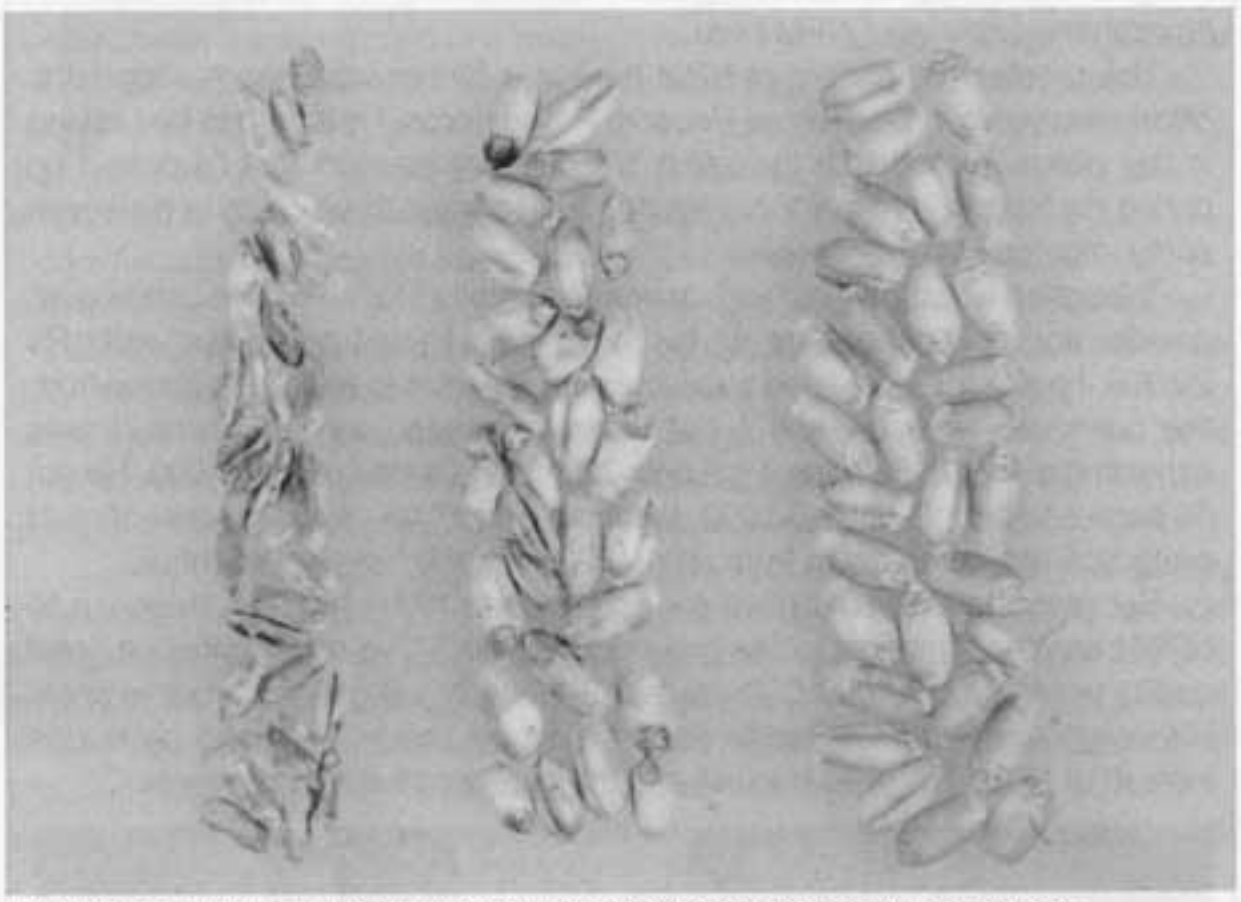
A multi-pronged attack against the sunn pest

By 2025 grain shortages in West and Central Asia and North Africa are predicted to reach 80 million tons. One of the reasons for this shortage is the damage done to wheat by the sunn pest. A programme for tackling the pest is underway. Key collaborating institutions in the programme are the International Center for Agricultural Research in the Dry Areas (ICARDA), the University of Vermont (UVM) and the National Agricultural Research Systems (NARS) from Iran, Syria, and Turkey.



Severely damaged seeds by Sunn pest feeding to the left and healthy seeds to the right.
Credit: ICARDA

Sunn pest feeding on wheat.
Credit: ICARDA

Sunn pest (*Eurygaster integriceps* Puton) is an insect that has emerged as the major factor reducing wheat production in West and Central Asia and Eastern Europe, commonly causing yield losses of 50-90 per cent. Damage often reaches 100 per cent; even rendering straw unpalatable to livestock. The area affected is enormous: over 15 million ha, representing regions with high population growth, scant rainfall, limited arable land, and low per capita income.

