

Research begins in the field


The Resistance Managers



Keeping a tab on the tiny troublemakers: Dr. Thomas Bretschneider (left) and Dr. Ralf Nauen consider macroscopic photographs of the pollen beetle.

Crop protection agents secure crop yields. But the problem is that these weapons against ravenous pests can come to lose their edge over the years. Scientists like Dr. Ralf Nauen and Dr. Wolfgang Thielert develop ingenious strategies to prevent this from happening. Resistance management is an essential tactic in the long-term control of beetles, aphids and other pest insects. Scientists in the Product and Project Support Group of Bayer CropScience's Research Department use this tactic to tackle pests – in order to support farmers around the globe.





Until recently, oilseed rape crops in Middle Europe weren't always able to develop as well as the one in the picture. Pollen beetle populations resistant to pyrethroid active substances were becoming ever more problematic, causing significant yield losses. Today, however, farmers can rely on Biscaya to control these pests effectively.

Crop protection researchers are involved in an ongoing battle. And it's the entomologists above all who have to keep a close eye on their opponents. This explains why the poster hanging above Dr. Ralf Nauen's desk shows a shiny black beetle – the so-called pollen beetle – magnified many dozens of times. This ravenous pest is one of the adversaries the biologists have to tackle. Nauen's specialist area: resistance development in insects and mites around the globe. For even if researchers continue to develop new, effective active substances for controlling pests, the target beetles and aphids can also “learn” to degrade these substances within their bodies – in other words, they become resistant, so that even the sharpest-cutting chemical tools lose their edge.

“The emergence of resistant pests is not a new phenomenon”, explains Nauen. “As early as 1908, researchers observed that a particular species of scale insect had started to survive lime sulphur treatments, even after successive applications,” says the entomologist. Nauen developed an early fascination for crop protection research. He was only sixteen years old when he came to Bayer CropScience, at first undergoing training as an assistant biology technician. Once exposed to research into insecticides, Ralf Nauen became determined to learn more, so he decided to follow his eight terms of chemistry with a biology course. He later went to England to do his PhD research. “Scientists used to avoid talking about resistance – despite evidence that even the best of active substances lose their efficacy eventually”, explains Nauen, thinking back to the early days of his career in crop protection. “But what's

important is how you deal with it. These days, a research-based crop protection company like Bayer CropScience is able to offer farmers solutions that preserve the efficacy of the active substances for as long as possible.” And this is exactly where he sees his work.

Dr. Wolfgang Thielert also knows just how to deal with resistant pest insects. The agricultural scientist is a colleague of Nauen in Bayer CropScience's Product and Project Support Group in Monheim. Together, they do everything possible to maintain the activity of crop protection agents. Thielert explains that farmers are faced with a similar situation to medical doctors. “It's comparable to what happens when an antibiotic is used inappropriately and loses its activity because the pathogen has become resistant”, explains Thielert, who has been active in the daily effort to control crop pests for 25 years now. Before devoting himself to insecticides research, the agriculturalist first gained experience at Bayer CropScience in the control of fungal pathogens and weeds. Thielert came to recognize the challenges facing agriculture during his youth, when helping with the harvest. “I remember being impressed by the fact that the farmers had to think ahead, and to take actions based on a number of decisions”, explains the agriculturalist. These days, he's working hard to make sure that the harvest can continue to be protected using effective insecticides.



On the pests' trail: Yellow bowls are useful for determining the density of pests in rape fields.



Pollen beetle invasion on a rape inflorescence.

And this is no small challenge either: resistance problems are ever present. "Take the example of the pollen beetle. For decades, control programmes were strongly dominated by the pyrethroid class of active substances. The problem was that their products all shared the same mode of action in the insect", explains Thielert. "Resistant populations are on the increase, and the pyrethroids are in danger of losing their efficacy", continues the agriculturalist. His colleague Nauen adds: "It is important that farmers make the most of the various classes of active substance that are available, with their different modes of action."

Pests in focus

A recommendation that is not always easy to put into practice. The two crop protection experts know this from their long years of work: farmers often have few alternatives at their disposal, meaning that very often, the same active substances tend to be applied repeatedly. With time, the pests adapt to the substances by developing resistance. "The resistant insects are able to produce enzymes that degrade the active substances more quickly. This selective advantage helps them to spread rapidly within the population, such that following generations of the pest no longer respond to the substances", explains Nauen.

