseases Research Institute, 719/33715, Varamin, Iran.

The cadavers of Sunn Pest, *Eurygaster integriceps* Puton, infected with entomopathogenic fungi have been observed in overwintering sites, suggesting that fungi are a natural mortality agent in this environment. Over 220 isolates have been isolated from Sunn Pest overwintering sites in West and Central Asia and Russia. Based on results from laboratory bioassays and fungal germination and sporulation characteristics, several promising isolates were selected for testing against Sunn Pest in overwintering sites in northern Syria and north-central Iran. From 2002-2003, fungal treatments were made using different formulations and application times. Results from these tests are reported and recommendations for future directions in the development of entomopathogenic fungi for Sunn Pest management are proposed.

THE DEVELOPMENT OF A MYCOINSECTICIDE FOR THE BIOLOGICAL CONTROL OF SUNN PEST. Dave Moore[1], Steve Edgington[1], Halil Kutuk [2], Hatice Satar[2], and Mustapha El-Bouhssini[4]. (1) CABI Bioscience, Bakeham Lane, Egham, Surrey TW 20 9TY UK Phone: 44 (0) 1491 829025; Fax: 44 (0) 1491 829123; e-mail: D.Moore@cabi.org; (2) Plant Protection Research Institute, P.O. Box 21–01321, Adana, Turkey (4) ICARDA, P.O. Box 5466, Aleppo, Syria.

The Sunn Pest complex causes significant losses of yield and quality of wheat and barley in West Asia. One potential control strategy is to use entomopathogenic fungi, such as *Beauveria bassiana* as mycopesticides to control the migrating overwintering adults and the summer generation in the crop. Isolates of *Beauveria bassiana* have been obtained from overwintering adults by collaborators and one of these was mass produced to a high quality specification. In the summer of 2003, oil based formulations of this isolate were applied to mature wheat crops in Turkey and Syria using an Ultra Low Volume hand-held sprayer. Despite good cover of both crop and insect, no significant mortality was obtained. Samples of summer adults were obtained from both countries and seven isolates of *B. bassiana* were obtained from 3500 cadavers. Laboratory bioassays at ICARDA showed that these isolates were comparable to a standard isolate used and it was

hoped that the summer isolates would be more effective in controlling the summer populations. Trials conducted at ICARDA in April and May 2004 gave no indication of control of adults, but treated nymphs showed 94% mortality compared with 40% for the controls after 5 days. Untreated nymphs placed on treated and untreated wheat showed 46% and 8% mortality respectively. This raises the possibility of targeting the early summer populations; research should focus on persistency of the fungus in the field, the reasons for poor field performance against adults (when isolates are effective in laboratory trials) and Sunn Pest behaviour before and after treatment.

MASS PRODUCTION OF ENTOMOPATHOGENIC FUNGI USED FOR THE BIOLOGICAL CONTROL OF INSECT PESTS. Nina E.Jenkins[1], Bibi S. Ali[2] and Dave Moore[3]. (1) CABI Bioscience at Department of Agricultural Sciences, Imperial College, Wye Campus, High Street, Wye, Ashford, Kent, TH25 5AH, UK; (2) CAB International, Caribbean Regional Centre, Gordon Street, Curepe, Trinidad and Tobago, West Indies; (3) CABI Bioscience, Bakeham Lane, Egham, Surrey TW 20 9TY, UK, Phone: 44 (0) 1491 829025; Fax: 44 (0) 1491 829123; e-mail: D.Moore@cabi.org

A research programme to develop a mycoinsecticide to control Sunn Pest has made good progress and it is necessary to plan ahead for some aspects of product development. One of the most important of these is mass production. Control over the areas susceptible to Sunn Pest damage will require large quantities of high quality fungal material, suitably formulated for long term storage and ease of use. For example, application over one million hectares may require 50 tonnes of dry spore powder; the scale-up of production beyond experimental facilities brings many challenges. CABI Bioscience has extensive experience derived from setting up production facilities, in Benin and Trinidad, providing consultancy support for commercial producers in South Africa, France and USA and working with many small scale producers in the Americas, Africa, Asia and Europe. Lessons from this experience, in terms of quantity of production and quality assurance procedures will be reported. Long term storage stability can be achieved through a combination of downstream processing measures and the selection of suitable packaging, thus ensuring predictable product viability even under fluctuating temperature conditions. Attention to all aspects of the production process will ensure that consistent and product is reliably available for sustainable pest management.

INITIAL STUDIES ON THE POTENTIAL USE OF AN ENTOMOPATHOGENIC FUNGAL GRANULAR FORMULATION ALONG THE EDGES OF WHEAT FIELDS. W. Reid[1], Z. Sayyadi[1], M. El-Bouhssini[1], B.L. Parker[2] and M. Skinner[2]. (1) ICARDA, P.O. Box 5466, Aleppo, Syria, Phone: (+963-21) 2213433; Fax: (+963-21) 2213490; e-mail: b.reid@cgiar.org; (2) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont 05405-0105, USA.

Two factors limit the use of entomopathogenic fungi for insect management in dry areas. One is the requirement of high moisture needed for fungal germination and the other lethal UV radiation from the sun. The ground surrounding the tiller zone of wheat plants is an area that Sunn Pest occupies that is shaded from the sun and allows for the trapping of moisture. The potential for application of entomopathogenic fungi to this zone was investigated. One isolate of *Beauveria bassiana*, SPT 22, formulated as a granular based on millet was assessed for Sunn Pest management in wheat fields. Two application rates were tested in screened cages seeded with Sunn Pest at an infestation rate of 16 adults per m^2 (1:1 sex ratio). Insects were removed two weeks post-application and assessed for mortality and fungal outgrowth. No significant differences between treatment mortalities were observed at the time of pick up. The high treatment rate produced 65% mortality among collected insects after a 5 d holding period and was significantly higher than the mortality of the other treatments that ranged from 20 to 32%. Six weeks post-application, the wheat in all cages was destructively sampled and the total numbers of Sunn Pests per cage counted. These ranged from 0 to 46, with the fungal-treated cages containing the lowest number of insects, however, this was not found to be statistically significant ($p=0.13$) from the other treatments. A second-year repeat of this experiment, including a heat-tolerant strain of *Metarhizium anisopliae*, isolate 500B is ongoing.

STUDIES ON THE EGG PARASITOID (*TRISSOLCUS* SPP., HYMENOPTERA: SCELIONIDAE:) OF SUNN PEST (*EURYGASTER* SPP., HEMIPTERA: SCUTELLERIDAE) IN TURKEY. Erhan Koçak, Central Plant Protection Research Institute, 06172 Yenimahalle, Ankara, Turkey, Phone: (+90 312) 3447430; Fax: (+90 312) 3151531; e-mail: erhan_kocak@hotmail.com

Sunn Pest is the most important pest of wheat and barley in Turkey, and about 75% of the cereal areas are under threat from the pest. The egg parasitoids *Trissolcus* spp. are the most effective natural enemies of the pest. The natural effect of *Trissolcus* species can reach 100% in some localities and so spray applications are avoided. *Trissolcus* spp. exhibit differences in distribution, density, effectiveness and specificity according to geographic areas. Research on taxonomy, biology, bio-ecology, mass rearing and releasing, distribution, and side effects of insecticides on *Trissolcus* species has been conducted. Also the green zone project, which supports

the parasitoids and increases their effectiveness in nature has just started. In this article, all research on *Trissolcus* spp. in Turkey is presented.

INFECTIVITY OF TWO ISOLATES OF *STEINERNEMA FELTIAE* (RHABDITIDA: STEINERNEMATIDAE) IN RELATION TO *EURYGASTER MAURA* L. (HETEROPTERA: SCUTELLERIDAE) ADULTS. Erhan Koçak[1], Ayhan Gokce[2] and İlker Kepenekci[1]. (1) Plant Protection Central Research Institute, Bağdat St., No.250, P.O. Box 49, Yenimahalle 06172, Ankara, Turkey, Phone: (+90 312) 3447430; Fax: (+90 312) 3151531; e-mail: erhan_kocak@hotmail.com; (2) Gaziosmanpasa University, Agriculture Faculty, Department of Plant Protection, 60100-Tokat,TURKEY.

