



The tiny leafminer, sometimes known as the pea leafminer, emerged from its home in the Americas sometime in the 1970s, invading farms in Africa, Asia, and Europe. Once thought to have spread to developing countries from Europe, scientists now believe that the leafminer traveled

GLOBAL COOPERATION  
NEEDED TO COMBAT  
LEAFMINER FLY



from its place of origin in Central America on vegetable and flower exports. It is now considered a significant threat to agriculture and the environment.

THE LEAFMINER FLY (*LIRIOMYZA HUIDOBRENSIS*), AN INSECT PEST THAT ATTACKS POTATOES AND A RANGE OF OTHER HORTICULTURAL CROPS, IS FAST BECOMING A WORLDWIDE CAUSE FOR CONCERN TO FARMERS, CONSUMERS, AND ENVIRONMENTALISTS

“Leafminer is nearly as serious a problem as the whitefly,” says Pamela Anderson, the International Potato Center’s Deputy Director General for Research. “It’s found throughout the tropics and is fast becoming a leading cause of pesticide abuse.” Anderson, an entomologist, was the head of the CGIAR Tropical Whitefly IPM Project until she joined the Center in June of 2002.

### TEST CASE IN CAÑETE

CIP first began working on the leafminer fly problem in the 1990s in Peru's Cañete Valley, one of the country's leading agricultural zones. This work is well known in agricultural circles as the first successful test case of classical integrated pest management (IPM) for leafminer fly, says Aziz Lagnaoui, a former CIP IPM



YELLOW TRAPS, FIRST TESTED IN CAÑETE VALLEY, ARE USED TO MONITOR LEAFMINER FLY POPULATIONS.

specialist now working with the World Bank's Department of Sustainable Development.

"Cañete was a convenient place to start, and the problems we encountered there were significant. In many instances farmers' fields looked like they had been attacked by flamethrowers," Lagnaoui says.

At the time, the valley's potato producers were spraying pesticides in dangerous chemical cocktails, mixing compounds such as methyl parathion with other toxic insecticides. Virtually all of the chemicals being used in Cañete had been classified by the World Health Organization as "extremely hazardous." The Cañete studies, which were conducted in cooperation with the NGO Valle Grande and local farmers, showed that the valley's leafminer fly explosion was directly linked to pesticide misuse. Even so, as the problem intensified, farmers used increasing amounts of chemicals, in some cases spending up to US\$800 per hectare. It was obvious, Lagnaoui says, that the insect had developed resistance and that the chemicals were no longer working.

Research in Cañete Valley eventually led to a major shift in strategy. Instead of attacking the pest during its adult stage, farmers were shown how to use parasitoid wasps to kill the larvae before they could grow to adulthood and



CIP RESEARCHER WARSITO TANTOWIJOYO AND FARMER-RESEARCHER GUNAWAN INSPECT A FIELD DURING A PROJECT PLANNING WORKSHOP IN TANAH KARO, NORTH SUMATRA.

highlands of Indonesia where they attacked potato and vegetable crops.

In each of the locations where it was found, the pest had become increasingly difficult to control with insecticides, and there were indications that the natural enemy complex had

reproduce. The tiny wasps, which feed only on leafminers, lay their eggs on or near the larvae, which serve as a food source.

Other measures that contributed to the success included the use of less toxic pesticides combined with crop rotation when possible, practices that help prevent the pest from developing resistance, or at least delay it. In addition, farmers were taught how to monitor infestation level before spraying. Valle Grande officials would later testify to the results: the research saved farmers a great deal of money and helped to promote a more sustainable way of controlling the pest.

#### POPULATION DYNAMICS

The progress made in managing the problem was encouraging, but by the mid-1990s the pest was spreading rapidly to other areas. Leafminers had become a problem in Southeast Asia, for example, and were already a major pest in the



been disrupted. It was agreed that basic studies on the population dynamics of the pest and its natural enemies would be needed to make informed recommendations for an integrated management scheme.

