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Pesticide Resistance – How it happens and how you can delay it

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It is a common misconception that using pesticides causes resistance. This is not the case -- resistance to fungicides arises as a result of random mutation. Think of it this way. Our *Homo sapien* ancestors likely all had brown eyes. Mutations in the genes that cause brown eye colour resulted in lack of melanin production in the iris and a small number of individuals were born with blue eyes. Having blue eyes does not jeopardize the ability of those of us with them to survive. So the frequency of this particular gene combination slowly spread throughout parts of Europe and then to North America, although it's still at a relatively low frequency compared to brown eyes. If, for some reason, having blue eyes were to make people more resistant to say, a fatal disease of global proportions, brown-eyed people would succumb and, eventually, the proportion of the world's population that has blue eyes would gradually increase so that there would be far more people with blue eyes than brown. The same idea applies to pesticide resistance.

A random mutation in the pathogen or insect pest population results in a small number (less than 1%) of individuals who can survive a particular pesticide or group of pesticides with a particular mode of action, such as the strobilurin fungicides (Flint, Sovran) or the organophosphate (OP) insecticides (Guthion, Lorsban, Imidan). In many cases, if an individual is resistant to one member of a chemical group, it is resistant to all of them: this is called "cross-resistance". As long as products in this group are not used, there is no benefit to having this resistance but also no detriment, so these individuals remain a small proportion of the population. However, once these products start to be used, some of the susceptible individuals, those without the resistance mutation, will be killed while those with the resistance mutation will survive. This shift may happen rapidly for some families and target pests and gradually for others. If products of the chemical group are used repeatedly and exclusively, the shift toward more and more resistant individuals will occur more rapidly and eventually the pesticide won't control disease at the labeled rate. If coverage or timing of the spray is less than optimal, control failure due to resistance will occur even faster.

The potential for the development of resistance to these site-specific products is high. So what can you do to delay it? Here are a few resistance management strategies:

Rotation

Do not exceed the maximum number of consecutive applications of products in a chemical family. Tables 2-7 and 2-8 in Publication 360 (2008-2009) list the chemical groups. Using a different product within the same group is not rotation. Fungicide groups with an "M" in the designation (such as captan) have multi-site activity and are not prone to resistance development: they can be used repeatedly without risk of resistance. Rotation strategies are different between fungicides and insecticides. The reason for this will be covered in a subsequent article.

Tank mixes

One strategy used in fungicide resistance management is to tank mix a resistance-prone product with one that is multi-site and not prone to resistance. For example for apple scab control, Nova is tank-mixed with a half-rate of a mancozeb product.

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Optimum timing
Do not rely on "kick-back" activity of fungicides, rather, apply them protectively whenever possible. Be aware that many of the new insecticides (Altacor, Delegate) work differently than OP's or synthetic pyrethroids (Pounce, Matador, Decis) so their timing will be different from our old work horses.

Use label rates
Using rates below those recommended on the label will expose the pest population to below-lethal doses of active ingredient and promote the proliferation of resistant individuals. This is especially the case for many of the newer products with very low rates per ha.

Spray coverage
A fungus spore or an insect doesn't care what's in the tank, only what's on the plant. You could have the most effective product in the world in your spray tank but if it doesn't reach the target, it can't do its job. This is especially true with the new chemistries that use g per ha instead of kg. With the old products, there was some "wiggle room": if the rate on the target wasn't quite right there was still enough there to do the job. New pesticides are labeled at the lowest effective rate based on efficacy trials. This lowest rate does not take into account the potential for less than optimal coverage or timing or the risk of resistance. Take a low rate and apply it with less than complete coverage and you're not applying enough to take care of business.

Despite what you may believe, there isn't an endless source of products available. We've been fortunate to get some great new pesticides in the past few years. There is no guarantee that we will continue to get new products as quickly in the future so it's up to you to keep the ones we have as viable as possible!