

**PROGRESS REPORT- 2000**  
**USGA TURFGRASS RESEARCH FOUNDATION**

**INTEGRATING NATURAL ENEMIES, CULTURAL CONTROL, AND PLANT RESISTANCE FOR SUSTAINABLE MANAGEMENT OF INSECT PESTS ON GOLF COURSES.** D.A. Potter, R. López, and A.J. Powell. Departments of Entomology and Agronomy, University of Kentucky Lexington, KY 40546-0091

**Objectives:**

- 1) Evaluate the role of ants and other beneficial predators in golf turf; determine the predominant species inhabiting golf courses; and develop tactics for managing mound-building pest ants on putting greens with reduced environmental risk or impact on beneficial species.
- 2) Investigate synergism between endophyte-enhanced, resistant turfgrasses and biorational insecticides for improved management of white grubs and black cutworms.
- 3) Examine the main and interacting effects of cultural practices (mowing height, irrigation, and N fertilization, PGR's ) on nutritional and defensive characteristics of creeping bentgrass, and on relative susceptibility to white grubs and black cutworms.

**Executive Summary:**

Ants are important predators on eggs and larvae of cutworms, grubs, and other pests, but on golf courses, these positive aspects must be weighed against the fact that some ant species build mounds on putting greens and tees. Our research showed that two commercially available baits containing either avermectin (Advance® Granular Carpenter Ant Bait; WhitMire Micro-Gen, Inc.) or hydramethylnon (Maxforce® granular ant bait; Clorox, Inc.) are effective for spot-treating ants in high-profile situations. Minimum effective rates were investigated. Fipronil (Chipco Choice®, Rhone-Poulenc, Inc.), a novel phenyl pyrazole, was found to be effective for season-long suppression of *Lasius* nests and mounds on putting greens. However, other experiments showed that in fairways and roughs, ants are beneficial in suppressing eggs and larvae of other insect pests. *Lasius* ants were found to cultivate and tend certain root-feeding aphids from which the ants obtain sugary honeydew as food. Managing such aphids may be one means of suppressing mound-building ants.

Two important toxicological studies were conducted to evaluate potential hazard of turfgrass insecticides to predatory insects, and to pollinators such as bumble bees that might visit weedy turf. Halofenozide (MACH2®) had no adverse effects on either predators or pollinators. Exposure to non-irrigated spray residues of imidacloprid caused sublethal, neurotoxic effects on predatory beetles and suppressed health of bumble bee colonies foraging on white clover while confined in field cages on the treated turf. However, post-treatment irrigation greatly reduced these potential adverse effects. In contrast, bendiocarb caused high acute mortality of predators. Residues of bendiocarb and chlorpyrifos also had severe impact on bumble bees foraging on weedy turf. pollinators. These results indicate that the new generation turf insecticides, especially halofenozide, are less hazardous to beneficial insects than are the

older organophosphates or carbamates. Hazard to pollinators can be further reduced by post-treatment irrigation, or by mowing flower heads of flowering weeds before treatments for surface-feeding insects are applied.

Feeding on roots of endophytic perennial ryegrass did not adversely affect survival or growth of Japanese beetle grubs, or their susceptibility to infection by milky disease bacteria, *Paenibacillus popilliae*. This is consistent with our earlier, USGA-funded work which indicated that endophytes do not provide significant resistance to grubs. We also found that use of the PGRs paclobutrazol or trinexapac-ethyl on creeping bentgrass neither increased nor decreased susceptibility of the turf to cutworms or sod webworms. In another experiment, three different organic fertilizers or urea were applied to perennial ryegrass golf fairways to test whether use of the organics may encourage higher incidence of the black turfgrass ataenius [BTA], a scarab that is reputedly is attracted to manure or compost. Two of the three organic fertilizers attracted adult BTA and resulted in higher densities of BTA grubs. This study must be repeated in 2001 to determine if the same pattern will occur. If validated, these results suggest that where BTA is a concern, preventive controls may be advisable on putting greens or other high-profile sites where manure-based organic fertilizers are used.