Entomopathogenic nematode species within the genera *Steinernema* (Rhabditida: Steinernematidae) and *Heterorhabditis* (Rhabditida: Heterorabditidae) are among the most important and rapidly increasing in usage biocontrol. European Sunn Pest (ESP) *Eurygaster maura* L. (Hemiptera: Scutelleridae) is one of the most important pests of cereals in Turkey. Two different *S. feltiae* isolates were tested against adult ESP under laboratory conditions. Each nematode isolate was tested at three doses [25, 50 and 100 infective juveniles (IJs) / 0.2 ml water per adult] and at three different temperatures (10, 15 and 25°C). Mortality was recorded after 72 h and 96 h of each incubation. The following results of death ratios in EPS at 96 h and a dose of 100 IJs/0.2 ml water per adult were obtained for *S. feltiae* (All); 50% at 10°C; 58.3 % at 15°C and 63.8% at 25°C; for *S. feltiae* (S3); 58.3% at 10°C and 15°C, and 74.9% at 25°C. Although death was found lower at lower doses, there was no significant difference between temperatures. These results indicated that entomopathogenic nematodes might be used in controlling ESP.

INITIAL STUDIES ON THE EFFICACY OF ENTOMOPATHOGENIC NEMATODES AGAINST SUNN PEST AND SURVEY OF SYRIAN SOILS FOR LOCALLY ADAPTED ISOLATES. Mohammed Abdulhai[1], Z. Sayyadi[2], W. Reid[2], M. El-Bouhssini[2], B.L. Parker[3] and M. Skinner[3]. (1) General Commission for Scientific Agricultural Research Aleppo Center, Aleppo, Syria, Phone: (+963-21) 4647200; Fax: (+963-21) 4644600; e-mail: mah70@scs-net.org; Mohamad_abdulhai@yahoo.com; (2) ICARDA, P.O. Box 5466, Aleppo, Syria, Phone: (+963-21) 2213433; Fax: (+963-21) 2213490; e-mail: b.reid@cgiar.org; (3) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont, USA 05405-0105.

Four laboratory trials were conducted using seven species of entomopathogenic nematodes (EPN). These included *Heterorhabditis indica, H. bacteriophora, H. zealandica, Steinernema riobravae, S. carpocapsae, S. glaseri,* and *S. feltiae.* Adult overwintering *Eurygaster integriceps* were challenged with three concentrations of infective juveniles. Initial mortality results were low, and only *H. indica, S. riobravae,* and *S. carpocapsae* were capable of reproducing in *E.*

integriceps, and only on insects collected immediately prior to migration. The following year, adult *E. integriceps* collected from the aestivation sites were challenged with isolates of *Heterorhabditis* sp. previously identified as pathogenic to Sunn Pest adults that had been collected from wheat fields. No significant treatment effects were found and nematodes were not found to be capable of reproducing in *E. integriceps*. Susceptibility may be dependent on the insect's physiological condition. Soil surveys to identify candidate nematode strains adapted to Syria were conducted in the spring months of 2004 in northern, northern east, middle, southern and coastal areas of Syria. Six isolates of EPN, from among two genera were recovered from six of the 148 sites sampled, and are currently being screened for efficacy against Sunn Pest.

III. 3. HOST PLANT RESISTANCE

EVALUATION OF WHEAT AND ITS WILD RELATIVES FOR RESISTANCE TO SUNN PEST UNDER ARTIFICIAL INFESTATION. M. El-Bouhssini[1], M. Abdulhai[2], M. Nachit[1], J. Valkoun[1], H. Ketata[1], M. Moussa[1], O. Abdallah[1], A. Joubi[1] F. Rihawi[1] and F.J. El-Haramein[1]. (1) International Center for Agricultural Research in the Dry Areas, P.O. Box 5466, Aleppo, Syria, Phone: (+963-21) 2213433, Fax: (+963-21) 2213490, E-mail: M.Bohssini@cgiar.org; (2) General Commission for Scientific Agricultural Research, Center for Scientific Agricultural Research, Aleppo, Syria.

There has been very little progress towards the use of host plant resistance against Sunn Pest worldwide. Besides the narrow genetic base in cultivated wheat for resistance to this pest, there are great difficulties in screening in hot spots in the field because of aerial insecticide sprays. Also, there is no reliable screening technique under artificial infestation. During the past five years ICARDA, in collaboration with its NARS partners in West Asia, has placed special effort on the development of a screening technique under artificial infestation. The method consists of using mesh screen cages (6 x 9 x 3 m) constructed directly in the field. The test is done in two stages, initial and advanced evaluation. In the initial screening, wheat entries are planted in hill plots at the usual planting time in the fall. Plants are infested at the time insects migrate to wheat fields using six adults/m^2. The parameters used in the evaluation for resistance are to rank shoot and leaf damage using a scale from 1-6. In the advanced screening, the selected wheat lines from the initial test are planted in rows 1-m long, and one cage with uninfested plants is used as a control. The method of infestation and evaluation is similar to that described in the initial test, except that two parameters are added: 1000 kernel weight and quality tests. Of the thousands of lines that have been tested using this new screening technique, several lines of wheat and its wild relatives have been identified with good levels of vegetative stage resistance. These lines are being used in the breeding programs to develop wheat varieties with resistance to Sunn Pest in West and Central Asia.

COMPARISON OF RESISTANCE TO SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON) IN SOME BREAD AND DURUM WHEAT LINES. Manouchehr Rezabeigi, Sunn Pest Research Department, Plant Pests and Diseases Research Institute, P.O. Box 19395-1454, Tehran, Iran, Phone: (+98-21) 2403692; Fax: (+9821) 2403691; e-mail: rezabeigi40@yahoo.com

Twenty-one bread wheat and 23 durum wheat lines were compared to study their resistance to the nymphal stages of Sunn Pest under field conditions in Varamin. Artificial infestation of treatments was conducted in small cages installed on 40-60 spikes in all replications. Comparing five measured characteristics, there

were no significant differences among the percent weight reductions, the mortality of nymphs and the total yield; but the percentage of damaged grains per nymph and the total percentage of damaged grains in durum wheat lines were lower than those of bread wheat and significant differences existed among them. As a result, we found that the durum wheat lines were more resistant than those of bread wheat to nymphal stages and newly emerged adults of Sunn Pest. In conclusion, we were able to increase the economic injury level (EIL) of nymphs in durum wheat fields.

RESISTANCE TO SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON) IN ADVANCED LINES OF DURUM AND BREAD WHEAT. Tohid Najafi Mirak[1] and Valiollah Mohammadi[2]. (1) Department of Cereal, Seed and Plant Improvement Institute (SPII), P.O. Box 4119, Karaj, Iran, Phone:+98-261-2782981; Fax: +98-261-2782698; e-mail: tnmirak@yahoo.com; (2) Department of Agronomy and Plant breeding, University of Tehran, Karaj, Iran

Resistance to Sunn Pest of 20 bread wheat lines and 21 durum lines was studied in two experiments under field condition using RCBD with three replications. Third instar Sunn Pest were released into nets placed on ears. Analysis of variance revealed significant differences among bread wheat lines in grain injury and 1000 kernel weight. SDS sedimentation was not significantly different in these lines. Based on grain injury and SDS sedimentation, M-75-14 and M-75-13 were the most and the least resistant lines, respectively. Durum lines did not differ significantly in their grain injury and SDS sedimentation, while their 1000 Kernel weight was different. Nymphal feeding decreased SDS sedimentation and increased 1000 kernel weight. It was concluded that the durum lines were more resistant than bread wheat lines.

