

# Protective coating

The western corn rootworm has been wreaking havoc in the cornfields of the United States for decades, causing harvest losses and insect control costs amounting to around US\$ 1 billion every year. Since 1991, the pest has also been spreading through Europe. Researchers at Bayer CropScience have now developed a product that is used to treat the seed so that the corn plants are effectively protected against the pest.



Attacks by the western corn rootworm which bores into the roots of the plants have caused especially large harvest losses in the United States.



Experts Dr. Wolfram Andersch (on the right) and Dr. Bernd Springer examine the effect of Poncho® on corn plants in the greenhouse.

Poncho®

## Necessity is the mother of invention

For many tiny organisms, seeds are like food handed to them on a plate: fungi, worms and insect larvae flock to these most nutritious grains. Crop protection researchers were already treating grains of seed with chemical solutions as long ago as the 19th century. For a long time, there were only two substances available for protection against fungal infestation in particular: copper vitriol and mercury chloride. Both had huge disadvantages. Mercury chloride is not only highly toxic to humans; it also damages the ability of treated seeds to germinate. In addition, soon after the outbreak of the First World War, it became more and more difficult to obtain copper. But it was the drastic shortage of food during the war which showed how important it was to protect the scarce supplies against pests. The food crisis and the copper shortage fuelled the powers of invention: Bayer launched its first seed dressing, named Uspulun® in 1915, which, despite its efficacy against fungi, did not impair the ability of plants to germinate and was less harmful to farmers. Since then, the company has been a world market leader in the field of seed treatment.

The wind has simply flattened the young corn plants; broken plants with pale leaves and withered roots are everywhere. "This is a typical example of how devastating the western corn rootworm is," says Dr. Mike Schwarz of Bayer CropScience in the United States. He is all too familiar with the cause of the damage: an unprepossessing, tough little insect. "In the United States alone, the western corn rootworm causes harvest losses and insect control costs of around US\$ 1 billion annually," reports Schwarz. This makes *Diabrotica virgifera virgifera*, to give the parasite its scientific name, the most important corn pest in North America financially.

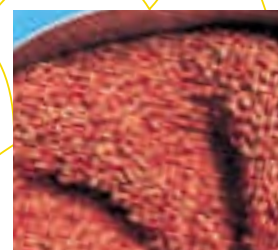
At present, farmers only have two ways of combating the voracious creature with insecticides: they either have to spray along the rows of corn or apply the active ingredient to the soil in the form of granules together with the seed when sowing. Aside from the ecological aspects, both procedures also have the disadvantage of entailing additional work for the farmer, thus costing both time and money. But all this will soon be changing, because Dr. Wolfram Andersch's insecticide research team at Bayer CropScience in Monheim has succeeded in making crucial progress in the fight against the pest. In cooperation with Japanese company Takeda, they have developed clothianidin, the first highly effective ingredient that can be used to "dress" seeds against the western corn rootworm. This treatment, in which special

equipment is used to coat each individual grain of seed with a thin layer of the insecticide, protects the plant against the insects for several weeks from the time of germination, with minimal use of the active ingredient.

"This is a crucial phase for protecting plants against the western corn rootworm," stresses Andersch. This parasite does not exert the worst damage in its adult form; it is the larvae which are the main problem. The adults lay up to 200 eggs in August and September in the upper layers of the soil. The 10 to 18 millimeter-long yellowish-white larvae then hatch in spring.

### Attack on the roots of the corn plants

Attracted by root excretions and carbon dioxide, they bore into the roots of the growing plant where they not only take nutrients and water away from the seedling, but in the case of heavier infestation they eat so much of the roots that the plant can barely support itself. Badly damaged plants then easily fall over in the wind. In some cases, the part of the shoot nearest the ground bends and the upper part straightens itself again and carries on growing upwards. This gives it the "gooseneck" appearance which is characteristic of plants damaged by the western corn rootworm. "So the plants not only produce less corn, but harvesting is also made more difficult by crooked and fallen shoots," explains Andersch.



Unlike untreated grains, the treated seed (bottom) has a protective coating which keeps the insect's larvae at bay.

Sandro Cusumano fills the batch treater with corn seed, which will be given a protective coating.



# Seed dressing

exposed to the insecticide than with seed dressing.

It is therefore no wonder that seed dressing is used throughout the world nowadays. But this technique presupposes that a suitable active ingredient can be found – which is not always easy. This is because on the one hand, the substance has to be highly effective so that it can afford the plant protection even in very low concentrations, and on the other hand, the insecticide must not impair the seed's ability to germinate, and must mix easily in a liquid with which the seeds are then sprayed.

“Take the case of the western corn rootworm, for example,” says Springer. “For a long time, there just wasn't an active ingredient which, when used as a seed dressing, could ensure adequate protection against the pest.”