## OVERALL GOAL:

The long-term goal of this project is to clarify factors that determine the distribution and abundance of insect pests of golf courses, especially ants, white grubs, and cutworms, and to develop sustainable tactics for managing these pests with reduced reliance on conventional insecticides. Under each of the Objectives I have given verbatim Abstracts of refereed papers that either were published in 2000, or have been accepted for publication. Then, I summarize additional work for that Objective that was started or completed in 2000.

**OBJECTIVE 1.** Evaluate the role of ants and other beneficial predators in golf turf; determine the predominant species inhabiting golf courses; develop tactics for managing mound-building pest ants on putting greens with reduced environmental risk or impact on beneficial species.

**Management of a Mound-building Ant, *Lasius neoniger* Emery, on Golf Putting Greens and Tees Using Delayed-Action Baits or Fipronil.** López, R, Held, D.W. and D.A. Potter (2000). *Crop Science* 40: 511-517

**ABSTRACT** The ant *Lasius neoniger* Emery can be a serious pest when its nesting and mound-building activities occur on golf putting greens and tees. Controlling turf-infesting ants is difficult because conventional insecticides usually fail to eliminate the subterranean queen. We compared the attractiveness of commercial and experimental ant baits to *L. neoniger* workers, and evaluated baits containing novel, delayed-action toxicants for selective control of *L. neoniger* on creeping bentgrass, *Agrostis stolonifera* L., golf tees. Efficacy of non-bait granular fipronil, a new phenyl pyrazole insecticide, also was evaluated. In choice tests, protein-based baits were more readily taken than baits containing sugar- or oil-based attractants. Abamectin-, hydramethylnon-, or spinosad-based baits significantly reduced numbers of ant mounds and nests when applied either as spot or broadcast treatments. Two commercial baits, Advance Granular Carpenter Ant Bait containing 0.011% abamectin B<sub>1</sub>, and Maxforce Ant Killer Granular Bait containing 0.9% hydramethylnon, were especially effective. Spot-treatment with either of these baits, using 1 g of bait per mound, eliminated 88-97% of the mounds within 3 d. Broadcast application of fipronil (0.028 kg AI/ha) on heavily-infested, sand-based creeping bentgrass putting green turf in May provided ≈ 80% reduction of ant mounds at 7 d after treatment, and 86% reduction at 60 d.

**Ant Predation on Eggs and Larvae of the Black Cutworm (Lepidoptera: Noctuidae) and Japanese Beetle (Coleoptera: Scarabaeidae) in Turfgrass.** López, R. and D. A. Potter. 2000. *Environmental Entomology* 29: 116-125.

**ABSTRACT** We studied ant predation on eggs and larvae of the black cutworm, *Agrotis ipsilon* Hufnagel, and on eggs of the Japanese beetle, *Popillia japonica* Newman, on golf courses and lawns in central Kentucky. *Lasius neoniger* Emery, accounted for > 99% of the ant mounds on golf putting greens and collars. Although often regarded as a nuisance pest, *L. neoniger* preyed heavily upon *A. ipsilon* eggs on turfgrass cores implanted into putting greens, collars, fairways, and roughs. Predation on eggs was lower in fairways than in roughs, and in plots where ant populations were reduced by insecticides. When 1600 individual first-instar cutworms were placed near *L. neoniger* nests on putting greens, 62% were attacked and killed upon their first encounter with the ants. Third- and fourth-instar cutworms generally fended off attacks by *L. neoniger* and *Formica pallidifulva nitiventris* Emery, but were invariably killed during encounters with *Formica schaufussi* Mayr and *Formica subsericea* Say, larger ants that are common in lawns and golf roughs. Predation on implanted Japanese beetle eggs also

tended to be greater in roughs than in fairways, and fewer grubs were found in areas of golf roughs where ants were abundant than where ants had been controlled. This study suggests that predation by indigenous ants provides an important buffer against pest outbreaks on lawns and golf courses.