EFFECT OF DIFFERENT CEREALS (WHEAT AND BARLEY) ON THE POPULATION OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON (HETEROPTERA: SCUTELLERIDAE), IN THE SOUTH EAST ANATOLIA REGION OF TURKEY. Vedat Karaca[1], Eyup Kiran[1], Serife Fidan[1], Mehmet Bashan[2], Ramazan Canhilal[3], Halil Kutuk[4] and Abdullah Demir[1]. (1) Diyarbakir Plant Protection Research Institute, The Ministry of Agriculture and Rural Affairs, Zirai Mucadele Arastirma Enstitusu, Yenisehir, Diyarbakir, Turkey; Phone: (+90-412) 223 83 21; Fax: (+90-412) 224 4775; e-mail: vedatkaraca@hotmail.com; (2) Biology Department, Faculty of Science and Literature, Dicle University; (3) General Directorate of Protection and Control, The Ministry of Agriculture and Rural Affairs; (4) Adana Plant Protection Research Institute, The Ministry of Agriculture and Rural Affairs, Turkey.

Sunn Pest is one of the most important pests of cereals (wheat, barley) in the South Eastern Anatolia region of Turkey. The aim of the study was to determine the effect of different cereal growing areas on the population density of Sunn Pest. The study was carried out in Diyarbakir, Mardin, and Şanlıurfa provinces during 1993-

1995. As a result, in 1993, the highest nymph population was found at an average of 15.5°C temperature and 22 mm rain monthly in wheat fields. In wheat and barley fields where there was an average of 2.2 overwintered adults per square meter, more nymphs were counted in wheat fields than in barley fields in different years. In the same year, more 4th and 5th instars were counted in wheat fields where there was an average 2.2 overwintered adults per square meter, than in barley fields where there was an average of 4.2 overwintered adults per square meter,. Indeed, more than 10 nymphs per square meter were counted in wheat fields where there was an average of 0.6 overwintered adults per square meter. As a result of this, in cereal fields , which had the same or similar overwintered adult populations, different nymphal densities may have occurred, dependent on climatic and environmental conditions

HOST-PLANT PREFERENCE AND PERFORMANCE BY DIFFERENT DEVELOPMENTAL STAGES OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, ON WHEAT CULTIVARS. A. Arzani, A. Mohammadi and B. Hatami, College of Agriculture, Isfahan University of Technology, Isfahan-84156, Iran, Phone: (+98-311) 391 3453; Fax: (+98-311) 391 2254; e-mail: a_arzani@cc.iut.ac.ir

Sunn Pest, *Eurygaster integriceps* Puton (Hemiptera: Scutelleridae), is one of the most destructive insect pests of wheat in Iran. Breeding of resistant cultivars is the most economical and environmentally safe method to eliminate the use of insecticides and to reduce crop losses due to this pest. This study was conducted to evaluate the host preference and performance of Sunn Pest at different developmental stages including adults, 4th and 5th instars and newly emerged adults using nine wheat cultivars. Four durum wheat cultivars comprising 'Shadas', 'Altar-84', 'Dipper-6' and 'Massara-1' and five bread wheat cultivars comprising 'Moghan', 'Tabasi', 'Niknejad', 'Anza' and 'Tajan' were grown in Abarkoh and Yazd, as highly infested areas, using a randomized complete block design with four replications in a fan layout. The results indicated that cultivars had different reactions to the different developmental stages of Sunn Pest. Overwintered adults showed the lowest and the highest preference to the 'Tabasi' and 'Niknejad' bread wheat cultivars, respectively. On the other hand, 4th and 5th instars as well as the newly emerged adults had the highest preference to 'Tabasi' cultivar and the lowest to the 'Tajan' cultivar.

THE EFFECT OF THE STARCH GRANULE SIZES OF GRAIN ENDOSPERM ON THE RESISTANCE OF WHEAT CULTIVARS TO SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON). Manouchehr Rezabeigi[1], Gh. Radjabi[2] and G. Nouri Ganbalani[3]. (1) Sunn Pest Research Department, Plant Pests and Diseases Research Institute, P.O. Box 19395-1454, Tehran, Iran, Phone: (+9821) 2403692; Fax: (+9821) 2403691; e-mail: rezabeigi40@yahoo.com; (2) Agricultural Entomology Research Department, Plant Pests and Diseases Research Institute, Tehran, Iran; (3) College of Agriculture, University of Mohageg-e-Ardabili, Ardabil, Iran.

The abundance of small (1-10 micron) and large (10-30 micron) starch granules in infested and uninfested flour of 12 wheat cultivars with different levels of resistance to Sunn Pest were measured. The results showed that there are significant differences between the rate of small and large starch granules in wheat cultivars. Based on this cue, it has been found that Sunn Pest inflicts damage mostly to the small size granules, and as the percentage of large granules increases the rate of susceptibility of wheat decreases. The correlations between the percentage of the large-size granules, the relative abundance of large granules to the small ones and resistance indices of wheat varieties have proved to be significant and positive. Therefore, measuring of starch granules has shown to be a good criterion in evaluating the resistance level of wheat varieties to the Sunn Pest and it may be possible to evaluate and screen wheat varieties based on the granule size of endosperm starch. Multiple regression equations have been developed to predict the indices of resistant lines of wheat to Sunn Pest.

DEVELOPMENT OF AN EFFICIENT WHEAT GENETIC TRANSFORMATION SYSTEM FOR THE CREATION OF THE TRANSGENIC WHEAT RESISTANT TO THE SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON). A. K. Gaponenko and V.S.Fadeev, Centre "Bioengineering" RAS, Prospect 60let Oktyabrya 7 kor. 1, Moscow, 117312 Russian Federation, Fax: 7-095-1350571; e-mail: alexg@biengi.ac.ru

Sources of resistance to the Sunn Pest (*Eurygaster integriceps*) have, to date, not been found in the *Triticum* genera. This means that it may not be possible to develop wheat resistance against Sunn Pest through common selection and breeding. Recent achievements of genetic engineering have shown that development of transgenic resistant crop varieties is the environmentally safest way of controlling crop pests. This approach allows for the use of a wide range of genes, isolated from different plants and microorganisms. These genes have to possess a few properties: first of all, their products must have no negative impact on human health, they cannot affect the bread making properties of the grain, and they must be very toxic to *Eurygaster integriceps*. The creation of transgenic plants requires three components; genes of resistance, an efficient genetic transformation system and the possibility to achieve high levels of transgene expression in the specific tissue. We

plan to use three different groups of genes: plant lectins, plant protease inhibitors and α-amylase inhibitors genes, with the possible inclusion of synthetic genes. Gene transfer techniques have been developed previously for certain wheat (*Triticum aestivum* L.) cultivars, but problems persist in Russian lines for low transformation rates and in vitro callus culture. We have adopted earlier developed methods of wheat regeneration from callus, obtained from immature embryos (Gaponenko et al 1984) for Lada, Mis and other Russian varieties and currently receive 80-100% regeneration frequency. We have optimized the various bombardment parameters of the Particle Inflow Gun (Finer and Wain, 1992) for the wheat ballistic transformation procedure including pressure, distance, gas volume used and types of particles. For this goal we have used the psGFPBAR vector obtained from Prof. Conger. The mode of the selection of transgenic wheat plants was made on the basis of the bar gene action. The established wheat transformation protocols for Russian wheat varieties has an efficiency of about 2-3% and allows us to start engineering wheat resistant to its main domestic pest - *Eurygaster integriceps* Puton.

III. 4. GENERAL TOPICS IN IPM

CEREAL SUNN PESTS AND SUSTAINABLE MANAGEMENT IN THE 21ST CENTURY. M. Javahery, Lyman Entomological Mus. & Research Laboratory, PO Box 140, Macdonald Campus of McGill University, 21111 Lakeshore, QC H9X 3V9 Canada, Phone: (514) 398-7988; Fax: (514) 630-5864; e-mail: javahery@allstream.net

The Sunn Pest is the common name of the heteropteran "Shield bug" (Scutelleridae) and "Stink bug" (Pentatomidae). These insects damage wheat and barley throughout West Asia, Near East and parts of North Africa. There are about 40 species of Sunn Pest. These bugs, particularly *Eurygaster integriceps* Puton reduce yield of crops and baking quality of flour made from damaged wheat and barley. In addition, damaged crops cannot be used as animal feed. The reduction of wheat production caused by several species from the genera *Aelia* and *Eurygaster* spp. has become a major problem for growers and governments of countries affected by these insects. A great deal of research has been done on the biology, ecology, and controlling methods of these serious pests during the past hundred years. Outbreaks continue to occur in some regions, every 5-8 years. Yield loss from their damage is estimated at 20-30% in barley and 50-90% in wheat if not controlled chemically. Heavy infestation can destroy all crops. Sunn Pest resistance has been observed to all used insecticides after 10-15 years. Sustainable management of Sunn Pest may be achieved by application of IPM based on the outcome of research carried out on these insects during the past century with regional collaboration. To this end, a network and web-based approach with database technology is a robust and useful means for collaboration and exchange of biodiversity information for Sunn Pest sustainable management.

