Preemergence Herbicides and the Severity of Leaf Spot Caused by Drechslera sorokiniana on Poa pratensis

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ABSTRACT


Four preemergence herbicides (benfon, bensulex, dacthal (DCPA), and siduron) were evaluated for effect on the severity of leaf spot caused by Drechslera sorokiniana on Poa pratensis. On leaves of plants not previously exposed to the herbicides and inoculated with conidia in aqueous droplets containing the various herbicides, leaf spot development either was not affected or was inhibited by all concentrations tested. Leaf spot development was inhibited, not affected, or stimulated on plants previously exposed to the herbicides by soil application and inoculated with conidia in water droplets. Benfon at all concentrations inhibited leaf spot development. Concentrations of 10^{-12}, 10^{-7}, and 10^{-8} of DCPA inhibited, had no effect, and stimulated leaf spot, respectively. Siduron stimulated leaf spot at 10^{-14} M but had no effect at other concentrations. All concentrations of bensulex stimulated leaf spot. The results suggest that, except for benfon and bensulex, stimulation or inhibition of D. sorokiniana leaf spot by preemergence herbicides is concentration specific.

Additional key words: benfluralin, Bipolaris, Helminthosporium.

The ability of herbicides to stimulate or inhibit diseases induced by fungal pathogens is well documented (1,15-17). The leaf spot induced on Poa pratensis L. by Drechslera sorokiniana (Sacc.) Subram. & Jain (= Helminthosporium sativum P. K. & B.) generally is stimulated by auxinlike postemergent herbicides (eg, 2,4-D, 2,4,5-T, MCP, dicamba) (9); the stimulation is associated with an interaction between the herbicide and seasonal leaf senescence that enhances pathogenesis on each older leaf (10). Results of other studies show wheat to be predisposed to infection by D. sorokiniana (12) and corn to infection by D. heterostrophus (H. maydis) (19) in response to 2,4-D; conversely, 2,4-D reduces root rot of barley incited by D. sorokiniana (21).

The preemergence herbicides benfon, bensulex, dacthal (DCPA), and siduron are applied to establish P. pratensis turf for preemergence control of annual grasses (6,18). The potential influence of these herbicides on pathogenesis by D. sorokiniana on leaves of P. pratensis is unknown; however, all inhibit root growth of grasses (3-5,20,23). Inhibition of root growth could induce stresses in the whole plant that might influence leaf spot development. The herbicides also inhibit or have no effect on conidial germination, germ-tube growth, mycelial growth, or conidial production of D. sorokiniana (11). Other research results show that benfon and bensulex reduce mycelial growth and delay sporulation by Drechslera cyanodontis (14), but the abilities of these herbicides to affect the pathogenicity of this pathogen on bermudagrass was not determined.

The research presented here was initiated to determine the potential influence of benfon, bensulex, DCPA, and siduron on leaf lesion development induced by D. sorokiniana on leaves of P. pratensis.

MATERIALS AND METHODS

The preemergence herbicides evaluated for influence on leaf spot development on P. pratensis included N-butyl-N-ethyl-o-o-o-trifluoro-2, 6-dinitro-p-toluidine (benfon, benfluralin), O,O-dinitropropyl phosphorodithioate S-ester of N-(2-mercaptoethyl) benzenesulfonamide (bensulex), dimethyl tetrachlororot...

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RESULTS

Inoculation of *P. pratensis* not previously exposed to preemergence herbicides with conidia of *D. sorokiniana* in droplets of preemergence herbicides either had no effect or inhibited leaf spot development. Benisulide at $10^{-6}$M and DCPA at $10^{-3}$M had no effect; other concentrations of benisulide and DCPA, and all concentrations of benefin and siduron inhibited leaf spot development (Fig. 1A–D).