Lethal and Sublethal Effects of Bendiocarb, Halofenozide, and Imidacloprid on *Harpalus pennsylvanicus* DeGeer (Coleoptera: Carabidae) Following Different Modes of Exposure in Turfgrass. Brian A. Kunkel, David W. Held, and Daniel A. Potter. *Journal of Economic Entomology*. *In Press*. (will appear in Feb. 2001 issue)

**ABSTRACT.** Routes by which non-target predatory insects can be exposed to turfgrass pesticides include topical, residual, and dietary exposure. We used each of these routes to evaluate potential lethal or sublethal effects of two novel turfgrass insecticides, imidacloprid and halofenozide, and a carbamate, bendiocarb, on survival, behavior, and fecundity of an omnivorous ground beetle, *Harpalus pennsylvanicus* DeGeer. Field-collected carabids were exposed to direct spray applications in turf plots, fed food contaminated by such applications, or exposed to irrigated or non-irrigated residues on turf cores. Halofenozide caused no apparent acute, adverse effects through topical, residual, or dietary exposure. Moreover, the viability of eggs laid by females fed halofenozide-treated food once, or continuously for 30 d, was not reduced. In contrast, topical or dietary exposure of carabids to bendiocarb inevitably was lethal. Exposure to imidacloprid by those routes caused high incidence of sublethal, neurotoxic effects including paralysis, impaired walking, and excessive grooming. Intoxicated beetles usually recovered within a few days in the laboratory, but in the field, they were shown to be highly vulnerable to predation by ants. One-time intoxication by imidacloprid did not reduce females' fecundity or viability of eggs. There was no apparent behavioral avoidance of insecticide residues, or of insecticide-treated food. Carabids exposed to dry residues on turfgrass cores suffered high mortality from bendiocarb, and some intoxication from imidacloprid, but these effects were greatly reduced by post-treatment irrigation. Implications for predicting hazards of insecticides to beneficial invertebrates in turfgrass are discussed.

Evaluation of Fipronil, Thiamethoxam, or Bifenthrin for Control of Ants on Creeping Bentgrass Golf Tees. Held, D.W. and D.A. Potter. *Arthropod Management Tests* (non-refereed). *In Press*. We evaluated fipronil and thiamethoxam, two novel persistent soil insecticides, and bifenthrin, a fast-acting pyrethroid, for effectiveness in suppressing ant colonies of *Lasius neoniger* on sand-based creeping bentgrass tees at Champion Trace Golf Course in Nicholasville, KY. Plots, distributed over nine total holes, were selected and blocked based upon pre-treatment ant counts on 5 Jun. A 6 x 6 m PVC frame was placed on each tee so as to incorporate the greatest number of mounds possible. Once situated, surveyor's shiners were set in the rough beside the tee and the distance to the frame measured so that samples could be taken from the exact spot on each subsequent sample date. Plots were treated on 5 Jun and sampled on 12 Jun, 19 Jun, 3 Jul, and 2 Aug, (7, 14, 28, and 58 DAT, respectively) by counting the number of active mounds. Bifenthrin and thiamethoxam provided short-term suppression, reducing mound counts at 7 and 14 DAT but not at later evaluations. Bifenthrin was somewhat more effective than thiamethoxam. Fipronil required 14 days before significant suppression occurred, but mounding was still suppressed after 58 days. There was no phytotoxicity from any treatment. Additional Work Related to This Objective:

Relationships Between Golf Course Ants and Root Aphids. Lopez, R. and D.A. Potter. (First

draft of manuscript is written). We observed that nests of *L. neoniger* usually have associated with them populations of subterranean aphids that feed on the roots of the grass where the ant nest occurs. Mutualism with root aphids was known for *Lasius* in other systems (Pontin 1978), but has not been studied in turf. The aphids may affect the success of *Lasius* nests because the ants feed on the honeydew secretions, and on the aphids themselves (Lopez and Potter, *unpublished data*). We sought to determine the types of grasses and habitats in which the aphids are abundant, suspecting that this might explain the distribution of the ants. Moreover, if the ants and aphids are co-dependent, then controlling the aphids might help to suppress the ants where their mound are intolerable.