SUNN PEST MANAGEMENT IN ROMANIA. Constantin Popov[1], Alexandru Barbulescu[1], Felicia Mureşanu[2], Silviu Vasilescu[1], Florica Gogu[3] and Iuliana Dobrin[3]. (1) Agricultural Research and Development Institute Fundulea, Romania, Fax: (+40-21) 3110722, e-mail: undulea@ricic.ro; (2) Agricultural Research and Development Station Turda, Romania, Fax: (+40-26) 4311792,e-mail: scaturda@rdslink.ro; feliciam22@hotmail.com; (3) Central Laboratory for Phytosanitary Quarantine, Bucharest, Romania.

Eurygaster integriceps is one of the most important pests of wheat in Romania. In the affected areas, security of the wheat harvest quality is inconceivable without active plant protection measures. Investigations over many years were conducted to attempt to underline the contributions of the key elements for the basis of the integrated control of Sunn Pest. Thus, the following elements have been examined: the ratio between species and their distribution areas in Romania, the size and space distribution of Sunn Pest populations, the study of the annual peculiarities

of their life cycle, the relationships between pest and oophagous parasites, and the establishment of the economic damage thresholds and means for their control. The most important elements were the prevalence of *Eurygaster integriceps*, occupying an area of about 1,000,000 ha of wheat crops in 24 districts; the contribution of the oophagous parasitoids *Telenomus chloropus* and *Trissolcus grandis*, and the economic damage thresholds as calculated differentially in accordance with the crop stage and harvest destination. Forecasting and warnings are of permanent concern in the whole country, and are based on a methodology developed by ARDI Fundulea, and applied across the country by the District Inspectors for Plant protection and Phytosanitary Quarantine. Chemical control of Sunn Pest in Romania is supported by the Government.

THE SUNN PEST IN FORMER USSR COUNTRIES: HISTORY AND CURRENT STATUS. Galia Zharmukhamedova, Institute for Plant Protection, Almaty, Kazakhstan, Phone/Fax: (+3272) 295609; e-mail: Galia-j@yandex.ru

The Sunn Pest (Eurygaster *integriceps* Puton) is one of the major pests of spring and winter wheat in all regions of their cultivation in the European part of Russia, the steppe zone of Ukraine, and the west and south regions of Kazakhstan and the Central Asia republics. A wide region of infestation and the exceptionally high harmfulness of Sunn Pest served as the main reason for conducting intensive studies and surveys for effective methods of crop protection, beginning at the end of the 19th century. Scientists have deeply and thoroughly studied the biology and ecology of the pest in the territories of the former USSR. The regularity of Sunn Pest quantity dynamics dependent on abiotic and biotic factors was studied, and on the basis of this, theoretical long-term and short-term regional forecasting models were developed. Different economic thresholds of Sunn Pest harmfulness depending on stage of the wheat, pest development and weather conditions were established. Based on these studies, strategies and tactics of plant protection were regularly developed. Currently, Sunn Pest control has two major goals; the production of high-quality grain and the maintenance of Sunn Pest population numbers below the economic threshold. Studies on IPM of Sunn Pest are focused on developing resistant varieties, increasing of regulative roles of natural entomophage populations and the development of biological preparations based on entomopathogenic fungal and bacterial microorganisms.

INVESTIGATION ON THE ECONOMIC INJURY LEVEL OF SUNN PEST *EURYGASTER INTEGRICEPS* PUTON (HETEROPTERA: SCUTELLERIDAE). Parvaneh Azmayesh Fard[1] and Hossein Noori[2]. (1) Plant Protection Department, College of Agriculture, Tehran University, Karaj, Iran, Phone: (0098-261) 2224022; Fax: (0098-261) 2238529; e. mail: Pafard@ut.ac.ir; (2) Agriculture Research Center of Qazvin, Iran.

The Sunn Pest (*Eurygaster integriceps* Puton) is the most important pest of cereals in Iran. One of the principal components in Sunn Pest management is calculation of the economic injury level (EIL) used to ascertain appropriate decision-making levels. This research was accomplished by assessing quantitative loss due to adult Sunn Pest at a research station in Qazvin province. One experimental phase of this research was performed under cages (2 x 1.25 x 1.80 meters) as a factorial test based on a randomized complete block design with five replications in which Zarin and Alvand wheat cultivars were the first factor and over-wintered adult densities including 2, 4, 6, 8, 10, 12, 15, 17 and 20 individuals per square meter were the second factors. The main issues to be dealt with in this phase were the yield, number of damaged spikes and shoots, the weight of 1000 grains, yield loss and the percentages of the yield loss. The EIL of Sunn Pest densities in both aerial and ground chemical control for the wheat cultivar Alvand were 10.65 and 13.63 adults per square meter, respectively, whereas for the wheat cultivar Zarin, the EIL was 10.94 and 14.01 for aerial and ground chemical control, respectively.

POSTER PRESENTATIONS

OUTBREAKS OF CEREAL SUNN PESTS AND SOLUTIONS FOR SUSTAINABLE CONTROL. M. Javahery, Lyman Entomological Mus. & Research Laboratory, PO Box 140, Macdonald Campus of McGill University, 21111 Lakeshore, QC H9X 3V9 Canada, Phone: (514) 398-7988; Fax: (514) 630-5864; e-mail: javahery@allstream.net

Sunn Pests occur naturally in low density on wild graminaceous plants. Monoculture and the development of high-yielding nutritive varieties of wheat and barley provide a better food source resulting in an increase in population and periodic outbreaks every 5-8 years of this pest. These bugs have a rather complex life history. They are monovoltine and migratory insects, which are highly adaptive to various habitats and ecological conditions throughout their geographical distribution (28°-55° latitude). Long-term studies of population development of the most serious species of Sunn Pests, *Eurygaster integriceps* Puton, were carried out in two ecologically different plains of Isfahan and Varamin, as well as in its over-wintering sites at high altitudes in the nearby mountains of Iran. These studies indicated that there were four major outbreaks between 1960-2004. The physiological conditions in the over-wintered adults (fat reserve) can serve as an indicator of potential population outbreaks. The extensive use of pesticides during the past 50 years has resulted in a significant decrease of both hymenopteran and dipteran natural parasitoids of Sunn Pests. Mass rearing of oophagous parasitoids at a rate of 15 000/ha has proved useful at a low density of one over-wintered Sunn Pest/m^2. Wide ranges of chemical compounds, which have been used against the Sunn Pest in the past, have proven to be effective for a period of 10 years. However, resistance to each pesticide has been noticed after about 10 years. Chemical treatment has led to an increase in yield of wheat production, but a long-term study has indicated more disadvantages rather than benefits. Therefore, there is an urgent need to implement other means of control such as biorational, cultural, semiochemical and entomopathogenic control, as well as selective chemical compounds, which are less harmful to parasitoids. This approach, also referred to as Integrated Pest Management (IPM), has been recommended after many years of investigation for regions affected by Sunn Pests. IPM is currently the most feasible solution for sustainable control of these highly serious and socio-economic insects.