To tackle the pest, collaborators from ICARDA, UVM and NARS have focused on developing a number of 'tools' which will be used in an integrated pest management (IPM) programme. These will replace the traditional use of chemical pesticides. The programme includes using resistant varieties of wheat, standardised methods for counting pest populations so that economic threshold (ET) levels can be determined, and biological agents. The researchers have drawn on expertise from local, regional, and international entomologists, socioeconomists, insect pathologists, chemists, pest managers, breeders and training specialists. Transferring this new approach has been undertaken by NARS.

Damage For the area's population, wheat is the staple food, providing over 40 per cent of per capita dietary calories and protein. Largely because of the sunn pest, wheat production in affected regions is commonly three times less than the world's average of five tonnes/hectare.

This insect feeds on the wheat leaves, stems, and grain all through the growing season. They inject chemicals that decompose the grain's gluten, the vital substance that gives dough the cohesiveness needed to rise. If as little as two to three per cent of grain is affected by these enzymes, flour is unsuitable for baking. Grain with evidence of sunn pest infestation sells for significantly less than undamaged lots.

Sunn pest adults spend about nine months overwintering in nearby local vegetation, and migrate back to cereal fields in the spring around mid-March. In wheat or barley fields they mate and start laying eggs.

Control Historically, government-coordinated aerial spraying of chemicals was the standard means of management, which for emerging national economies, was expensive, often costing over US$150 million annually, draining budgets already limited for agriculture. Recently, though, farmers and pest specialists have noticed pesticides have become less effective as damage by the pest has increased. There was also concern about the damage to the environment and the danger to local communities.

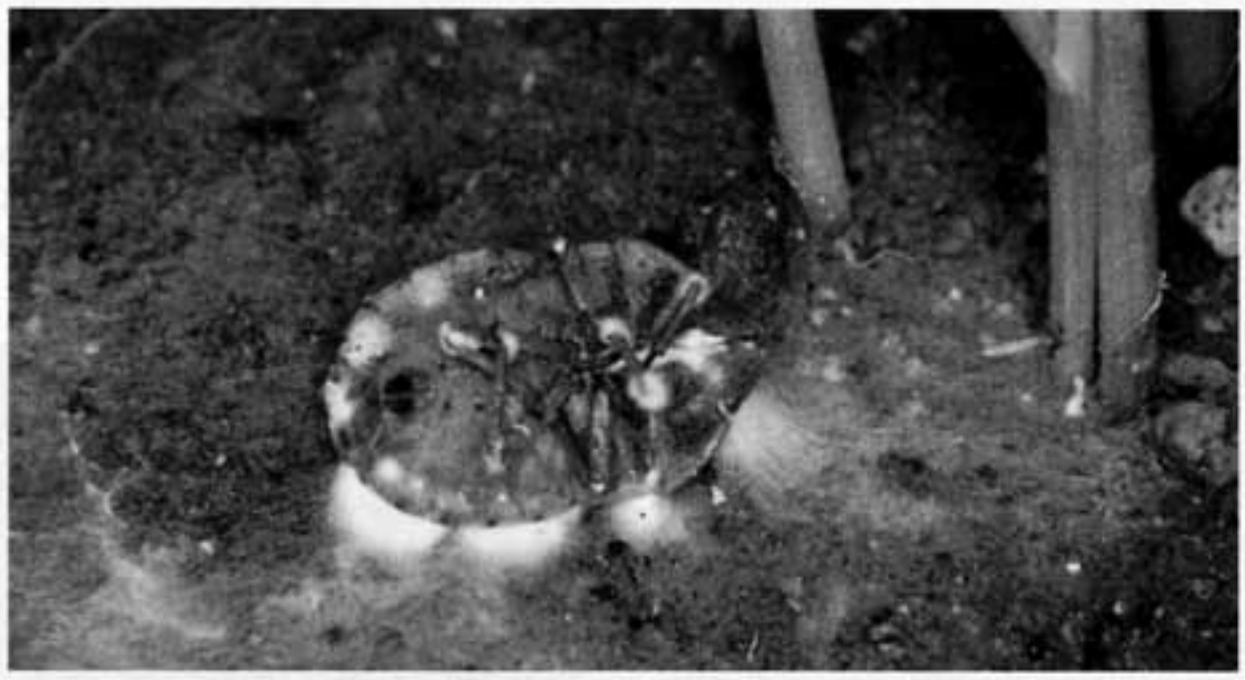
Local governments controlled aerial spraying. The decision to spray was taken after pest counts or economic thresholds (ET) reached a certain level, but the spraying itself was carried out over large areas indiscriminately, killing some of the pests and most of the beneficials.

Soon after the IPM programme started it was decided to improve the method for pest counting and deter-

mining the ET levels. Accurate pest counts and forecasting are crucial for IPM. Farmers and government representatives must be able to accurately predict damage so they can calculate if and when action is needed. No standardised scouting methods existed across the region, which made it difficult for researchers in different countries to collaborate. Results from country to country were not comparable. Through this programme, scouting methods and established ET values were reassessed, leading to revised standard levels and higher ETs. Farmers have been taught how to make accurate counts and determine the right ET levels by attending farmer field schools, which were aided by training materials produced and translated into local languages.