The scientists' work also includes regular collection of pests from fields throughout the whole of Europe, within the framework of resistance monitoring programmes. Over the years, insects and mites from more than a thousand populations have found their way into the laboratories of the Product and Project Research Group. "The samples sometimes arrive in bizarre packages. We were once sent insects in an empty insecticide container", says Nauen, grinning. "Of course, it was no longer possible to investigate these, because the minimal amount of product left in the container was still enough to kill them". Living beetles – packed into little bags, newspaper or boxes – are carefully scrutinized by the researchers in the laboratory. The insects are tested for their response to various active substances. This allows a resistance map to be created for Europe, showing the prevalence of different pollen beetle strains. But the Bayer CropScience researchers are also called upon to provide "emergency support" in connection with the appearance of resistance: "In 2006, pollen beetle populations exploded so strongly that even vegetable plots were being attacked. Then it was clear that we couldn't afford to wait anymore – we had to do something", is how Thielert remembers the call for help from the agricultural community. "This emergency situation prompted the regulatory authorities to bring forward the approval of a new insecticide that was still in the last stages of the regulatory process, so that it could be applied in time to control the beetle plague",

explains the agriculturalist. The resistance problem had built up in German fields within only a few years: in 2003, less than five percent of the beetle population was resistant to pyrethroids, whereas in 2006, as much as 50 percent of the population hardly responded at all to the active substances.

Practically-oriented research

Nauen points out the extent of the damage without hesitation: "Fifteen percent of the German agricultural area is planted with winter oilseed rape, that is, around 1.4 million hectares. Taking 2006 as an example, the pollen beetle caused economic losses of between 25 and 30 million Euros". On receiving accelerated registration in 2006, the crop protection product in question – Biscaya® – was initially allowed for use to counter this exceptional problem on a limited area only. In the meantime though, this thiacloprid-based product has clearly shown its potential against the pollen beetle in practice, and it now represents a valuable addition to the palette of available products. "Practical field studies showed early on that the active substance thiacloprid is safe for bees if used as recommended," explains Nauen. "That's an important factor for farmers. It means that they can treat their oilseed rape fields during flowering without endangering these beneficial insects." Thielert also emphasizes the advantages of doing development work near to the point of use, because it brings mutual advantage



Dr. Wolfgang Thielert examines maize plants at the Monheim Research Centre.

to both partners. “We receive feedback about the properties of the active substance in field trials, and the farmers get to tap the latest scientific knowledge. The level of interest is high, and we are able to count on the cooperation of a large number of farmers”, is how Thielert describes this fruitful collaboration. Nauen also considers contact with farmers a very important complement to his laboratory research – even in his private neighborhood. And not just because he goes out collecting beetle samples himself. “People who know what I do for a living sometimes ask me how to deal with their pest problem.” For more than ten years now, Nauen has also been applying his knowledge and expertise through his work for the Insecticide Resistance Action Committee (IRAC). Since 2008, he has been the President of this international group. “Applying an intelligent resistance-management strategy allows us to preserve the sensitivity of pests to different active substances over a prolonged period. The trick is to attack the insects at different points in their metabolic pathways”,

Spoiling aphids’ appetite

Like Biscaya®, the insecticide Calypso® is also based on the active substance thiacloprid. It protects plants from sucking pests such as aphids. The active substance becomes distributed via the plant’s vascular system. This means that aphids sitting on the undersides of leaves can also be reached. As soon as the pests tap into the leaves’s vascular bundles, they come into contact with thiacloprid. The insecticide quickly stops the aphids in their tracks: they refrain from sucking and producing honeydew. At the same time, Calypso inhibits the spread of viral infections within the crop, because once the pests come into contact with the insecticide, they are no longer able to move to other plants – a strong advantage in terms of vector control. A further plus-point: if used as recommended, thiacloprid is safe to pollinating insects such as honeybees and bumblebees, as well as to other beneficials, including predatory mites.

explains Nauen. And this is exactly how thiacloprid makes its contribution. The active substance, which belongs to the class of neonicotinoids, binds to a different receptor in the beetle’s nervous system from the pyrethroids.

Outstanding research effort

Thielert has already received an award for his exceptional research – the Otto-Bayer medal. During his work in Product and Project Support, he has been investigating a hitherto unexpected additional benefit delivered by certain active substances. “We found indications that crop plants treated with our well-proven insecticides Confidor®, Admire® and Gaucho® are better able to cope with situations of stress than untreated plants”, recalls the researcher.

These observations were followed up in systematic trials, first in the laboratory and glasshouse, and later, in the field. Working with an interdisciplinary team, Thielert was able to show that plants treated with these products suffer less from stress under certain defined conditions than untreated plants. Between them, the work of the two entomologists Thielert and Nauen in the area of pest control has helped to understand the power of innovative active substances – and thereby contributed to securing the harvest around the globe. ◀