THE EFFECT OF TEMPERATURE ON THE DEVELOPMENT, REPRODUCTIVE POTENTIALS, AND LONGEVITY OF *TRISSOLCUS SEMISTRIATUS* NEES (HYMENOPTERA: SCELIONIDAE) UNDER CONSTANT TEMPERATURES. S. Tarla[1] and S. Kornosor[2]. (1) Department of Plant Protection, University of Mustafa Kemal, Antakya/Hatay, Turkey, Phone: 0326 245 58 36; Fax: 0326 245 58 32; E-mail: starla@mku.edu.tr; (2) Department of Plant Protection, University of Cukurova, Balcalı/Adana, Turkey.

Egg parasitoids are the most important natural enemies of Sunn Pest. *Trissolcus semistriatus* Ness is the most common species attacking *Eurygaster*

integriceps Puton (Heteroptera: Scutelleridae) in South Anatolia. The effects of five constant temperatures (18, 22, 26, 30, and 34±1°C, L:D 16:8 photoperiod and 65±5 % RH.) on the development, reproductive potentials, and longevity of *T. semistriatus* were evaluated, using *E. integriceps* eggs as the host. The developmental time was found to be inversely related to temperature. Egg to adult emergence varied from 7.1±0.01 to 22.6±0.09 days for females and from 6.1±0.03 to 20.7±0.08 days for males. The theoretical lower developmental threshold and thermal requirement was estimated as 11.8 °C, 138.8 degree-days (DD) for males and 11.6 °C, 161.3 DD for females via linear regression. According to temperature male parasitoids emerged one or two days before females. The mean number of progeny ranged from 91.6±5.46 to 120.9±5.13 offspring per female during their lifetime. Females lived significantly longer than males in all temperatures. Depending on the increasing temperature, the longevity of females and males decreased. Female longevity ranged from 10.9±0.73 days at 34±1°C to 67.9±2.44 days at 18±1°C, while males lived from 8.8±0.87 days at 34±1°C to 34.8±3.85 days at 18±1°C. The temperatures at which the experiments were conducted did not significantly affect the sex ratio and emergence rate of *T. semistriatus*.

BINOMIAL AND SEQUENTIAL SAMPLING OF ADULT SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON (HETEROPTERA: SCUTELLERIDAE). M. Amir-Maafi[1], B.L. Parker[2] and M. El-Bouhssini[3]. (1) Sunn Pest Research Department, Plant Pest and Disease Research Institute, P.O. Box 719/33715, Varamin, IRAN, Phone: (+98-21) 2403692; Fax: (+98-21) 2403691; e-mail: Mamaafi180@yahoo.com; (2) Entomology Research Laboratory, University of Vermont, 661 Spear Street Burlington, VT 05405-0105, USA; (3) ICARDA, P.O. Box 5466, Aleppo, Syria.

During a two-year field survey of the Sunn Pest, *Eurygaster integriceps* Puton (Heteroptera: Scutelleridae) on winter wheat, data sets were generated which consisted of 100 estimates of mean density (*m* Sunn Pest per quadrate (=1m^2)), variance (s^2), and the proportion of empty quadrate (P_0). Each estimate of the Sunn Pest population was based on counts per individual quadrate on each sampling occasion. Taylor's power law was used to model relationships between mean densities (per m^2 (=quadrate)) and variances for Sunn Pest on winter wheat in Varamin, Iran. The slope of the model was >1.0 for Sunn Pest, indicating that Sunn Pest adults showed aggregated spatial patterns. Sequential sampling plans, based on numerical (complete) and binomial (presence or absence) counts, for Sunn Pest were developed using Taylor's parameters and estimated from the linear regression of ln(m) on ln[-ln(P_0)]. Suggestions are made concerning the use of the sampling plans and the levels of precision that may be attained.

EFFECTS OF INDOXACARB TO A PREDACIOUS MIRID AND TWO SPECIES OF PREDATORY MITES FOUND IN ORCHARDS. Noubar J Bostanian[1], Charles Vincent[1], John M Hardman[2] and Nancy Larocque[1]. (1) Horticultural Research and Development Center, Agriculture and Agri-Food Canada, 430 Gouin Blvd., Saint-Jean-sur-Richelieu, Qc, Canada J3B 3E6; (2) Atlantic Food and Horticultural Centre, Agriculture and Agri-Food Canada, 32 Main Street, Kentville, N.S., Canada B3N 1J5, Phone (450) 346-4494, ext. 202; Fax (450) 346-7740; e.mail: vincentch@agr.gc.ca

Indoxacarb is a novel oxidiazine pro-insecticide that has no toxic effects to the adults, fecundity and eclosion of *Amblyseius fallacis* (Garman) a predacious phytoseiid and *Agistemus fleschneri* (Summers) a predacious stigmaeid. These are the two key predators that control tetranychid and other phytophagous pest mite species in apple orchards. Indoxacarb is toxic to *Hyaliodes vitripennis* (Say) a predacious mirid that has also been reported from several Quebec orchards where IPM programs are used. However, this mirid is not as important nor widely distributed as the predatory mites mentioned above. The LC_{50} for the mirid is about one half the recommended dose (0.054 g AI litre^{-1}) of indoxacarb for apple orchards. Following an application, the intoxicated mirids remained motionless as their prolegs and posterior had been paralyzed. Twenty-four hours later, they appeared smaller, shrunken and severely desiccated. Indoxacarb should only be used where *H. vitripennis* is absent and the predacious mites are solely responsible to manage the phytophagous pest mite species

UDA-245: A BOTANICAL INSECTICIDE/ACARICIDE FOR WORLDWIDE HORTICULTURAL USES. Noubar J Bostanian[1], Hélène Chiasson[2] and Charles Vincent[1]. (1) Horticultural Research and Development Center, Agriculture and Agri-Food Canada, 430 Gouin Blvd., Saint-Jean-sur-Richelieu, Qc, Canada J3B 3E6; (2) Codena inc., Saint-Charles-sur-Richelieu, Qc, Canada J0H 2G0, Phone (450) 346-4494, ext. 202; Fax (450) 346-7740; e-mail: vincentch@agr.gc.ca

Crop protection still relies largely on the use of synthetic pesticides. The use of natural products is slowly gaining acceptance among consumers because of environmental and health concerns. Monoterpenes as well as some sesquiterpenes may be a source for new classes of acaricides and insecticides. These are volatile oils subject to rapid degradation and generally less persistent in the environment than synthetic products. UDA-245 is a mixture of terpenes with such properties. It is extracted from *Chenopodium ambrosioides*, a North American herbaceous plant. Laboratory studies with adult two spotted spider mites (*Tetranychus urticae* Koch) showed that a 0.5 % concentration of this compound was significantly better than neem oil and as effective as abamectin with adult European red mites (*Panonychus ulmi* (Koch)). Used as an insecticide during greenhouse studies, UDA-245 at a 0.5% concentration was more effective than neem oil and as effective as insecticidal soap with the green peach aphid (*Myzus persicae* (Sulzer)) and more effective than neem

oil and endosulfan and as effective as insecticidal soap with the greenhouse whitefly (*Trialeurodes vaporariorum* (Westwood.)). UDA-245 at a 1.0% (greenhouse bioassay) tested with neem oil and insecticidal soap was the only treatment that maintained control of the western flower thrips (*Frankliniella occidentalis* (Pergande)). At 0.5% concentration UDA-245 was not significantly more toxic than the control (water0 treatment with the whitefly parasitoid *Encarsia formosa* (Gahan). The LC_{50} for *Orius insidiosus* (Say) and *Aphidius colemani* Viereck, two important beneficials was over twice the recommended field rate.

