STUDIES ON THE CONTROL OF

ANNUAL BLUEGRASS WITH ENDOTHALL

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Annual bluegrass (Poa annua L.) is generally regarded as the most serious weed problem facing the professional turf manager. It forms a dense, vigorous stand that is highly competitive with more desirable turfgrass species. Undesirable features of this species include its inability to blend well with preferred turfgrasses, prolific seedhead production under a wide range of mowing heights and its tendency to die out under mid-summer stress conditions.

Research was initiated in 1969 to determine which experimental and commercially available herbicides offered the greatest potential for controlling annual bluegrass. Endothall was subsequently selected as a promising material for more detailed study. Initial field tests with this herbicide revealed that endothall, applied once at 2 and 4 lb/A and 3 times at 1 lb/A in 2-week intervals, provided increasingly greater control of annual bluegrass in merion Kentucky bluegrass turf (2). The turf was completely browned by these treatments within 2 weeks but the merion recovered within 4 weeks. Annual bluegrass eventually reappeared, presumably from seed, in areas that were not completely filled in by merion. The selective response was therefore attributed to the recuperative capacity of merion from underground rhizome tissue. A comparable study on a Seaside creeping bentgrass--annual bluegrass fairway resulted in extensive and prolonged injury to the bentgrass with no significant reduction of annual bluegrass.

Greenhouse studies were conducted with single-plant sand cultures of merion Kentucky bluegrass, penncross creeping bentgrass and annual bluegrass. The same rates of endothall were applied to these plants as in the field study; however, the results were quite different. Three applications of ½ lb/A, 2 or 3 applications of 1 or 2 lb/A and one application of 4 or 8 lb/A caused a selective growth suppression of annual bluegrass. These results provided an interesting concept--a chemically induced reversal of the ecological relationship between annual bluegrass and the 2 perennial turfgrasses. If the growth vigor of annual bluegrass could be reduced substantially below that of Kentucky bluegrass or creeping bentgrass through periodic applications of an herbicide, the turf manager might have a tool for gradually reducing annual bluegrass infestations without objectionable effects on the turf. Engel and Aldrich (1) reported a significant reduction of annual bluegrass in colonial bentgrass fairway turf from repeated applications of endothall at ½ lb/A. Field studies were undertaken to evaluate this approach on Kentucky bluegrass and creeping bentgrass turfs. Endothall was applied at ¼ and ½ lb/A at 2-week intervals during spring, summer and fall periods. Spring applications did not result in significant reductions of annual bluegrass while summer and early fall applications caused extensive browning or discoloration of the turfs. Further evaluations are required to determine the conditions favoring selective suppression of annual bluegrass by endothall, but without causing turfgrass discoloration.

Another approach was investigated in which endothall was applied to the roots of the 3 grass species in sand culture. A 100 ppm concentration of endothall was found to cause selective kill of annual bluegrass with little effect on merion Kentucky bluegrass or penncross creeping bentgrass. Hence, superior selectivity was achieved with this mode of application to the plants. Subsequently, granular formulations of endothall were developed to evaluate the "root-application" approach in turfgrass stands. Selective kill of annual bluegrass was achieved with granular endothall, but the required application rates were very high compared to the effective rates used in foliar-application studies. In greenhouse tests, 16 lb/A of the active ingredient in granular endothall was necessary for selective control of annual bluegrass growing in a sandy loam soil, however, muck-grown annual bluegrass was not completely controlled at 32 lb/A. Hence, the composition of the underlying soil medium was an important factor affecting the efficacy of granular endothall.

INTRA-SPECIES VARIABILITY

Continuous propagation of annual bluegrass in sand culture revealed a large morphological variability within the species. Several clones were selected and asexually propagated to develop homogeneous groups of different biotypes. These were then treated with 50 and 100 ppm endothall solutions applied to the roots. The bushy, upright-growing ("annual") biotypes were killed by these treatments while the more prostrate-growing ("perennial") biotypes were only stunted. Hence, the morphological variability observed within the annual bluegrass species was associated with a large response variability to root-applied endothall.

BASIS OF HERBICIDAL SELECTIVITY

One basis for the selectivity of endothall between annual bluegrass and Kentucky bluegrass was already pointed out--the differential recuperative capacity of Kentucky bluegrass from rhizome tissue following foliar browning from high rates of foliar-applied endothall. This implies that endothall works primarily as a contact herbicide. Research was conducted to determine whether absorption, translocation or metabolism of the herbicide by the 3 grass species also contributed to selectivity. Radioactive endothall was applied to the foliage and the roots of plants in sand culture to study absorption and spray retention differences among the 3 grass species. Results indicated that substantially more endothall was taken up by the roots of annual bluegrass compared with the other 2 grass species (3). Foliar absorption was not significantly different among the 3 species, however, annual bluegrass retained more of the herbicide on its leaf surfaces indicating that total absorption may actually be greater for this species. The question as to whether absorption differences were adequate to account for the selectivity observed in previous experiments was studied. Results showed that an internal concentration of endothall, over 3 times that adequate to kill annual bluegrass, could be reached in Kentucky bluegrass and creeping bentgrass without causing lethal effects. Yet, there was only an approximately 2-fold difference in absorption. Hence, differential absorption of endothall failed to completely explain selectivity.

Translocation studies revealed that endothall moves rapidly upward in the xylem tissues of all three grass species following root application. Foliar applications resulted in upward (acropetal) and downward (basipetal) movement of the herbicide with no observable differences among species. As translocation differences were not observed, this does not appear to contribute to selectivity. Metabolism studies also showed no differences in the rate of decomposition of endothall among the 3 grass species.

The effects of endothall on photosynthesis, respiration and transpiration were investigated to determine whether different responses occurred following treatment. Foliar-applied endothall caused a temporary and immediate suppression of photosynthesis in all species, especially annual bluegrass. Respiration rates increased, temporarily, while transpiration was apparently unaffected. Root applied endothall caused a continuous and large reduction of photosynthesis in annual bluegrass with little effect on the other grasses. Respiration was only slightly affected in the 3 grasses. Transpiration was reduced in Kentucky bluegrass after 3 days, and in annual bluegrass after only one day. The substantially greater effects of endothall on the photosynthesis and other processes in annual bluegrass, as compared to the other grass species, suggest that the physiological systems of annual bluegrass were more sensitive to this herbicide. Herbicide action, therefore, appears to be an important factor in the selectivity of endothall between annual bluegrass and some perennial turfgrasses.

In conclusion, endothall offers promise as a possible control, or at least as part of a control program, for annual bluegrass infestations in turf. Differential growth suppression of annual bluegrass in Kentucky bluegrass and bentgrass turfs may be feasible with light application rates of endothall in spring. Renovation of annual bluegrass-infested Kentucky bluegrass turf is possible with higher rates of endothall in summer or early fall providing reinfestation can be controlled with suitable herbicides. Finally, selective kill of annual bluegrass may be feasible with granular (root-applied) endothall providing the underlying soil is low in clay and organic matter, and the cost is not prohibitive.

LITERATURE CITED

1. Engel, R. E. and R. J. Aldrich. 1960. Reduction of annual bluegrass, Poa annua, in bentgrass turf by the use of chemicals. Weeds 8:26-28.
2. Turgeon, A. J., W. F. Meggitt and Donald Penner. 1972. Role of endothall in the control of annual bluegrass in turf. Weed Science (submitted).
3. Turgeon, A. J., Donald Penner and W. F. Meggitt. 1972. The basis for selectivity of endothall in turf. Weed Science (submitted).