Developing dicamba-resistant broadleaf crops

In a project that began about a dozen years ago, UNL scientists discovered a gene that has been used to create broadleaf crops that tolerate spraying with the popular herbicide dicamba.

Now, even as an industry partner is working to bring dicamba-resistant crops to market, these plant scientists are continuing to explore new and expanded uses for the technology they discovered.

The availability of dicamba-resistant crops means that farmers eventually will have more options for controlling weeds in broadleaf crops such as soybeans, canola, cotton, tobacco and vegetables.

Dicamba-based herbicides, sold under trade names such as Banvil and Clarity, are relatively inexpensive and easy on the environment because the chemical disappears quickly in plants and soil. But like all broadleaf herbicides, dicamba kills broadleaf crops as well as their weedy cousins so its use presently is limited to corn and other grassy crops.

The UNL team identified soil bacteria that break down dicamba and isolated the gene responsible for imparting resistance. The gene was inserted into a plant's chromosomes, successfully transferring dicamba resistance to the plant.

Researchers also discovered they could modify the gene to target the DNA of the plant chloroplast, where photosynthesis occurs. This approach has significant practical implications. Since chloroplast genes are inherited through the maternal side, not through male pollen, it eliminates the chance that resistance could inadvertently spread to other plants through pollen.

The team's genetic modification technique has worked in both lab and field trials. For example, soybeans carrying the dicamba-resistant gene were unharmed by dicamba sprayed at a rate of 2.5 pounds per acre, about 10 times the normal application rate.

Two rows of soybean plants are shown eight days after they were sprayed with dicamba. The plants on the left, which contain the dicamba-resistant gene, are thriving. The plants on the right died.

UNL has patented this technology. In 2005 UNL signed an exclusive licensing agreement with Monsanto Co. to develop crops tolerant to dicamba, using UNL's technology.

Meantime, UNL researchers are testing this approach on other crops and expect further developments.

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defense system from calling for reinforcements and allowing the intruders to enter unimpeded.

The UNL team found that one of the proteins – HopU1 – disrupts the plant's immune system when the disease-causing bacterium *Pseudomonas syringae* injects it into a plant. This disruption helps the pathogen infect its plant host. Researchers found that HopU1 is a type of enzymatic protein – an ADP-ribosyltransferase that had never before been found in plant pathogens. This type of protein is also found in organisms that cause human diseases such as cholera and diphtheria.

After identifying HopU1 as one of the injected proteins, the scientists began studying which plant components this virulence protein targets. That's key to identifying new components of plant immunity.

The team discovered that HopU1 modifies RNA-binding proteins. Their work suggests that the pathogen disrupts plant immunity by suppressing immunity-related RNA metabolism – part of the process that turns a plant's DNA code into proteins to help fight off infection. A plant lacking one of the HopU1 targets is more susceptible to the pathogen. These RNA-binding proteins, also found in animals, were not previously known to be part of plants' or animals' immune systems.

New software analyzes biofuel production

Biofuel production promises to reduce oil imports, turn crops into energy, grow rural economies and decrease greenhouse gas emissions.

It's a tall order. Determining how individual biofuel plants and their grain supply measure up is critical to the burgeoning industry's long-term success.

In 2007, UNL agricultural researchers unveiled a tool to assess plant performance. Their Biofuel Energy Systems Simulator (BESS) software analyzes total energy yield and efficiency, greenhouse gas emissions and resource requirements for biofuel production systems – from seed to biofuel and byproducts.

Quantifying the environmental impact of individual biofuel systems has environmental, economic and public policy implications. To meet emerging renewable fuel standards or to participate in the growing carbon credit market, plants will have to document their environmental performance.

The user-friendly software is backed by complex modeling tools and extensive scientific data. Users can customize data unique to their operation or explore different scenarios. BESS estimates net energy efficiency and net greenhouse gas emissions for each production component and the whole system. It's more flexible and customizable than existing energy and emissions models.

Researchers envision versions for soybean biodiesel and biomass ethanol production from switchgrass and corn stover.

The free software is available at *www.bess.unl.edu.*

A new tool from UNL agricultural scientists will enable ethanol plants, like this one at Fairmont, to measure their greenhouse gas mitigation and energy efficiency.