## Western corn rootworm now threatens European fields too

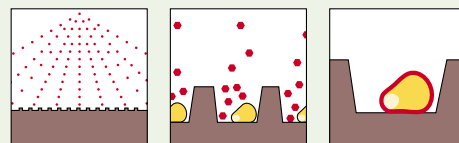
This only changed when Bayer researchers came across clothianidin in the mid-1990s. The active ingredient, which belongs to the neonicotinoids class, is highly effective against pests and is also much less toxic to other organisms than any granules previously used in corn cultivation. In addition, Poncho® not only remains in the immediate environment of the seed grain, but is also distributed throughout the entire plant: the insecticide is taken up by the roots of the developing plant and is transported to the leaves and

The new product, which is being marketed worldwide under the name of Poncho® for use in corn and other crops such as sugar beet, rape and cereals, helps to prevent such harvest shortfalls. As numerous comparative studies carried out by Bayer researchers have shown, treating seeds with Poncho® considerably increases the crop yield. There is a clear reduction in root damage to corn plants: in some cases, corn fields in which the seeds were treated with clothianidin yielded more than 60 percent more than those in which the plants grew from seed

without the protective coating. The development of Poncho® is an example of how ecology and economy do not have to be in conflict but can complement each other. Dr. Bernd Springer from Biological Development in Monheim illustrates this with some figures. “With the use of clothianidin as a seed dressing, less than 1 percent of the field surface area comes into contact with the active ingredient.” When granules are used, the quantity of active substance required is also considerably less than with spraying. Even so, about ten times more field surface is

### Less is more

Seed dressing is an effective means of controlling pests. In this way, much less of the field's surface area comes into contact with the crop protection products than with spraying or granules which are applied directly into the furrows.



	Whole field sprayed	Granules in furrow	Seed dressing
Treated area (m <sup>2</sup> )	10,000	500	58
Effective quantity of substance (g/ha)	1,350	600	40



### Unwelcome passengers

In the past, only American corn fields were ravaged by the western corn rootworm. But since 1991 this pest has increasingly been spreading through Europe, too. A plausible explanation put forward by scientists is that since it made its first appearance en masse in the area around the Yugoslavian city of Belgrade, it could have been brought in during the Balkan conflict with American aid supplies. Since then, the pest has steadily expanded its territory, even causing serious economic damage in the area around Milan.

tips of the shoots by transpiration flow. Clothianidin acts exclusively on insects. As soon as it enters their bodies via the skin or digestive tract, it binds to the receptors of the natural neurotransmitter acetylcholine, which play an important part in impulse conduction, at the conduction sites (synapses) of nerve cells. This results in hyperexcitation: the insects stop feeding and finally die. Another advantage of Poncho® is that it not only works against the western corn rootworm. Many of the Bayer researchers' studies found other benefits: "Clothianidin is also highly effective against all other major pests in corn cultivation in North America, such as wire worms, cutworms, flea beetles and white grubs," says Andersch. Compared to North America, Germany and many other European countries still seem like a safe haven as far as the western corn rootworm is concerned. Whereas it has been a huge problem on the other side of the Atlantic since intensive corn cultivation began there in the 1940s, until only a few years ago, the "Old World" had been entirely spared by the pest which originated in Mexico. But things are different now, because in the early 1990s, the insect started to prosper in Europe as well. Experts such as agrarian entomologist Professor Stefan Vidal of the University of Goettingen, Germany, believe that it reached Serbia as a "stowaway" with American aid supplies to Serbia. "This is the only plausible explanation," says Vidal, who – together with other scientists, – has

been studying the spread of the pest for several years. Since then, it has been spreading like wildfire – by 60 to 100 kilometers every year, depending on where the western corn rootworm finds suitable conditions for breeding. Vidal estimates that it will reach Germany within one to five years: "It can no longer be prevented." Here, too, conditions are ideal for the larvae: intensive, annual corn cultivation. Experts predict that without effective protection against the new invader, agriculture will be threatened with massive losses: the damage could soon amount to up to € 500 million every year. Says Dr. Rolf C. Becker, product manager in Monheim: "It's far too late to completely eradicate the western corn rootworm in Europe. But with the aid of Poncho, European farmers will at least be guaranteed a good corn harvest in the future." Bayer CropScience recently received authorization for Poncho® for use against the western corn rootworm in the United States and Canada; authorization for Europe is expected to follow in 2004. Once approval has been granted, farmers will receive ready-dressed corn seeds straight from their seed dealers.

For more information and to find out about research into the spread of the western corn rootworm, go to: [www.gwdg.de/~instphty/vidal/diabrotica/](http://www.gwdg.de/~instphty/vidal/diabrotica/)



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Susanne Lohmann carries out a practical test by measuring the height of the corn plants (top) and checking their roots with the still visible grains of seed (red).

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