EVALUATION OF WHEAT CULTIVARS AND ADVANCED LINES FOR RESISTANCE TO SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON) IN IRAN. A. R. Haghshenas, D. Afiuni and M. Mahlooji, Isfahan Agricultural and Natural Resources Research Center, Isfahan, Iran; Phone: (0311) 7753013; Fax: (0311) 7757022; E-mail: ar_haghshenas@yahoo.com

The Sunn Pest, *Eurygaster integriceps* Puton, is one of the most important pests of wheat; the main damage caused is a decrease in grain quality. Every year a large amount of pesticides is used for control of this pest. The use of resistant varieties represents a potential means of managing this pest to decrease environment pollution, maintain biological balance and reduce pesticide use. To evaluate the resistance of wheat to Sunn Pest, 20 wheat lines and varieties were screened in the field from 2001 to 2003 at the Kaboutarabad Agricultural Research Station at Isfahan Province. The studied lines and varieties were Shiraz, Pishtaz, Marvdash, Mahdavi, Ghods, Falat, M-73-18, seven lines from the M-78 series and six lines from the M-79 series. Each year, the lines and varieties were planted in two separate experiments, one of which served as a pesticide-treated Sunn-Pest-free control. The statistical design was a Randomized Complete Block Design with four replicates. The planted area of each plot was 7.2 m^2 (6 x 1.2m). Metal cages of 25cm diameter were placed on the heads of varieties and 50 second to third instar were released into each cage. After maturity, mortality percentage of nymphs, average weight of newly emerged adults, grain damage percent, percent of reduction in weight per 1000 grains (TKW) were calculated in each treatment. Some other morphological traits were measured, and finally grain yield of each plot was determined. Analysis of variance for grain damage percent showed that there was significant difference ($P<0.01$) between genotypes. Genotypes No. 3 (M-73-18), 11 (M-79-4), 5 (M-78-7), 8 (M-78-15) and 17 (Falat) had the lowest percent grain damage. There was no significant difference in mortality percentage of nymphs between genotypes. Genotypes No.7 (M-78-14), 8 (M-78-15), 13 (M-79-7), 17 (Falat) and 12 (M-79-5) produced the highest grain yield respectively. According to these analyses, resistant, semi-resistant and susceptible varieties were recognized.

STUDY ON PREDATORY AND PARASITE MITE ASSOCIATED WITH OVERWINTERING SITES OF SUNN PEST IN WESTERN IRAN.
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The Sunn Pest is the most important pest of wheat in western Iran. Major overwintering sites of the Sunn Pest are beneath *Astragalus* spp. Most probably it has different natural enemies in different groups of Arthropoda in the overwintering sites, one of them are the Acari. Mites are one of the largest and most biologically diverse groups of the Arachnida. The highest population densities and species richness of free-living mites occur in the organic strata of soils where they form the numerically dominant component of the arthropod mesofauna and may constitute up to 7% of the total weight of the invertebrate fauna. Predacious and parasitic species have an effect in decreasing the population numbers of Sunn Pest. They are abundant in overwintering sites and were observed in a feeding position. This study was carried out from 1997 to 2003. In this survey, 14 mite species of predatory and parasitic mites were collected. Their scientific names are: *Neophyllobius astragalosi* Khanjani & Ueckermann, *Molothrognathus fulgidis* Summers & Schlinger, *Spinibdella cronini* (Baker & Balock), *Lorryia navidi* Khanjani & Ueckermann, *Tydeus kabutarahangiensis* Khanjani & Ueckermann, *Lorryia vieniens* Khanjani & Ueckermann, *Prozercon nr. tragrdhi* (Halbert), *Androlaelaps karawaiewi* (Berlese), *Hypoaspis sclerotarsa* Costa, *Plesiodamaeus ornatus* Prez-Indigo, *Scutovertex marenoi* Balogh & Mahunka, *Brasilobates maximus* Mahanka, *Scheloribates fusifer* Berlese, *Microcaeculus* sp.

THE PRESENT SITUATION OF SOME ALTERNATIVE HOSTS (*DOLYCORIS BACCARUM* L., *PIEZODORUS LITURATUS* F.) ON THE NATURAL ENEMIES OF SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON) IN THE SOUTHEASTERN ANATOLIAN REGION OF TURKEY.
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The Sunn Pest (*Eurygaster integriceps* Puton) is the most important harmful insect pest associated with wheat and barley in the Southeastern Anatolian. This pest has many natural enemies including parasitoids and predators in the region not only in cereal areas but also in lentil areas due to the presence of some pentatomid bugs such as, *Dolycoris baccarum* L. and *Piezodorus lituratus* F. which damage lentil and play a role as alternate hosts for these natural enemies. These pentatomid species were researched from the point of view their occurrence, distribution, hosts and importance as potential hosts of the natural enemies including mainly scelionid egg parasitoids and tachinid adult parasitoids in lentil agroecosystems. Data obtained on biological and ecological properties of these pentatomid species evaluated in an

associated lentil-cereal IPM aspect is taken into consideration with data obtained from Sunn Pest and its natural enemies in the same region.

SCREENING OF SOME WHEAT VARIETIES TO SUNN PEST IN NINEVEH PROVINCE, IRAQ. Suaad Irdeny Abdullah, Faculty of Agriculture and Forestry, Mosul University, Iraq, e-mail: Suaad_irdeny@yahoo.com

Screening of wheat varieties for resistance to Sunn Pest, *Eurygaster integriceps* Puton, was done in Alkooch fields, near Mosul, in two seasons; 2000/2001 and 2001/2002. A total of five wheat varieties were planted (Intesar, Om-rabee, Makciback, Abu-Graib and Karonia) under natural conditions for screening. Results showed that all five wheat varieties were infested by Sunn Pest. The most susceptible variety was Intesar, with an average of 4.9 and 6.1 adults/m^2 during the two seasons respectively. The averages of Om-Rabee and Makciback were 3.2 and 3.5 in the first seasons and 3.7 and 4 adults/m^2 in the second season. The Karonia variety demonstrated less susceptibility in the two seasons than the other varieties with an average of 0.6 and 0.5 adults/m^2; the yield of this variety showed more than the other varieties with an average of 5.8 and 6.3 ton/ha, respectively.

TEMPERATURE AND RAINFALL: FACTORS FOR FUNGAL SUCCESS IN SUNN PEST OVERWINTERING SITES. Margaret Skinner[1], Bruce L. Parker[1], William Reid[2] and Mustapha El Bouhssini[2]. (1) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont 05405-0105, USA, Phone: 802-656-5440, Fax: 802-658-7710, e-mail: m.skinner@uvm.edu; (2) ICARDA, P.O. Box 5466, Aleppo, Syria.

Humidity and temperature are critical factors influencing the survival and efficacy of entomopathogenic fungi. These factors must be considered when determining the best time to make a fungal application to Sunn Pest, *Eurygaster integriceps* Puton, overwintering sites. At ICARDA, Tel Hadya, Syria, temperature was recorded from 2002-2004 in a typical Sunn Pest overwintering site under pine trees at the soil/litter interface, where the insect is commonly found in winter. Precipitation data from the ICARDA weather station were also compiled. Considering the response of entomopathogenic fungal to temperature and the moisture requirements for germination, recommendations are made for the most appropriate timing of applications to Sunn Pest overwintering sites in the Aleppo, Syria region, taking advantage of climatic conditions to encourage infection.

THE INVESTIGATION OF A-AMYLASE ACTIVITY IN HIBERNATING SUNN PEST (*EURYGASTER INTEGRICEPS* PUTON). Majid Kazzazi[1], Ali R. Bandani[1], S. Hosseinkhani[2], A. Ashoori[1]. (1) Plant Protection Department, Faculty of Agriculture, University of Tehran, Karaj, Iran, Phone/Fax: 0098-261-2238529; e-mail: mkazzazi@ut.ac.ir; (2) Biochemistry department, University of Tarbiat Modares. Tehran, Iran.

Cereals, especially wheat and barely are strategic crops in Iran and much effort is put into increasing yields. However, insect pests, in particular Sunn Pest, are the main hurdle to crop production and many control measures have been taken in order to suppress their populations. Sunn Pest not only causes quantitative damages, but also destroys the baking properties of the wheat. The overall aim of the current study is to take new approaches in controlling Sunn Pest, therefore, in the first instance we are going to identify and characterize alpha-amylase activity of the insect. Bugs were collected from their hibernating sites during winter. These bugs were dissected in saline and their salivary glands and guts were separated and collected. Alpha-amylase activity in the midguts and salivary glands has been determined using starch as the substrate. In the early spring when adult bugs get activated and return to wheat field, they were collected and their alpha-amylase activity determined as mentioned above. Results showed that in both groups, the amounts of alpha – amylase activity in guts was the same but this activity was different in salivary glands for the bugs collected from hibernating sites from those collected from fields in early spring.

