GREENHOUSE RESEARCH EXPLORES HERBICIDE/TURF DISEASE RELATIONSHIP

By Clinton F. Hodges, Professor of Horticulture and of Plant Pathology, Iowa State University, Ames, IA

Postemergent herbicides are indispensable tools for the maintenance of high quality turf. Most temperate origin grasses show good tolerance to the auxin-like herbicides (2,4-D, 2,4,5-T, MCPP, dicamba) but absorption of the herbicides by tolerant grasses has aroused interest in the potential influence the herbicides may have on the physiology of the tolerant grass. Studies with various crops have examined potential interactions between herbicides in tolerant and non-tolerant species and the severity of diseases. Since most postemergent herbicides are synthetic growth regulating hormones, much interest also has been directed at their immediate effect on the growth and reproduction of plant pathogenic fungi. The purpose of this presentation is to summarize research conducted in our laboratory on the influence of postemergent herbicides (2,4-D, 2,4,5-T, 2,4,5-TP, MCPP, dicamba) on the biology of *Helminthosporium sorokinianum* (= *Drechslera sorokiniana)* and on the severity of leaf spot on Kentucky bluegrass.

Herbicide Effects on the Pathogen

Leaf spot development induced by *H. sorokinianum* involves the life processes of both the pathogen and the leaf of the grass plant. The effect of any substance on the development of the lesion must be viewed relative to both living entities. The influence of 2,4-D, 2,4,5-T, 2,4,5-TP, MCPP, and dicamba show various stimulatory and inhibitory effects on the germination of *H. sorokinianum* conidia, growth of germ tubes, mycelium growth, and conidia production. Relatively high concentrations (10-3M) of these herbicides prevent the germination of conidia, but more dilute concentrations (10-4 to 10-12M) have no effect on germination. These observations suggest that the concentrations of 2,4-D, MCPP, and dicamba currently used for weed control in turf will neither inhibit nor stimulate the germination of *H. sorokinianum* conidia.

The most dramatic effect of 2,4-D, 2,4,5-T, 2,4,5-TP, MCPP, and dicamba on *H. sorokinianum* is stimulation of growth of conidia germ tubes after germination. The growth of germ tubes may increase 2X to 3X in response to various concentrations of each herbicide. Only 2,4,5-TP demonstrates some inhibition of germ-tube growth at higher concentrations. The significance of germ-tube stimulation relative to infection of leaves and disease development is unclear. It is well established that stimulation of the growth of a pathogen is not necessarily related to its ability to increase disease.

Most of the commonly used postemergent herbicides will stimulate mycelium growth of *H. sorokinianum* in culture. MCPP and dicamba are stimulatory in very dilute amounts. 2,4-D shows stimulation at high concentrations. The importance of mycelium stimulation relative to disease development is unknown. Such stimulation could, however, be of some importance in aiding *H. sorokinianum* colonize dead grass tissue.

The influence of postemergent herbicides on the ability of *H. sorokinianum* to produce spores is mixed. 2,4,5-T and MCPP inhibit sporulation at most concentrations. 2,4-D, 2,4,5-TP, and dicamba show some stimulation of sporulation. These observations could be important to the ability of *H. sorokinianum* to produce spores on dead grass tissue; herbicide stimulated or inhibited spore production could subsequently influence the number of potential infections.

Herbicide Effects on Leaf Spot Development

Research conducted in our facilities over the last six years has established that the postemergent, synthetic auxin-like herbicides (2,4-D, 2,4,5-T, 2,4,5,-TP, MCPP, and dicamba) can function in a host-pathogen-herbicide interaction involving *H. sorokinianum* and Kentucky bluegrass, to increase or decrease leaf spot severity. Kentucky bluegrass exposed to 2,45-T, MCPP and dicamba by means of leaf sprays or soil applications and then infected with *H. sorokinianum* show a 2X to 3X increase in leaf spot severity. Plants sprayed with 2,4-D and then infected generally show no change in disease development, but 2,4-D applied to the soil increases disease severity markedly. 2,4,5-TP applied to Kentucky bluegrass as a spray or as a soil drench inhibits leaf spot development at higher concentrations and stimulates development at lower concentrations.

> The most dramatic effect on leaf spot development is stimulation of the growth of conidia germ tubes

Recent studies in our laboratory have established that herbicide stimulation of *H. sorokinianum* leaf spot on Kentucky bluegrass is associated with the aging process of the leaves. Leaf spot normally becomes more severe on each older leaf of the shoot; when the shoot is exposed to 2,4,5-T, MCPP, or dicamba and infected the increase in disease is least severe on the youngest leaves and most severe on the older leaves.