Replicated plots of seven cool-season turfgrasses, growing on a Maury silt loam soil at the UK Turfgrass Research Facility, were sampled twice by randomly searching for *Lasius* ant mounds on each plot and removing a 14-cm diameter soil core where ant nests were found. Grasses included Palmer II perennial ryegrass, KY 31 and Falcon tall fescues, common and Adelphi Kentucky bluegrasses, Aurora hard fescue, and Penncross creeping bentgrass. Cores were then taken to the laboratory and the soil and roots were carefully separated. All aphids found with the ants were collected with a moist paint brush and preserved for identification by systematists at the U.S. National Museum (we are still awaiting these ID's). Aphids infesting the different plots were preserved separately because each type of grass seemed to have a different type of aphid. All of the grasses supported abundant populations of root aphids. *Lasius neoniger* seems to be opportunistic, exploiting whatever species of root aphids is abundant in the particular turfgrass in which the ant nest occurs. The relationship appears to be mutualistic: the ants protect the aphids from predators, carry them about, and stroke them for carbohydrate-rich honeydew.

At Champion Trace Golf Course, 5 cm diameter core samples were systematically taken from three greens, and from surrounding collars and roughs, monthly during May, June and July. Similar samples also were taken from tees and roughs. Cores were processed in the manner described earlier. We found that aphids were always abundant in cores taken from Kentucky bluegrass roughs, but aphids were never found in sand-based tees and greens. Possibly, the compacted, sandy soil is unsuitable for the aphids. In just one instance we found two dead (diseased) aphids on the interface between the sand and the native soil in a core from a green. These samples suggest that the typically higher populations of *L. neoniger* ants around the perimeter of putting greens or tees may reflect the ants' exploiting the "best of both worlds"; i.e., using the sandy soil to facilitate their own nest-building, harvesting the abundant protein food (e.g., insect fragments) from the putting green surface, while maintaining satellite chambers with root aphids in close rough.

Another interesting discovery was that *Lasius neoniger* commonly exploits cavities in the roots of plantain (*Plantago* spp.), originally formed by weevil feeding, as "stables" in which to cultivate root aphids. In weedy lawns or roughs with abundant plantain, we invariably found *L. neoniger* nest galleries associated with plantain. In nearly all cases, the taproot of the weed was hollowed out, and colonies of ant-tended root aphids were found within.

Do Turfgrass Insecticides Pose a Hazard to Bees that Forage on Treated Weedy Turf?  
Gels, J.A. and D.A. Potter. (*This work will be presented by invitation in a Symposium on Conservation of Pollinators at the national meeting of the Entomological Society of America in*

