Herbicide-resistant grape could revitalize Midwest wine industry

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An herbicide that is effective at killing broadleaf weeds in corn, but also annihilated most of the grapes in Illinois and other Midwestern states, may finally have a worthy contender. Researchers at the University of Illinois have developed a new grape called Improved Chancellor which is resistant to the popular herbicide 2, 4-D.

"In 1946, 2,4-Dichlorophenoxyacetic or 2, 4-D was introduced. It was a wonder herbicide," said Robert Skirvin, plant biologist in the College of Agriculture, Consumer and Environmental Sciences. "It works really well in corn and wheat and grass crops because it kills the broadleaves, so the grasses are resistant to it, but grapes are incredibly sensitive to it."

Skirvin said that 1/100th of the amount of 2, 4-D commonly used on corn to kill broadleaves, will kill grapes. Today, more than 50 years after it was introduced, it's still the third most widely used herbicide in the United States.

The discovery of the gene that makes Improved Chancellor resistant to 2, 4-D came about by accident. "The USDA found a soil bacterium that had a gene that breaks down 2, 4-D. Someone noticed that after spilling 2, 4-D on the ground, something in the soil broke it up – metabolized it. They were looking for something to control pollution and discovered this soil bacterium instead," said Robert Skirvin, plant biologist in the Collegeof Agriculture, Consumer and Environmental Sciences.

Skirvin received permission to use the bacterial gene and began in 2002

to transfer it to a grape that would ultimately be resistant to 2, 4-D. He and his graduate student Richard Mulwa followed standard genetic engineering techniques in order to transfer the gene to grape cells. "Selecting the transformed cells is the most delicate stage of the process because out of hundreds of thousands of cells, there may be only 25 cells that actually contain the gene," said Skirvin.

He explained that in order to locate the cells that have the gene, another gene that's an antibiotic to Kanamycin is inserted as a marker. The cells are then placed onto a medium that's very high in Kanamycin. All of the normal cells die. The only ones that will live are the ones with the antibiotic marker – which are also the cells that contain the 2, 4-D resistant gene. Stephen Farrand, a U of I microbiologist, assisted in all aspects of the gene transfer and Margaret Norton oversaw all of the tissue culture operation.

"Then we have to take the cells and regenerate them into plants. We use a tissue culture media and start the cells growing. After about two years in the lab, we had tiny seed-like shoots that developed from the transgenic grape cells. These were grown until they were big enough to be transferred to a limited access greenhouse where they were allowed to mature and produce fruit."

From these experiments, eight Chancellor plants were obtained; it was determined through DNA testing that only three of them had the herbicide resistant gene. Cuttings were taken of those three and planted. The plants were then sprayed with 2, 4-D. Each of the three Chancellor plants was tested at the equivalent amount of .5 kilograms per hectare of 2, 4-D, 5 kilograms per hectare and 10 kilograms per hectare, along with one of the original Chancellor plants as a control.

"It was quite an accomplishment to get the gene into the plant," said Skirvin. "This grape could help salvage the wine and grape industry in

theMidwest." If all goes well, Skirvin hopes that in about five years they'll be able to work with a grape grower to produce wine using their new patented cultivar that they have named 'Improved Chancellor.'

Because the new grape is genetically modified it hasn't been tested outside of the greenhouse yet. Skirvin hopes to get permission to grow them in an isolation plot outdoors by spring 2009.

"We have to do tests to make sure that there aren't any poisonous compounds that would get into the grape or the wine. We'll test the grapes and after spraying with 2, 4-D check the break down products to find out where the 2, 4-D goes and what happens to the 2, 4-D after it enters the plant. The Improved Chancellor is resistant to 2, 4-D, but the herbicide must be going somewhere, so we need to make sure there are no harmful compounds in the fruit.

"After the grapes have been tested and found safe to eat, I think it's going to be beneficial to Minnesota, Nebraska, Illinois and other Midwestern states -- anywhere grain is grown and 2, 4-D is sprayed on the crops," said Skirvin.

"A grape resistant to 2, 4-D would be a huge plus to our industry," said Kansas grower Rebecca Storey. "As a vineyard and winery owner we have suffered losses from this chemical that runs in the tens of thousands of dollars -- not to mention the time and effort to identify the sprayer and prove the damage in a court of law. This grape would be a gift to our industry."

Source: University of Illinois at Urbana-Champaign

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