Mechanism of Herbicide Stimulated Leaf Spot

Existing plant science literature suggests that auxin-like herbicides may function to retard or to stimulate the aging process in leaves. Such observations may provide some insight into the host-pathogen-herbicide interactions resulting in more severe leaf spotting of Kentucky bluegrass. It seems that in a very general way, auxin-like herbicides introduced into young leaves, where cell division and expansion is occurring, may help maintain this youthful condition; however, introduction of the

same auxin-like herbicide into fully developed leaves where cell division and expansion have ceased, and where normal aging processes have started, may increase the rate at which the leaves age. It is known that leaf spot severity increases on each older leaf of the shoot; i.e., leaf spot is enhanced by the aging processes of each older leaf. Therefore, when the two oldest fully developed leaves of the shoot are exposed to auxin-like herbicides they may age at a faster rate and, if infected, the disease will increase in severity. This concept is less clear relative to disease development on the youngest, expanding leaves. The increase in leaf spot severity on the youngest, visible leaf of Kentucky bluegrass exposed to auxin-like herbicides is less than that on each older leaf; in fact, 2,4-D will not increase the disease on the youngest leaf. The youngest leaf often shows the same or slightly higher disease levels in response to the auxin-like herbicides. The two youngest leaves are in a very youthful condition and as such do not respond to infection with extensive yellowing and blighting. Hence, the youthfulness of these leaves retards extensive disease development; the promotion of disease on these leaves by the herbicides is minimal. The slight elevation in disease is not explainable relative to aging because in young, expanding leaves the auxin-like herbicides would probably be youth promoting. The greater increase in disease on the second oldest leaf still suggests a herbicide-aging interaction that increases disease.

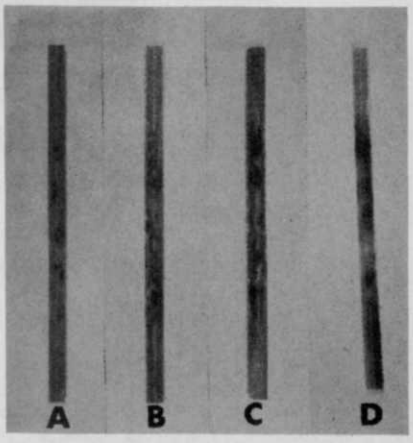
Significance of the Herbicide-Leaf Spot Interaction in the Field

Observations on the stimulation of *H. sorokinianum* leaf spot on Kentucky bluegrass by postemergent, auxin-like herbicides have been made under the controlled conditions of greenhouse and growth chamber studies. To date, experimental evidence from field studies has not been obtained. The leaf spot symptoms produced in response to herbicides in greenhouse studies, however, are not unlike those observed in the field during late spring, summer (with irrigation), and fall to early winter. It is probable, therefore, that herbicide stimulation of leaf spot may occur in the field. Such stimulation probably would be erratic in its occurrence; i.e., the herbicide, pathogen, and proper moisture and temperature must occur simultaneously to increase the severity of leaf spot. Early spring applications of herbicides probably would have little effect on leaf spot development because of the lush, youthful condition of the leaves; with normal senescence, however, in late spring and early summer the herbicides may be a factor in increasing leaf spot severity, especially with irrigation or during a wet season. Preliminary studies suggest that increasing temperature from 72° to 86° will increase the yellowing and blighting caused by leaf spot on plants exposed to herbicides. This suggests that on irrigated Kentucky bluegrass auxin-like herbicides could have a substantial effect on promoting leaf spot damage during periods of warm weather. Auxin-like herbicides might be most promotive of leaf spot in fall and early winter when shorter daylength, and the herbicides may contribute to the rate at which leaves age and subsequently predispose them to more severe leaf spot development.

All factors must occur simultaneously to increase severity

Acknowledgements

I wish to thank the O.J. Noer Research Foundation for financial support of much of the research from which this abstract is derived. **WTT**



Severity of leaf spot increases on each older leaf of a Kentucky bluegrass shoot in response to 2,4-D, 2,4,5-T, MCPP, and dicamba. A. Youngest leaf shows small brown lesions with minimal yellowing of tissue around lesions. B. The second youngest leaf shows enlarged brown lesions and an increase in yellowing of tissue around lesions. C. Next to the oldest leaf on the shoot showing enlarged brown lesions and yellowing that surrounds and interconnects lesions. D. The oldest leaf of the shoot shows very large lesions and extensive yellowing of the entire leaf. Leaf spot severity normally increases on each older leaf, but the herbicides increase the level of disease beyond what normally occurs.