Leaf spot development on plants exposed to preemergence herbicides by soil application and then inoculated with conidia in water droplets was inhibited, not affected, or stimulated. Leaf spot development was inhibited by all concentrations of benefin (Fig. 1A) and stimulated by all concentrations of benisulide (Fig. 1B). The effects of DCPA and siduron on leaf spot development were influenced by concentration. DCPA inhibited leaf spot at $10^{-3}$M, had no effect at $10^{-2}$M, and was stimulatory at $10^{-1}$M (Fig. 1C). Siduron had no effect on leaf spot development at $10^{-1}$ and $10^{-2}$M, but stimulated leaf spot at $10^{-1}$M (Fig. 1D).

DISCUSSION

Pathogenesis by *D. sorokiniana* on leaves of *P. pratensis* differs in response to preemergence herbicides, depending on whether conidia are applied in herbicide droplets to leaves of plants not previously exposed to the herbicides or whether conidia are applied in water droplets to leaves of plants growing in soil treated with herbicide prior to inoculation. The absence of an effect or the inhibition of leaf spot development when conidia are applied to the leaves in herbicide droplets (Fig. 1A–D) coincides with in vitro inhibition of conidia germination and germ-tube growth by benefin, benisulide, DCPA, and siduron (11). The presence of the preemergence herbicides during conidial germination, whether in vitro or on the leaf surface, is inhibitory to the germination process and subsequent leaf spot development. The various herbicides examined in this study are applied to established *P. pratensis* in liquid and granular form. Therefore, it is possible for these herbicides to come into direct contact with conidia on leaf surfaces and influence germination and primary infection.

Pathogenesis by *D. sorokiniana* on leaves of *P. pratensis* is stimulated or inhibited on leaves of plants previously exposed to the herbicides by soil application and inoculated with conidia in water droplets. It is probable that the pathogen responds to some physiological change induced by the herbicide in the host. A common mode of action for these herbicides in grasses is inhibition of mitosis in root apices (3,5,20,23). Preemergence herbicides may or may not be readily translocated; the dinitroanilines (benefin) are not readily translocated to leaves (20), whereas the substituted ureas (siduron) are readily translocated to stems and leaves (7) and are metabolized by *P. pratensis* (13). The inhibition of root growth by the herbicides included in this study could significantly influence leaf spot development irrespective of their ability to be translocated. Root inhibition could result in hormonal imbalances and interfere with uptake and translocation of minerals (2); such disturbances could influence the physiology of the whole plant and pathogenesis by *D. sorokiniana* on the leaves.

The quantity of soil-applied preemergence herbicides absorbed by the roots of *P. pratensis* relative to the volume applied is unknown. Some portion of the herbicides is probably adsorbed on the clay and peat components of the soil mix employed (7). This effect, however, is expressed across all treatments. The significant increase in leaf spot development in response to benisulide and siduron was greatest at the most dilute concentrations (Fig. 1B and D); also, the greatest inhibition of leaf spot development by benefin and DCPA likewise occurred at the most dilute concentrations (Fig. 1A and C). Because the greatest stimulation and inhibition of leaf spot development occurs at the lowest concentrations of the various herbicides, the potential adsorption of the herbicides on the clay and peat components of the soil mix does not seem to be a major factor affecting the results.

It is important that the response of *D. sorokiniana* leaf spot on *P. pratensis* exposed to preemergence or postemergence herbicides (9) by soil application generally is different. The auxinlike postemergence herbicides (2,4-D, 2,4,5-D, 2,4,5-TP, MCP, and dicamba), with few exceptions, stimulate leaf spot by increasing the extent of chlorosis associated with lesions (9). In the present study, only benisulide is stimulatory at all concentrations (Fig. 1B). DCPA and siduron show some ability to stimulate leaf spot (Fig. 1C and D), but most concentrations of DCPA and siduron and all concentrations of benefin (Fig. 1A) either have no effect or inhibit leaf spot.

Fig. 1. The influence of preemergence herbicides on the severity of *Drechslera sorokiniana* leaf spot on *Poa pratensis*. Mean percentages of disease per living leaf within droplet and soil-drench treatments followed by the same letter are not significantly different according to Duncan's multiple-range test (P=0.05).

LITERATURE CITED


