individual plots were 1.5 × 1.5 m. Analysis of variance was done using the General Linear Model procedure in Statistical Analysis System as a strip split-block design. Various post hoc contrasts were hypothesized for a planned comparison of core treatments within each herbicide treatment, including the comparisons of coring done prior to herbicide treatment and coring done at 1, 2, 3, or 4 months after herbicides were applied.

Core cultivation at 1, 2, 3, or 4 months after herbicide application did not affect the efficacy of herbicides applied at recommended rates to control large crabgrass (Table 1). Even though plots treated with oxadiazon at 2.2 $kg \cdot ha^{-1}$ and cored at 1 or 2 months after herbicide treatment had a higher large crabgrass cover than did plots cored prior to herbicide treatment, the difference was small and not agronomically important. This difference did not occur when oxadiazon rate was increased to 4.4 $kg \cdot ha^{-1}$. This observation with oxadiazon agrees with results on goosegrass control study conducted in Georgia (6) and crabgrass control study performed in Michigan (3).

In this study, there were differences in weed cover among the core cultivation treatments where no herbicide was applied. Weed cover was higher in plots that were cored in April (1 month after herbicide treatment date), June (3 months after herbicide treatment date), and July (4 months after herbicide treatment date) than when untreated plots were cored in March (prior to herbicide treatment date). Even though crabgrass cover in plots cored in May was not significantly different from plots cored in March, there was a trend for a higher cover in the later-cored plots. The increased cover of large crabgrass in plots cored in April or later (in nonherbicide treated plots) indicates that large crabgrass seed were present in the cores removed at each coring date.

DCPA was ineffective in controlling large crabgrass, regardless of core cultivation treatment (Table 1). Similar levels of large crabgrass control occurred among all other herbicide-treated plots.

Bermudagrass cover in untreated plots was consistently lower than in herbicide-treated plots (data not shown). Because DCPA did not control large crabgrass effectively, turf cover in DCPA treated plots was not as high as in other herbicide-treated plots.

The results obtained from this experiment indicate that core cultivation may be performed without significantly reducing the activity of oxadiazon, bensulide, bensulide + oxadiazon, and benefin on large crabgrass.

Literature Cited

1. Beard, J.B. 1973. Turfgrass: science and culture. Prentice-Hall, Englewood Cliffs, N.J.
2. Bhowmik, P.C. and J. Troll. 1983. Preemergence crabgrass control in turfgrass. Proc. Northeast. Weed Sci. Soc. 37:391–395.
3. Branham, B.E. and P.E. Rieke. 1986. Effects of turf cultivation practices on the efficacy of preemergence grass herbicides. Agron. J. 78:1089–1091.
4. Johnson, B.J. 1976. Dates of herbicide application for summer weed control in turf. Weed Sci. 24:422–424.
5. Johnson, B.J. 1976. Herbicides for season weed control in turfgrasses. Agron. J. 68:717–720.
6. Johnson, B.J. 1982. Oxadiazon treatments on overseeded putting green turf. Weed Sci. 30:335–338.
7. Turgeon, A.J. 1980. Turfgrass Management. Reston Publishing Co., Reston, Va.
8. Van Yahres, R.D. and J.A. Jagschitz. 1982. Pre- and postemergence herbicides for the control of crabgrass in lawn areas. Proc. Northeast. Weed Sci. Soc. 36:292–297.
9. Watschke, T.L. and M.S. Welterlen. 1982. Preemergence crabgrass control in turf. Proc. Northeast. Weed Sci. Soc. 36:298–300.

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Annual Bluegrass and Creeping Bentgrass Germination Response to Flurprimidol

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Abstract. **Seed of *Poa annua* var. *reptans* (Hauskins) Timm. (annual bluegrass) and *Agrostis palustris* Huds. 'Penncross' (creeping bentgrass) were treated at planting with flurprimidol at rates of 0.00, 0.28, 0.56, 0.84, 1.12, 1.68, and 2.24 $kg \cdot ha^{-1}$. Data were collected on germination of each species. Flurprimidol rates greater than 0.56 decreased germination for both species. Chemical name used: α-(1-methylethyl-α-[4-(trifluoromethoxy)phenyl]-5-pyrimidine methanol (flurprimidol).**

