MAXIMIZING FUNGICIDE EFFICACY THROUGH PROPER SPRAYING TECHNIQUES

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In 1981, a field research program was initiated by the members of the turfgrass pathology laboratory at Virginia Tech to investigate various procedures for making the most effective spray applications of turfgrass fungicides. The individual experiments were designed to determine (i) the optimum amount of water per 1,000 square feet of turf, (ii) the appropriate nozzle types and nozzle tip sizes, and (iii) the most suitable pressure at the nozzles for the control of turfgrass diseases under conditions of 1 1/2 to 2 inch cutting heights and under bowling green and golf course putting green mowing heights.

Also, trials have been conducted to evaluate the effectiveness of the sticking agents that are formulated with the various fungicides. The objective of these tests were to (i) determine how much fungicide can be washed off of turfgrass leaves if a rain shower occurs before the application dries, and (ii) how effective the sticker is in holding the material on the leaf after the spray has dried.

The diseases included in the trials were Sclerotinia dollar spot (incited by S. homoeocarpa), melting-out of Kentucky bluegrass (incited by Drechslera poae, and Rhizoctonia blight (incited by R. solani). The fungicides tested included both contact and systemic materials. The following is a summary of the results of these trials.

Optimum Dilution Rates and Nozzle Tip Sizes

One series of experiments tested for the relationship between dilution rates, nozzle orifice size and fungicidal effeciency. Concentration of the various fungicidal treatments ranged from 0.5 to 32 gallons of water per 1,000 square feet of turf.

Only one nozzle type was used in this group of experiments, the Uni-jet flat fan (manufactured by Spraying Systems Co., Wheaton, Ill.) The variables consisted of different spray tip sizes in combination with different water gallonages. In this series, all applications were made at a nozzle pressure of 30 psi. The various dilution rates and corresponding nozzle tip sizes used in these experiments were as follows:

Tip Size	Gallonages
T-800050	0.5, 1.0, 2.0, 4.0
T-8002	0.5, 1.0, 2.0, 4.0
T-8008	4.0, 8.0, 16.0, 32.0

The results of these experiment have shown that with the flat fan nozzle, there is a direct relationship between nozzle tip size, the dilution level and the effectiveness of individual fungicides. Where orifice size is concerned, with each fungicide, optimum disease control was consistently achieved with the T-8002 tip. The dilution levels for maximum disease control for the materials included in these trials were as follows:

Fungicide	Dilution per 1,000 sg. ft.
Daconil 2787	1 gallon
Dyrene	1 - 2 gallons
Bayleton	2 gallons
Chipco 26019	0.5 - 4 gallons
Banner	2 gallons
Vorlan	1 - 2 gallons

Optimum Nozzle Types and Nozzle Pressures

Additional experiments have been performed to test the relative effectiveness of certain fungicides when applied with different nozzle types and at varying pressures at the nozzle. The nozzle types included in this series were (i) the Uni-jet flat fan with T-800050, T-8002 and T-8008 tips, (ii) Uni-jet flood jet TK-30, and (iii) the swirl chamber 'Raindrop' RA-15. The individual nozzle prespures for the flat fan nozzles were 10, 30, 60 and 90 p.s.i., while with the flood jet and raindrop nozzles, the pressures at the nozzles were 20, 30, 40 and 55 p.s.i. The fungicides tested in these trials were Bayleton, Chipco 26019, Dyrene, Rubigan, Daconil 2787, and Actidione TGF.

With the flat fan nozzle, maximum disease control with all fungicides tested was obtained at 30 - 60 p.s.i. at the nozzle. A significant drop in disease control effectiveness occurred with all fungicides when they were applied at 10 p.s.i. Maximum disease control with the 'Raindrop' swirl chamber nozzle was obtained at 30 p.s.i. at the nozzle. The flood jet nozzle was most effective at 30 - 40 p.s.i. at the nozzle.

Of the three nozzle types, the flat fan T-8002 and the swirl chamber RA-15 gave comparable levels of disease control. The performance of the TK-30 flood jets, however, was significantly inferior to the other two nozzle types.

Effect of Post-Spray Rainfall on Fungicide Effectiveness

The fungicides included in this trial were Dyrene 4-F, Dyrene 50WP, Actidione Thiram, Chipco 26019, Daconil 2787, Rubigan, and Bayleton. The variable in this experiment was the time of watering of each plot after it had been sprayed with the fungicide in question. The watering schedule was as follows: (i) in one series, the plots were watered with the equivalent of 1/8 acre inch of water while the leaves were still wet from the spray application, (ii) in a second group, as soon as the spray dried on the leaves, the plots were watered wih 1/8 acre inch of water, (iii) while in a third series, all watering was withheld until the third day after the spray had been applied.

The results of these tests showed that if leaf washing from rainfall or sprinkler irrigation occurs before the spray dries on the leaves, non-systemic fungicides are rendered completely ineffective in disease control. However, once these sprays have dried on the leaves, the leaf washing operation will not alter their disease control effectiveness.

The systemic fungicides were not as vulnerable as the non-systemics to reduction in disease control effectiveness by rainfall or watering before the spray dries on the leaves. There can be a significnant difference, however, among systemic fungicides with respect to the degree of reduction in disease control effeciency brought on by leaf washing before the spray dries. Leaf washing before the spray dried reduced the effectiveness of Rubigan in the control of Sclerotinia dollar spot by 50 percent. The effectiveness of Bayleton in dollar spot control, however, was not reduced if leaf washing occurred before the leaves dried.

Conclusions

This research has shown that in the use of a boom-type spray system, there are specific dilution rates at which fungicides perform most effeciently. Also, nozzle type can have a significant effect on fungicide performance. Flat fan T-8002 and swirl chamber RA-15 nozzles both provide effective levels of fungicide distribution at 30 p.s.i. at the nozzle. Flood jet TK-30 nozzles do not give levels of disease control comparable to that obtained with flat fan or swirl chamber nozzles.

If the maximum potential of a fungicide is to be realized, it is important that careful consideration be given to the selection of the optimum dilution level, nozzle type and size, and nozzle pressure for its application.

Where leaf washing after spray application is concerned, our studies have shown that:

1. Rainfall or sprinkler irrigation of a treated area before the spray dries on the leaves will significantly reduce the disease control effectiveness of non-systemic materials.

2. If the fungicide formulation contains an effective sticking agent, either rainfall or sprinkler irrigation immediately after the spray dries on the leaves will not appreciably reduce the material's initial disease control effectiveness.

3. Systemic fungicides are not as vulnerable as non-systemics to reduction in disease control effectiveness by rainfall or watering before the spray dries on the leaves.

4. The basic effectiveness of a turfgrass fungicide is established by the initial amount of water used in the spray application. Once the material has dried on the leaves, it can not be dislodged or redistributed on the plant by sprinkler irrigation or rainfall.