RELATION BETWEEN WEED GRASSES AND LIFE CYCLE OF SUNN PEST IN THE SETIF HIGH PLAINS (NORTH-EAST OF ALGERIA). Mohamed Fenni, Department of Agronomy, University Ferhat Abbes, Setif 19000, Algeria, Phone: 213 36837472; Fax: 213 36925122; Fennimodz@yahoo.fr

In the Setif high plains winter cereals are grown every year on more than 80% of the cultivated land. Wheat and barley are frequently cultivated under rainfed conditions without irrigation. In these areas Sunn Pest (*Aelia germari* Kuster, Heteroptera: Pentatomidae) has become one of the most important insect pests and causes serious damage to wheat. Adults overwinter in the mountains located in the north (altitude between 1200 and 1600 m), and descend to cereal fields in the spring. Our study showed that during migration to wheat fields (second half of March - beginning of April), *A. germari* populations first feed and develop on weed grasses, mainly those at the edges of fields. This period corresponds to the pre-ovulation, which is an essential phase to the continuation of their life cycle. Graminaceous weeds, which we list as intermediary plant hosts, are *Avena, Bromus, Dactylis, Lolium* and *Hordeum* spp. The early development of these weeds relative to the cereals is supported by the use of bad cultivation techniques (e.g. bad ploughing, late sowing). This study showed that the weeding and in particular on the edges of the

fields is an effective control of Sunn Pest. This remains complementary to chemical and cultural methods usually used.

BIOLOGY, ECOLOGY AND CHEMICAL CONTROL OF SUNN PEST, *AELIA GERMARI* KUSTER (HETEROPTERA, PENTATOMIDAE), IN THE SETIFIAN HIGH PLAINS (NORTH-EAST OF ALGERIA). Mustapha Bounechada, Department of Agronomy, University Ferhat Abbes, Setif 19000, Algeria, Phone: 213 36835859; Fax: 213 36835859/ 213 36925122; Bounechadam@yahoo.fr

The study was conducted in the Setifian high plains during 1999-2000. *Aelia germari* is one of the most important insect pests on cereals. The objectives of this study were to study the life cycle of *A.germari* under field conditions and to determine the age distribution of the Sunn Pest population in relation to the different phenological stages of the wheat plant (*Triticum durum*) and the damage caused by it. The results showed that the insect had two generations per year. The insect emerges from winter diapause during the early spring (second half of March – beginning April) when the average temperature is ~ 20°C. The insect has five developmental stages. The first and second generations take 40 and 35 days respectively. This study also gives information on the chemical insecticides used in the region against *A. germari*.

A STUDY OF THE SUNN PEST SPECIES ON CEREAL CROPS IN THE SETIFIAN HIGH PLAINS (NORTH-EAST OF ALGERIA). Adel Nadjib Chaker, Department of Agronomy, University Ferhat Abbes, Setif 19000, Algeria, Phone: 213 36925122; Fax: 213 36925122; chakeran@yahoo.fr

The Setifian high plains (North-East of Algeria) is one of the largest areas of cereal production in Algeria. Several insect pests attack these crops; among these are the Sunn Pest species. A survey for Sunn Pest species on cereal crops (*Triticum durum* var. Mohamed bachir) was conducted in different localities of the Setifian area from 1999-2000. Ten Sunn Pest species were recorded. The most harmful were *Aelia germari, Eurygaster maurus* and *Dolycoris numidicus*. The importance of each varied according to season and locality. The study also showed the damage caused by the pest could be detected on durum wheat.

PREDICTION OF SUNN PEST LIFE CYCLE USING ENVIRONMENTAL DATA OVER THE NORTH –EAST OF THE I.R. OF IRAN. A. Movaghar Moghaddam[1], M. Fallahi[2], B. Bazrafshan, A.R. Shah Tahmasebi[1], S. Samadi[1], T. Golmakani[1], L. Goli Mokhtari[1]. (1) Climatologic Research Institute, Mashhad, P. O. Box: 91735-676, Iran; Phone: (+98-511) 3400306/9; Fax: (+98-511) 3400310; e-mail: moghaddam123000@yahoo.com; (2) Control Management Plants Khorasan, Iran.

Thirty-two percent of the total agricultural crops in Iran are destroyed by pests, diseases and weeds. Cereals are the most important and strategic of these crops. It has been shown that pests and diseases cause great economic damage to the country. Environmental factors such as temperature, humidity, radiation etc. are very important for pest life cycles. Temperature is an important parameter for pest's growth. Pests in each stage of their life cycle need special temperatures. In this paper, we study the Sunn Pest (*Eurgaster integriceps*) life cycle (immigration, oviposition, damage duration) in the North-East of Iran. Then we use the growth degree days (GDD) by calculation of a rectangular model for 16 stations in North-Eastern Iran, which have been chosen as pilot sites and have been studied for the last 10 years. We provide for the North-East of Iran, a geographical classification map for the beginning of Sunn Pest growth, damage duration, and end of the oviposition stage and probability of their occurrence. This map helps with the prediction the Sunn Pest outbreaks. This pattern can be used for parts or all of Iran.

MORPHOMETRIC ANALYSIS OF TWO POPULATIONS OF *EURYGASTER MAURA* L. (HETEROPTERA: SCUTELLERIDAE) FROM IRAN. Jafar Mohaghegh, Plant Pest & Disease Research Institute, P.O. Box 1454, 19395 Tehran, Iran, Phone: (+98-21) 240 36 92; Fax: (+98-21) 240 36 91, E-mail: jmohaghegh@lycos.com

Morphometric differentiation may explain bio-ecological distinctions among populations of a given species. Two populations of *Eurygaster maura* collected from the northeast (Golestan province) and the northwest (Azarbayejan province) of Iran were compared, using principal component analysis over 22 body measurements (8 absolute and 14 proportional, separately and in combination). The northeast population occurs in a relatively humid subtropical climate, whereas the northwest population inhabits a relatively humid temperate climate. Morphometric analysis revealed a distinction between the two populations, mainly affected by the absolute measurements. The northeast individuals were relatively larger than those of the northwest; total body lengths of the former were 13.56 ± 0.098 and 13.25 ± 0.076mm (female and male, respectively), and the respective values for the latter were 12.75 ± 0.078 and 12.63 ± 0.098mm. Different habitats and climatic conditions may explain, in part, these morphometric variations. The findings may also suggest separate geographic origins for the studied populations.

STUDIES ON THE DETERMINATION OF THE FAT RATE OF SUNN PEST, *EURYGASTER INTEGRICEPS* PUTON, (HETEROPTERA: SCUTELLERIDAE) TO FORECAST SUNN PEST POPULATIONS IN FIELDS IN THE SOUTH EAST ANATOLIA REGION OF TURKEY. Vedat Karaca[1], Eyup Kiran[1], Serife Fidan[1], Mehmet Bashan[2], Ramazan Canhilal[3] and Abdullah Demir[1]. (1) Diyarbakir Plant Protection Research Institute, The Ministry of Agriculture and Rural Affairs, Zirai Mucadele Arastirma Enstitusu, Yenisehir, Diyarbakir, Turkey; Phone: (+90-412) 223 83 21; Fax: (+90-412) 224 4775; e-mail: herbodemir@hotmail.com; (2) Biology Department, Faculty of Science and Literature, Dicle University; (3) General Directorate of Protection and Control, The Ministry of Agriculture and Rural Affairs

Sunn Pest is one of the most important pests of cereals (wheat and barley) in the South East Anatolia Region of Turkey. The objective of the study was to determine the fat rate of Sunn Pest from wheat and barley fields and overwintering sites to forecast Sunn Pest populations in fields. The study was done in Diyarbakir, Mardin, Şanlıurfa, Elazığ provinces and in overwintering sites in Karacadag. The lowest fat rate (2.36%) was determined in overwintered adults in wheat fields in the spring. The highest fat rate (29.82 %) was seen in new generation adults, just migrated to overwintering sites in autumn. In 1998, the fat rate of Sunn Pest under the snow in the overwintering sites was 60.1% lower when compared to Sunn Pest in the wheat fields. At the end of study, it was determined that the fat rate of Sunn Pest reduced by 41.9% during the overwintering period.

