



K-State turf: Feb 26th 2009

Fungicide Synergy

In early February, I was at the national conference of the Golf Course Superintendents Association of America (GCSAA). On a day when I was not teaching, I sat in on two other seminars. In both, the question of fungicide synergism came up.

The term “synergy” is defined as “the interaction of two or more agents or forces so that their combined effect is greater than the sum of their individual effects.”

You might think about synergistic effects in people, where several people acting together can sometimes accomplish more than the sum of everyone working independently. Sometimes the phrase “1 + 1 = 3” is used. Of course, antagonism is also possible, where working together is NOT efficient and $1 + 1 = 1.5$.

The term synergy has also been used to describe pesticide interactions. That is, certain pesticide combinations may lead to better control than would be expected based on the performance of each pesticide alone. In contrast, antagonism occurs when pesticides interfere with each-other’s efficacy and results are worse than expected.

To test for synergy, it is necessary to do replicated tests of the components alone and in combination, then use statistical analyses to determine whether the effects are merely additive ($1 + 1 = 2$) or if true synergy is occurring ($1 + 1 = 3$). (*For the math fans out there, part of that method is explained below.*)

In the well-known text *Diseases of Turfgrasses, Third Edition*, by Houston Couch, several synergistic fungicide interactions are reported. In particular, synergistic effects were reported from several particular mixtures of low-rates of fungicides. That is, effective disease control was reported to be possible using reduced rates of each component of the mix, giving better-than-expected control.

Recently, Dr. Rick Latin (Purdue) and Dr. Lee Burpee (University of Georgia) conducted a thorough set of field experiments (two sites over 3 field seasons) to re-examine fungicide synergy for dollar spot control for some of these mixtures. The results were

published in both the academic journal *Plant Disease* as well as in the trade publication *Golf Course Management*. The tests included four combinations:

propiconazole (Banner Maxx) + triadimefon (Bayleton)
propiconazole (Banner Maxx) + iprodione Chipco 26GT)
propiconazole (Banner Maxx)+ vinclozolin (Curalan)
propiconazole (Banner Maxx)+ chlorothalonil (Daconil WeatherStik)

as well as each fungicide alone.

In 92 comparisons based on these four mixes, 84 showed simple additive effects ($1+1=2$), 5 showed antagonistic effects ($1 + 1 = 1.5$), and 3 showed synergy ($1 + 1 = 3$). Thus, the authors concluded that synergistic effects are unlikely to be observed with these products.

Why the discrepancies with prior reports? Of course, the pathogen can evolve over time to respond differently to fungicides, and pathogen populations can vary from site to site. And, fungicide formulations can change. This could account for some discrepancies. In addition, some of the prior reports were not “peer-reviewed” in academic journals, leading to some skepticism.

There are other good reasons for tank-mixing, of course. Additive effects are helpful. Combining materials can expand the number of diseases controlled. And, some pesticide labels recommend tank-mixes as part of a fungicide resistance strategy.

Testing for synergy:

Example:

When applied alone, fungicide A provides 50% disease control and fungicide B provides 75% disease control. When applied together (using the same rates), disease control = 85%. Is this synergy, or just additive effects?

If fungicides interact additively ($1 + 1 = 2$), we expect that the % control of the mixture will be as follows:

$$\text{Expected (A + B)} = A + [B(100-A)]/100$$

where A = observed control in A-alone and B = observed control in B-alone

In our example:

$$\text{Expected} = 50 + [75(100-50)]/100 = 87.5$$

The expected 87.5% disease control is pretty close to what we observed. That is, this does not appear to be synergy. The next step is to repeat the experiment several times,

get the averages, and use statistics to determine whether the observed control is equivalent to what we expect based on additive effects.

If the observed disease control is statistically higher than expected, than a synergistic effect is occurring. For example, if the *combined* disease control was more like 99%, we would suspect synergy the statistical analysis would probably confirm it.

Anyone still reading? If so, here is some obscure trivia for you. The word “Synergy” is also the name of the holographic computer from the 1980’s cartoon “Jem.” Type “Showtime, Synergy!” into google.com and see for yourself. It’s pretty bad. Hey, just because I remember it, doesn’t mean I was actually a fan. I only watched it a few times. Honest. I just remembered the Synergy part because it is kind of a cool word.

References:

Couch, H 1995. *Diseases of Turfgrasses*. Third Edition. Krieger Publishing Company, Malabar FL.

Burpee, L, and Latin, R. 2008. Reassessment of fungicide synergism for control of dollar spot. *Plant Disease* 92:601-606.

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