Poa annua L. (annual bluegrass) invades close-cut, irrigated, intensively managed cool season turfs and within 3 to 5 years may dominate the stand (11). Annual bluegrass may invade desired species, filling voids left by mismanagement, disease, traffic, cultivation, and other stresses (1). Annual bluegrass may reestablish these areas vegetatively (1) or from seed in the soil (7). Control programs are based on the removal of annual bluegrass over a number of years while managing the turf for the desired species, or reestablishment of the desired species after annual bluegrass eradication (2, 5, 8). One management approach would be to employ a plant growth regulator to inhibit selectively the growth of annual bluegrass and encourage the desired species, allowing a gradual transition from annual bluegrass dominance while maintaining turfgrass aesthetic and functional qualities. Flurprimidol reduced annual bluegrass in perennial ryegrass (*Lolium perenne* L.) (2). Flurprimidol applied to annual bluegrass and creeping bentgrass (*Agrostis palustris* Huds.) polystands exhibits selectivity for annual bluegrass growth suppression, indicating a potential for use in the conversion process (10). If the annual bluegrass population in a mixed stand is very high, overseeding with creeping bentgrass is sometimes implemented. Haley and Fermanian (6) found that flurprimidol was active on young seedlings of annual bluegrass and creeping bentgrass, but information on germination response was not reported. The objective of this research was to determine if flurprimidol applications influenced germination of annual bluegrass and creeping bentgrass.

Clay pots 100 mm in diameter were seeded in the greenhouse, where temperatures fluctuated between 10° and 24°C. The growth medium was 5 sandy loam : 3 sand : 1 peatmoss, (by volume). Half the pots were seeded to 'Penncross' creeping bentgrass (lab germination 85%). The remaining pots were seeded to annual bluegrass (lab germination 92%). Both species were seeded at a rate of 25 seeds/pot. Seed of annual bluegrass was obtained by harvesting mature seed heads from a stand of annual bluegrass located at the Hancock Turfgrass Research Center, Michigan State Univ. The harvested seed was assumed to be of the perennial annual bluegrass biotype, due to the high germination (92%) observed immediately after harvest (1).

Immediately following seeding, pots were treated with flurprimidol at rates of 0.00, 0.28, 0.56, 0.84, 1.12, 1.68, and 2.24 $kg \cdot ha^{-1}$. Treatments were applied with a backpack CO_2 sprayer with an 8002E nozzle calibrated to deliver 384 $liters \cdot ha^{-1}$. Pots were irrigated three times daily for 4 min with an automatic misting system. The experiment was conducted on two dates (Oct. 1984 and

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Table 1. Flurprimidol effects on annual bluegrass (*Poa annua* var. *reptans*) and creeping bentgrass (*Agrostis palustris* 'Penncross') germination. Values presented represent means of both species.

Rate ($kg\cdot ha^{-1}$)	Germination (%)[z] Test date 1	2
0.00	100	100
0.28	92.0	92.3
0.56	86.7	85.3
0.84	86.7	78.3
1.12	81.0	76.3
1.68	47.7	60.0
2.24	50.3	73.7

[z]Percent germination for the controls were normalized and treatment values were adjusted to a percentage of the control. Germination counts taken 21 days after treatment.
LSD (P = 0.05) for test date = 6.5%; LSD (P = 0.05) for rate = 8.4%.

Jan. 1985). Data were collected on the number of seed germinating per pot. Nongerminating seed were examined for evidence of radicle emergence. Pots were arranged in a randomized complete block. The rate and species factors were split on the date of test factor for a 2 × 7 × 2 factorial treatment design. On each test date, six replications were used. Mean separation was accomplished using the least significant difference (LSD) multiple comparison technique.

Results of the analysis of variance showed that flurprimidol rates and date of test were significant sources of variation. A significant rate × test date interaction also was observed; however, no variability due to species was observed. As flurprimidol rate increased, germination generally decreased. Rates ≥ 0.56 $kg\cdot ha^{-1}$ significantly reduced germination when compared to the control (Table 1). The significant rate × test date interaction and test date main effect result from the germination values observed for the 1.68 and 2.24 $kg\cdot ha^{-1}$ rates. No explanation is evident for the significant rise in germination observed for the 2.24 $kg\cdot ha^{-1}$ rate in test date 2.

Examination of nongerminating seed found no evidence of radicle emergence, indicating that flurprimidol may act as a germination inhibitor. Flurprimidol is in a class of plant growth regulators shown to inhibit gibberellic acid (GA) biosynthesis (3, 4). Gibberellic acid is produced in the embryo of the grass seed during germination. The GA produced stimulates the cells of the aleurone layer to manufacture α-amylase, an enzyme necessary for endosperm digestion (9). If the embryonic production of GA is inhibited by flurprimidol, the products normally made available from endosperm digestion are limited, which may account for the germination inhibition seen in this study.