ECOLOGICAL PRINCIPLES OF SUNN PEST MONITORING IN KAZAKHSTAN. Amangeldy Sarbaev, The Laboratory of Plant Immunity and Protection at the Research-and-Production Center for Agriculture and Plant Growing, Almaty, Kazakhstan, Phone: (8-3272) 983608; Fax: (8-3272) 983608; (8-3272) 55118; e-mail: cimmyt@nets.kz

An investigation of Sunn Pest in Kazakhstan has allowed us to identify their natural habitat, harmfulness, and population dynamics in relation to abiotic and biotic factors of the environment. Their biology, ecology, phenology and economic thresholds have been studied. Methods of forecasting and the appropriate time for Sunn Pest population surveying and estimation and crop treatment have been developed. The regional systems of wheat crop protection have been improved.

STUDIES ON SUNN PEST OVERWINTERING SITES, PARASITOIDS AND EFFECTS OF SUNN PEST ON CEREAL LINES AND VARIETIES IN KONYA PROVINCE, TURKEY. A. Faik Yildirim[1], Engin Kinaci[2] and Meryem Elmali[3]. (1) Anatolian Agricultural Research Institute, P.O. Box 17, Eskişehir, Turkey, Phone: (+90-222) 3242967; Fax: (+90-222) 3240300; e- mail: faik1952@mynet.com; (2) Osmangazi University Faculty of Agriculture Eskişehir, Turkey; (3) Selçuk University, Faculty of Agriculture Konya, Turkey.

Sunn Pest is one of the most important pests of cereals in Central Anatolia, Turkey, affecting both grain yield and quality. In this study, the overwintering sites, Sunn Pest death rate in overwintering sites, and their migrations to cereal fields in Konya province was investigated. It was found that *Eurygaster maura* and *E. austriaca* are prevalent in the Konya area. The rate of egg parasitoids of Sunn Pest ranged from 4 to 93.8 % and parasitoids were more abundant in irrigated and bushy areas. *Trissolcus grandis* was the most common egg parasite in the region. Caged experiments were conducted and field screenings of resistance were done. In the cage experiments, there was variation among varieties in the rate of grains damaged by the pest, and the hard red grains were less damaged. In the fields, nymphs and new adults of Sunn Pest were found to be higher in number in some lines and varieties than others.

HARMFULNESS OF SUNN PEST IN GRAIN CROPS OF AZERBAIJAN. Sardar Ibragimov, M.H. Seidov and N.H. Azizova, Azerbaijan Research Institute of Agriculture (ARIA), Azerbaijan; Phone: (+994-12) 97-49-31; Fax: (994-12) 97-49-31; E-mail: sardar164@yahoo.com; sevka_m@yahoo.com

In Azerbaijan, the most widespread cereal pests are Sunn Pest (*Eurygaster integriceps*), the grain ground beetle (*Zabrus tenebriorides*), the cereal leaf beetle (*Lema melanopa*), the green bug (*Schizaphis graminum* = *Toxoptera graminum*), grain thrips (*Haplothrips tritici*), stem sawflies, gout flies and cereal flies. Sunn Pest is the most important pest of winter wheat; it is distributed in all cereal-cultivated zones of Azerbaijan. On winter crops Sunn Pest appear at the end of March or the beginning of April at 11-20°C. Egg masses are laid the following 15-20 days. During the spring period bugs pierce stems at the base, causing destruction of leaves, frequently the stem dies off. Damage of stems during booting and the beginning of the heading stage of winter wheat causes discolored ears and caused shrinkage of grains. Occurrence of nymphs coincides with the booting stage of winter wheat. The second instar appears before heading of winter grain; from this age nymphs start to feed. Mass occurrence of last instar coincides with the beginning of the waxy ripeness of winter wheat. As the nymphs feed on the grains they shrink causing damage to the endosperm, which results in loss of germination and low baking quality. Experiments on studying individual winter wheat varieties' resistance to this harmful bug were carried out in Azerbaijan at the Terter and Qobustan experimental base stations of ARIA. Estimation and observation were

done from the occurrence period of the overwintered bugs to the occurrence of the fifth instar. Observation under natural conditions showed that bugs occupied various varieties in unequal abundances. Results of our observations have shown that varieties at which earring, milk, waxy and full ripeness stages pass faster are poorly occupied. Late-ripening varieties with prolonged organogenesis stages were occupied more intensively. There is a relation between the development of the harmful bug from that of its host plant; when the development of nymphs and the rate of grain development do not coincide, it causes death among the younger instars and reduces the survival of the insects capable of developing through to the overwintering imago. Literature results and our observations suggest that the organogenesis stages play a strong role in nymph feeding and impact the harmful bug imago. Varieties with slower organogenesis had 7.5 – 9.0% damaged grains, while varieties with faster organogenesis had 1, 2-3, and 0% damage. The following factors negatively affected bug biodynamics: (i) Antibiosis, adverse influenced the pests at eggs laying, and feeding; (ii) Morphological features of plants (pubescence, a waxy bloom, glum hardness); (iii) Early maturing varieties- plant ontogenesis and bug development are not synchronized; (v) Moisture content in caryopsis. In Azerbaijan conditions relatively resistant varieties to Sunn Pest were Mirbashir -50, Qaraqilchiq -2, Azamatly-84, Nurlu -99 and Qiymatly - 2/17. In connection with the outbreaks of many kinds of pests of grain crops during the previous years, entomological research in Azerbaijan is required.

SUNN PEST POPULATION UNDER DIFFERENT PLANT SPECIES IN OVERWINTERING SITES IN IRAN. Bruce L. Parker[1], Masood Amir-Maafi[2], Margaret Skinner[1], Mustapha El-Bouhssini[3], and Scott D. Costa[1] (1) Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington, Vermont 05405-0105, USA, Phone: 802-656-5440, Fax: 802-658-7710, e-mail: bparker@zoo.uvm.edu; (2) Sunn Pest Research Department, Plant Pests & Diseases Research Institute, 719/33715, Varamin, Iran; (3) ICARDA, P.O. Box 5466, Aleppo, Syria.

Sunn Pest populations were determined beneath *Astragalus* sp., *Artemesia* sp., *Quercus* sp., and *Serratula latifolia* in overwintering sites in Esfahan and Varimin, Iran. When comparisons were made within an overwintering site, higher numbers of Sunn Pest adults were found overwintering beneath *Astagalus* sp. than *Artemesia* sp. Sunn Pest adults also overwinter beneath *Quercus* sp. and *S. latifolia* in Iran although populations were generally low. Implications for sampling and management of overwintering Sunn Pest adults are presented.

INVESTIGATIONS ON THE MASS PRODUCTION AND STORAGE POSSIBILITIES OF THE EGG PARASITOID, *TRISSOLCUS GRANDIS* (THOMSON) (HYMENOPTERA: SCELIONIDAE). Münevver Kodan[1] and M. Oktay Gürkan[2]. (1) Central Plant Protection Research Institute, 06172 Yenimahalle, Ankara, Turkey, Phone: (+90 312) 3447430; Fax: (+90 312) 3151531; e-mail: munevverkodan@hotmail.com; (2) University of Ankara, Faculty of Agriculture, Department of Plant Protection, Dışkapı-Ankara, Turkey.

In this study, the mass production of *Trissolcus grandis* on stored eggs of *Dolycoris baccarum*, an alternative host of the parasitoid, was investigated. Parasitized 6-8 day old and 10-12 day old *D. baccarum* eggs were stored at 5±1°C in a refrigerator for 5-60 days after which parasitoid emergence was determined. Parasitoid emergence occurred until the 20th day of storage but no emergence occurred after the 25th day. Emergence period was similar both in stored eggs and the control. Longevity was shorter in parasitoids obtained from stored eggs when compared with control. All examined parameters were similar both in 6-8 day old and 10-12 day old parasitized and stored eggs.

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