

Corn *Fungicide* Resistance

Farmers Should Prepare To Face Fungicide Resistance In Corn

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Fungicide resistance will almost certainly happen in corn, and while it's not going to be disastrous, farmers should prepare to counter attack it, according to Dr. Paul Vincelli, plant pathologist at the University of Kentucky, "You can reduce the risk to yourself and your neighbors by just being very careful to use fungicides where they can be well-justified," he said. "I really don't have to waffle here on this, the eventual development of fungicide resistance in corn is almost a certainty. What we don't know is when or where."

Vincelli doesn't expect that resistance to fungicides in corn will create widespread problems or a catastrophic crop effect. However, he said all the ingredients are in place for fungicide resistance in corn, and biology predicts that it will happen in time, whether it's this year, next year, or sometime in the future.

One of the reasons for his prediction is the simple fact that fungicides are being used. For fungicides known to have a resistance risk, the concept is simple: Applying the fungicide kills those fungal spores that are sensitive to it, leaving only the spores that are resistant to the fungicide.

"That's good, that's what you want," he said. "You want to kill the sensitive spores so that you can get the disease control. But if there is a resistant spore in your field, and that is the big if, then of course it will survive the application; and the next time the fungus becomes active, if weather permits it to become active, those resistant spores now have a chance to build. So, over time the use of the fungicide selects for the resistant individuals, allowing them to grow and prosper."

What no one really knows is where those resistant spores are. Are they in Caldwell County, are they in Daviess County, or are they in your field, but not your neighbors? Wherever they are, the use of fungicide will select them to be the only survivors, and in time you'll learn you have a failure when the population is 100 percent resistant.

Therefore, one ingredient promoting resistance is selection. When farmers use fungicides, that automatically creates "selection pressure" — killing off the sensitive spores and leaving the resistant ones.

"Number two, the very best fungicides in corn are also highly prone to resistance," Vincelli said. "The very best fungicides are the strobilurin fungicides, such as Quadris and Headline. Quilt and Stratego also include a strobilurin fungicide as do other products as well. Those are really good fungicides, that's why growers use them, but they're also known world-wide to be highly prone to a high level of resistance. So we know we can expect to have resistance to strobilurins in corn diseases, we just hope we can delay that by 10 or 20 years, but we expect resistance to develop in time."

A third ingredient promoting resistance is the type of fungi now that farmers try to control in corn. One of those is *Cercospora zeae-maydis*, or the grey leaf spot fungus.

"We know world-wide that *Cercosporas* are adaptable to fungicides," he said. "There are lots of examples of *Cercospora* fungi adapting to fungicides, developing resistance. Unless the grey leaf fungus is somehow different from its sister species, we expect it to develop resistance in time. Maybe it already is developing, maybe we're already selecting for resistance in our fields and we just don't know it yet. *Cercospora* fungi are genetically adaptable to fungicides."

A fourth point is farmers are using fungicides to control southern rust, which is a disease of corn that usually doesn't cause problems in Kentucky, but can show up especially in late planted corn. Southern rust is also somewhat adaptable to fungicides, but whether it can do so against strobilurin fungicides is unclear.

"Southern rust disease blows north every year, it doesn't survive the winters in Kentucky," Vincelli said. "It survives in Mexico and then it blows into Georgia, for example. They have a lot of southern rust problems there in the corn and so, logically they spray. Sometimes they even spray twice to control southern rust. Growers in the South may be selecting for resistance in southern rust. If so, those spores from the South will blow into states like Kentucky. If resistant spores arrive here, you're going to spray a strobilurin and you're not going to get any rust control whatsoever."

"So we have all four ingredients," he continued. "We've got selection going on with fungicides being used, high risk fungicides for resistance, the strobilurins; we have grey leaf spot, a genus that's adaptable to fungicides, and southern corn rust is also somewhat adaptable; and growers in the South are using the fungicides and possibly selecting for resistance. Hopefully the process will be slow, but we just don't know. We won't know until it happens."

Vincelli's main recommendation to curb resistance is to use fungicides as judiciously, as

carefully, as minimally as possible. It is absolutely fundamental biology that the more you use fungicides the more selection pressure you put on the spores, and the faster you will build the resistance.

Farmers can hope there isn't a resistant spore in their field; but if there is, they won't know it, and they will be selecting for it by using fungicides.

"So the principle management recommendation we make on all crops worldwide is for fungicide users: Use the fungicide as minimally as you feel you can, agronomically," he said. "That's one; a second is use mixtures. The mixture helps because you are using fungicides from different fungicide families, like a strobilurin plus maybe a triazole type fungicide. That way, you now have two weapons instead of one. So even if a resistant spore survives the strobilurin in the mixture, the triazole will have con-



tacted that spore and will kill it." By using mixtures instead of solo active ingredients you will slow the buildup of resistance. That's pretty fundamentally solid biology in all crops.

"So that's really another option," he added. "One is use fungicides minimally and to use them in combination, in mixtures with different families of active ingredients. That's pretty easy to do in corn because if you buy a premix, they're going to contain different active ingredients in different families of fungicides."

A third point discussed in the farming community is to use the high label rates. The idea is, if you use the high label rates you're going to, theoretically at least, slow down or prevent resistance to fungicide.

"The reality is that's a good idea, but it's almost certain not to work for strobilurins," Vincelli said. "Strobilurin fungicide resistance, when it happens, is almost always a very high level of resistance. In other words you could spray a hundred times the labeled rate, of course you'd be violating the law, and in addition you'd be spending a hundred times what the product costs, you'd be painting your fields white with fungicide and it still wouldn't control the resistant strains. The nature of resistance to strobilurins typically is extremely high levels of resistance when it develops. Suddenly, the fungus is tolerant to extremely high levels, so using the high label rate is almost always not going to work with strobilurins so I don't think that's really a solution that we can count on in corn."

Vincelli showed a slide of several petri dishes with varying amounts of fungicide applied. One petri dish held no chemical, and others had chemical values of 31, 63 and 125 parts per million.

The dishes demonstrated that in the absence of fungicide the zero part per million dish shows the sensitive strain grows very well, all the way to the end of the plate. The resistant strain also grows very well, all the way to the end of the plate. So, in the absence of fungicide, they've both grown very well.

"However, with fungicide the sensitive strain is suppressed completely, even at 31 parts per million. The fungus is not growing in these petri dishes containing fungicide. The sensitive strain is absolutely shut down with these moderately high to high doses of fungicide. The resistant strain, at the same dose, is growing beautifully; as a matter of fact, sometimes fungi grow even faster if they're resistant. The fungicide actually stimulates them for reasons that are quite complex and not always understood."

"So, in other words, what this shows is qualitative resistance. There is no dose that a grower could apply legally or practically or economically that will stop the fungus; so this represents the kind of resistance we get from strobilurin fungicides. Once we have a resistant strain out there, forget it, you can't use the strobilurin fungicides to control it. Whether you use high rates, low rates, middle rates, illegal rates, you can't control it." Δ

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