In 1997, CIP scientists initiated the first in a series of population dynamics studies. By collecting basic information about the pest and

LEAFMINER DAMAGE (ABOVE) IS EVIDENT IN THE FIELDS OF BANJARNEGARA, CENTRAL JAVA.

associated natural enemies, the studies provided a better understanding of the pest's biology and behavior, as well as its interactions in different farming systems and ecologies. Indonesia was considered an ideal location to conduct the studies because of its tropical environment and because the leafminer was a relative newcomer to the area.

"Population dynamics studies can be tedious and even back-breaking research, but without them you're working in the dark," says Anderson. "The natural tendency is to say that leafminer is a problem, so let's do something about it. Until you have a basic understanding of how the insect relates to the environment and to the farmers' production system, however, it's unlikely that you're going to make progress towards sustainable management."

#### **MAKING WAY FOR NATURAL ENEMIES**

Working with funds provided by the Australian Centre for International Agricultural Research, CIP scientists studied the leafminer and its natural enemies in close collaboration with local farm groups, national research institutes, and a variety of nongovernmental organizations. The trials, which are on-going, continue to provide important new information on the biology and

ecology of the pest and its natural enemies. One key finding has been that in potato plots where no insecticides were applied over three cropping cycles, leafminer populations gradually decreased, along with damage to the crop. The studies also showed that parasitoid species emerging from leafminer pupae had become more diverse, increasing the chances of controlling the pest without insecticides.

In North Sumatra, where the pest was previously abundant, the studies showed that the insects had all but disappeared. Moreover, when farmers who had stopped potato production resumed growing the crop, the leafminer's natural enemies that had re-established themselves continued to suppress the pest. Equally encouraging was the fact that participating farmers began to recognize the negative link between pesticides and leafminer infestation.

#### **GLOBAL PROJECT**

"We've also learned from the studies that the best way to tackle leafminer fly is globally and collaboratively," Anderson adds. The problem is simply too big, too widespread, and too important for any one organization to handle it on its own.



## HOPE FOR A LEAFMINER-RESISTANT POTATO

The long-term goal of a population dynamics study is to set the stage for the development of recommendations for an integrated pest management (IPM) program that farmers can use to effectively and sustainably manage pest infestations. IPM “packages” typically include traps, biological control agents, selective insecticides, and, when available, resistant varieties.

At the present time, there are no commercial potato varieties with high levels of resistance to leafminers. Recent trials, however, have identified five advanced lines—two of them with high levels of resistance—that may prove useful in managing the pest.

“The resistance was discovered by chance when a series of CIP breeding lines entered standard evaluation trials in 2002,” says Meredith Bonierbale, Head of CIP’s Crop Improvement and Genetic Resources Department. “These particular

lines were developed for other purposes, such as for resistance to late blight or production from true potato seed,” she says. “Fortunately, the broad genetic base of CIP’s breeding populations and their exposure to diverse stress conditions during selection enables us to identify varieties that will be robust in countering various pest and disease problems beyond our primary targets.”

Experiments conducted with farmers in Peru’s Cañete Valley will help to test whether or not the new lines can be used to produce a successful crop without resorting to pesticides. If the trials are successful, it should then be possible to boost the effectiveness of future IPM schemes by providing farmers with the option of planting resistant varieties.

The availability of a leafminer-resistant potato, entomologists say, could reduce the number of times a farmer needs to apply insecticides by 70 or 80 percent.

For example, taxonomists estimate that there are approximately 3,000 different species of leafminers, although only four species cause serious damage to food crops. Those four, however, can be hard to distinguish. "To move forward, we will need the services of molecular taxonomists who can identify with certainty the existence of the pest at specific locations," says Anderson. Similar services would be required for leafminer predators and parasitoids, which are also difficult to identify.

"It's our hope that in the future leafminer research will be conducted globally so that we can attack the problem from a systems perspective," Anderson says. At the moment, CIP research is limited to the species that attack potatoes. A global project would address all

major species across a range of cropping systems and ecologies. It would also involve researchers from many different national and international organizations, drawing in financial resources from multiple sources and eliminating duplication of effort.

"What we would like to see is a program that pulls together the best research currently available, fills in the gaps in our knowledge, and eventually provides us with a comprehensive overview of the problem," Anderson says. Critical to that effort would be the use of modern molecular techniques, geographic information systems, and computer modeling. The project, Anderson estimates, would cost approximately US\$7.5 million over a five-year period.