Using the revised ET levels, fewer and more timely aerial applications are now made. More natural enemies are now preserved and sunn pest populations are reduced.

As a direct result of this project, reliance on insecticides was shown to be counter-productive and ineffective. NARS scientists have taken the results from this programme to their agricultural policymakers and convinced them that ground applications by farmers according to revised ETs is cheaper, more ecologically sound, and, most important, more effective. This policy change has been fully implemented in Turkey and Iran in over three million hectares, producing significant savings and decreased sunn pest damage. These shifts in government policy have resulted in targeted pesticide applications which will enable the mix of natural enemies to be restored. In turn, this allows other IPM components, including fungi, predators, host-plant resistance, and others, to be used to their full potential.



Sunn pest infected by insect killing fungi

Credit: ICARDA

Turkish farmers attend a farmer field school.

Credit: ICARDA

Biological methods

About a decade ago, UVM scientists started looking at the potential for using insect-killing fungi for sunn pest control. Over 250 indigenous fungal strains from the region were isolated and placed in permanent storage; many fungal strains were characterised to determine their potential as pathogens; mass-production techniques were perfected and simple, region-appropriate formulations were developed; trials were conducted to assess fungal efficacy and persistence under field conditions. Scientists at CAB International Bioscience, UK, completed molecular analyses to better understand regional relationships among sunn pest fungi.

As a result of the great promise of fungi for sunn pest management demonstrated through this programme, a model insect pathology facility was established at ICARDA--the first in the Central and West Asian and North African region (CWANA)--with the capacity to conduct high-level research on fungal-based management, mass produce fungi for large-scale field testing, and provide a training site to expand capacity regionally.

Two possibilities for using the fungi *Beauveria bassiana* are being investigated. Oil formulations of fungi could be used to infect the pest as it migrates to the wheat fields in the early spring; this technology is being developed in collaboration with CABI Bioscience. The other option is the use of granular formulations, which could be used to infect the sunn pest in their over wintering sites among the foothills surrounding the fields.

Another biological agent that is being considered is the use of parasitic wasps which occur naturally in the area. The effectiveness of these parasitoids is still being researched. Rearing facilities have been established, and releases of parasitoids have taken place in several countries. Another IPM tool is the use of resistant varieties of wheat. Screening of wheat cultivars from the region was initiated at ICARDA using a method based on field screenings. This resulted in identification of several sources of resistance to the sunn pest in wheat and its wild relatives. These are being used by breeders to develop resistant varieties.

Collaboration

ICARDA entomologists have always worked closely with NARS scientists and appreciate the pest issues facing CWANA farmers. The emergence of the sunn pest as a persistent problem called for a fresh look. The IPM initiative was launched in 1996 following discussions between ICARDA and UVM entomologists, who had expertise with insect-killing fungi. Natural infections of fungi had been observed killing the sunn pest for many years, but expertise to investigate this biological control approach was lacking in the region. With funds from the US Agency for International Development, and later from the Conservation, Food and Health Foundation, collaborative research proceeded. NARS scientists from several countries were involved in the early phases, and it was their expertise which made it easier to collect infected sunn pests from overwintering sites in nine West and Central Asian countries. Despite significant progress with insect-killing fungi, it was clear from the beginning that beneficial microbes alone could not solve the problem. A comprehensive IPM approach was the only way to achieve sustainable control. Funds were solicited from the United Kingdom's Department for International Development (DFID) that allowed the core partners to expand their scope. Developing the key IPM tools has involved close collaboration with researchers in Syria, Turkey, and Iran, as well as developing methods for technology transfer to the farmers through field schools.

Much of the IPM work has taken place in Turkey, Syria, and Iran, but the impact is far wider. Through training workshops, brochures in local languages, scientific conferences, a BBC film, and many other activities, the benefits of this programme have reached other countries, including Afghanistan, Iraq, Uzbekistan, Kyrgyzstan and Kazakhstan. The success of the sunn pest IPM program demonstrates that a multidisciplinary, international, collaborative approach is our only hope for solving the serious regional pest problems of the world.

More information from Drs. Margaret Skinner and Bruce L. Parker, Entomology Research Laboratory, University of Vermont, 661 Spear Street, Burlington VT 05405-0105, USA. Tel: +1-802-656-5440; fax: +1-802-658-7710; e-mail: bruce.parker@uvm.edu; m.skinner@uvm.edu; web site: www.uvm.edu/~entlab. Dr. Mustafa El Bohssini, ICARDA, P O Box 5466, Aleppo, Syria. E-mail: m.bohssini@cgiar.org

"Hands-on-training" at an IPM workshop in Kabul included how to calibrate sprayers.

Credit: ICARDA