CONCLUSION

Isoxaben is unique in its ability to control broadleaf weeds preemergence (PRE) in cool-season turf, its spectrum of weed control, and its residual properties in soil. Literature regarding various aspects of isoxaben for weed control in winter cereals in Europe is prevalent. However, limited research has been conducted on the control of broadleaf weeds in turf. This research addressed the sensitivity of turf weeds to isoxaben applied PRE and postemergence (POST). Effects of isoxaben application timing and rates on soil longevity and duration of broadleaf weed control in turfgrass were also determined.

Species sensitivity of selected broadleaf weeds to isoxaben was determined using a petri-dish bioassay experiment. The rate required for 50% radicle growth reduction was determined. Dandelion and buckhorn plantain were less sensitive to isoxaben concentrations of 0.005 to 0.01 µg/ml, compared to common lespedeza, black medic, and white clover. Buckhorn plantain appeared to be more sensitive than dandelion based on radicle elongation response to isoxaben at 0.04 and 0.08 µg/ml. The GR_{50} value for buckhorn plantain was numerically lower than that of dandelion. The three leguminous weed species were similar in their sensitivity to isoxaben.

Isoxaben applied POST at 2.24 kg/ha (twice the maximum use rate) gave less than 30% shoot growth reduction of buckhorn plantain, dandelion, common lespedeza, spotted spurge, and yellow woodsorrel. Approximately 45 to 65% shoot growth reduction was observed in Florida betony, white clover, and black medic after POST application of isoxaben at 2.24 kg/ha. These results can be compared to those of the petri-dish study. Both studies demonstrated that the leguminous weed species were more sensitive than dandelion or buckhorn plantain to isoxaben. This may be due to a more sensitive target site in these species or due to differential accessibility of isoxaben to the target site. Isoxaben reduced regrowth of Florida betony and hastened the decline of certain broadleaf weeds when tank mixed with growth-regulator type herbicides. A tank mix of isoxaben with POST herbicides would control existing weeds and provide residual control.

Application timing affected the soil dissipation of isoxaben. Fall-applied isoxaben persisted in the soil for a longer period than spring-applied isoxaben based on extraction of the parent compound from the soil and quantification. At three and six months after treatment (MAT), approximately 20 and 70% higher levels of isoxaben, respectively, were extracted from the top 3.8 cm of soil following fall application when compared to spring treatments. Spring followed by fall application resulted in approximately 85% higher levels at 9 MAT, compared to any single application. Half-life (DT_{50}) of isoxaben was estimated as 2.7 months following spring application, 5.7 months following fall application, and 6.1 months following spring plus fall application. The cooler winter months following fall application may have resulted in slower microbial degradation of isoxaben. This would explain the higher residue levels and longer half-life of isoxaben after fall application compared to spring treatment. The 6 to 9 month period following fall application corresponds to the months of May to July when soil temperature and precipitation levels were higher. Herbicide dissipation rates through microbial degradation may be higher during these warmer months, which resulted in low levels of isoxaben at 9 MAT after fall application.

A soil bioassay study to determine breakdown of isoxaben in the soil produced results comparable to those from the laboratory analysis. When the soil bioassay results were compared to quantitative results from high performance liquid chromatography, correlation coefficients of 0.85 for yellow rocket and 0.89 for buckhorn plantain were obtained. Yellow rocket control from fall application of isoxaben lasted for six months and that from spring application of isoxaben lasted for about 3 months. Compared to spring application of isoxaben, buckhorn plantain was controlled better at 3 months following fall application of the herbicide. Application timing did not seem to influence spotted spurge control, perhaps due its lower sensitivity to isoxaben.

The weed species at a given location is a key factor for determining the application timing of isoxaben. Isoxaben applied in spring at 1.12 kg/ha provided excellent control of buckhorn plantain, white clover and dandelion for 4 to 5 MAT. Isoxaben applied in spring provided poor control of broadleaf weeds one year after application. Fall-applied isoxaben at 1.12 kg/ha provided excellent control of winter annuals and good to excellent control of most broadleaf weed species that germinated the following spring or early summer. At the Virginia Beach location, all rates of isoxaben gave complete control of buckhorn plantain but poor to no control of dandelion at 8.5 MAT. Repeat application of isoxaben in spring and fall enhanced weed control when compared to a single spring application at Virginia Beach. These results were in agreement with laboratory data of residue levels following the different application timings, where fall-applied isoxaben lasted longer in the soil compared to spring-applied isoxaben.

The primary means of isoxaben breakdown in soil is through microbial degradation. Microbial activity is known to be higher during summer months compared to winter months due to differences in soil temperature. Fall-applied isoxaben lasted longer in the soil based on quantitative data as well as weed control data. Application of this herbicide in fall just before most winter annuals germinate would control these weeds as well as certain summer annuals that germinate during the following spring. For control of both summer and winter annuals isoxaben should be applied in spring and fall. A combination of isoxaben plus growth-regulator type herbicides would control existing weeds and provide residual control. Long-term broadleaf weed management in turf using isoxaben requires further field research. Research on the POST control of broadleaf weeds in the field when isoxaben is combined with other POST herbicides or adjuvants would be useful. Research is also required on optimum irrigation or precipitation required for soil activation of isoxaben without causing runoff.

VITA

Rakesh Sarasamma Chandran was born to Raghavan Chandrahasan and Thatupurackal Parvathi Sarasamma on September 17, 1966, in Trivandrum, India. After receiving a B.S. in Agriculture from the Kerala Agricultural University in 1988, he came to the United States and completed a one-year internship in gardening at Longwood Gardens, Pennsylvania. He completed an M.S. degree in Environmental Horticulture (turfgrass physiology) from the University of Florida under the supervision of Dr. A. E. Dudeck. In fall 1993, he joined the department of Plant Pathology, Physiology and Weed Science at Virginia Tech to work on a doctorate in Weed Science under the combined supervision of Drs. J. F. Derr and S. W. Bingham.