Results of this experiment indicate that at low rates (0.28 $kg\cdot ha^{-1}$), flurprimidol exhibits no inhibition of annual bluegrass or creeping bentgrass germination. At rates ≥ 0.56 $kg\cdot ha^{-1}$, both species show the same germination response to flurprimidol application. Thus, there would be no advantage in using flurprimidol in an overseeding program in terms of reducing the competition from germinating annual bluegrass. Results also indicated that the use of flurprimidol at rates ≥ 0.56 $kg\cdot ha^{-1}$ should not be practiced at or near time of bentgrass overseeding. If overseeding is not planned, flurprimidol will have some preemergence activity on annual bluegrass seed present in the soil. Only one biotype of annual bluegrass was evaluated, and the extreme variability exhibited by this species should be considered when extending these results to all annual bluegrass biotypes.

Literature Cited

1. Beard, J.B., P.E. Rieke, A.J. Turgeon, and J.M. Vargas, 1978. Annual bluegrass (*Poa annua* L.) description, adaptation, culture and control. Michigan State Univ. Agr. Expt. Sta. Res. Rpt. 352.
2. Breuninger, J.M. and T.L. Watschke. 1982. Post emergent *Poa annua* control with growth retardents. Proc. Northeastern Weed Sci. Soc. 36:314.
3. Coolbaugh, R.C., S.S. Hirano, and C.A. West. 1978. Studies on the specificity and site of action of α-cyclopropyl-α-[p-methoxyphenyl]-5-pyrimidine methyl alcohol (ancymidol), a plant growth regulator. Plant Physiol. 62:571–576.
4. Coolbaugh, R.C., D.I. Swanson, and C.A. West. 1982. Comparative effects of ancymidol and its analogs on growth of peas and *ent*-kaurene oxidation in cell free extracts of immature *Marah macrocarpus* endosperm. Plant Physiol. 69:707–711.
5. 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.
6. Haley, J.E. and T.W. Fermanian. 1985. The effect of flurprimidol on germination and development of *Poa annua* and *Agrostis palustris*. Agron. Abstr. p. 116.
7. Jagshitz, J.A. 1986. Establishment of turfgrass, crabgrass, and annual bluegrass following herbicide use. Proc. Northeastern Weed Sci. Soc. 40:270–271.
8. Jagshitz, J.A. 1979. Annual bluegrass control in Kentucky bluegrass turf with herbicides. Proc. Northeastern Weed Sci. Soc. 33:308–313.
9. Salisbury, F.B. and C.W. Ross. 1978. Plant physiology. Belmont, Calif. Wadsworth, 2nd Edition.
10. Shoop, G.J., R.H. Hoefer, and D.G. Ortega. 1986. Flurprimidol (EL-500) growth regulator effect on bentgrass fairways in the northeast. Proc. Northeastern Weed Sci. Soc. 40:131.
11. Watschke, T.L. and J.M. Duich. 1977. Control of *Poa annua* with endothal. Proc. Northeastern Weed Sci. Soc. 31:357–360.

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Differences in Wound Closure Rates in 12 Tree Species

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Abstract. **Purposefully inflicted wounds were observed on 12 species of trees commonly used in urban landscapes and along city streets. One group was observed in an urban environment in Nashville, Tenn., the other in a rural lawn environment in Wooster, Ohio. Wound closure in both environments was more closely correlated to species than to commonly used growth parameters. In both environments, *Fraxinus pennsylvanica* and *Liquidambar styraciflua* closed wounds more quickly than *Pyrus calleryana* 'Bradford', *Gleditsia triacanthos* var. *inermis*, and *Betula nigra*.**

Urban street trees are particularly vulnerable to mechanical damage that can lead to wood decay (2–4) and death. Wounds leave disfiguring scars that close at different rates. This study was undertaken to determine if wound closure rates are closely related to rate of growth and vigor, as measured by growth parameters, or to species.

In Nashville, Tenn., eight specimens each of 10 street tree species commonly used in the mid-south were selected. All were growing in an urban environment no further than 1.2 m (4 ft) from pavement; all replications of a taxon were within one city block of one another. Larger numbers of replicates were used in the urban environment (Tennessee) to counter the expected increase in variation. In the Wooster study, four specimens each of eight street tree species commonly used in Ohio were selected at the Shade Tree

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