December 2000) Parasitic mites and diseases have contributed to a marked decline in honeybee populations, so that conservation of bumblebees and other native pollinators is increasingly important. If long residual insecticides used for control of turf-infesting white grubs are translocated into pollen or nectar, then pollinators could potentially be harmed. Pollinators might also be exposed to short-residual surface insecticides applied to turf with white clover or other flowering weeds. Stands of tall fescue with white clover were sprayed with carbaryl, chlorpyrifos, or lambda-cyhalothrin, representing a carbamate, organophosphate, and pyrethroid insecticide, respectively. To simulate exposure to grub treatments, similar, replicated plots were sprayed with imidacloprid either with, or without, post-treatment irrigation. After residues had dried, commercially-available hives of the bumblebee, *Bombus impatiens* were placed on each plot, each enclosed in a large pollination cage. Foraging as well as defensive responses of each colony were periodically recorded. After 2 or 4 weeks (short-residual and imidacloprid tests, respectively) the colonies were sacrificed to evaluate hive health including number and weight of brood, workers, queen, and honey reserves. On August 7th, 6 wk after treatment, the hives were frozen and dissected for comparison. Non-irrigated residues of carbaryl or chlorpyrifos has severe impact on been colonies, whereas the pyrethroid had lesser, but still significant effects. Non-irrigated imidacloprid also adversely affected some aspects of hive health, but post-treatment irrigation eliminated these adverse effect. This study indicates that post-treatment irrigation greatly reduces hazard of insecticide applications to pollinators. When surface insecticides must be applied to turf with flowering weeds such as clover or dandelions, mowing beforehand to remove flower heads will reduce hazards to pollinators.

**OBJECTIVE 2.** Investigate synergism between endophyte-enhanced, resistant turfgrasses and biorational insecticides for improved management of white grubs and black cutworms.

Absence of Interaction between Endophytic Perennial Ryegrass and Susceptibility of Japanese beetle (Coleoptera: Scarabaeidae) grubs to *Paenibacillus popilliae* Dutky Walston, A.T., Held, D.W., Mason, N.R., and D.A. Potter. J. Entomol. Sci. In Press.

We tested whether feeding in perennial ryegrass, *Lolium perenne* L., infected with its endophyte, *Neotyphodium lolii* adversely affects survival or weight gain of third-instar *P. japonica*, and whether such grubs are rendered more susceptible to *Paenibacillus* (= *Bacillus*) *popilliae* (Dutky), casual agent of milky disease. Spore powder was mixed with soil at rates from  $2.5 \times 10^8$  to  $4 \times 10^9$  spores per kg, and then spore-inoculated soil was planted with either endophyte-infected or endophyte-free 'Assure' perennial ryegrass. Endophyte levels were confirmed by ELISA immunoblot assay. Early third instar Japanese beetle grubs were introduced 12 wk after grass was sown and examined for milky disease weekly for 5 weeks. Disease incidence was confirmed by examining hemolymph at 400 $\times$  for *P. popilliae* spores and rods. Grub weights, percentage survival, and percentage infection were analyzed for main effects and interaction of endophyte level, spore concentration, and sample date by multivariate analysis of variance (MANOVA) for repeated measures and for main effects and interaction of grass type and spore concentration within sample dates using 2-way ANOVA and orthogonal contrasts. Survival and weight gains of grubs was not affected by endophyte. As expected, concentration of *P. popilliae* significantly affected incidence of milky disease. Contrary to our hypothesis, however, endophyte level did not significantly affect the percentage of grubs that became infected,; i.e., there was no synergism or antagonism between endophyte and *P. popilliae*.

**OBJECTIVE 3.** *Examine the main and interacting effects of cultural practices (mowing height, irrigation, and N fertilization, PGR's) on nutritional and defensive characteristics of creeping bentgrass, and on relative susceptibility to white grubs and black cutworms.*

Effects of two plant growth regulators on suitability of creeping bentgrass for black cutworms and sod webworms. Rogers, M.E., Held, D.W., Williams, D. and D. A. Potter. *Internat. Turfgrass Society Research Journal. In Press.*

**ABSTRACT** Plant growth regulators are often used on turfgrass to reduce mowing frequency and grass clipping waste, increase root growth and stress tolerance, and suppress seed head formation. Given their effects on grass physiology, which include changes in plant nutritional value and production of plant allelochemicals, use of plant growth regulators might be expected to affect suitability of treated grass as food for turfgrass insects. Effects of two plant growth regulators, trinexapac-ethyl and paclobutrazol, on survival and growth of sod webworms (Pyralidae), the black cutworm, *Agrotis ipsilon* Hufnagel, and Japanese beetle grubs, *Popillia japonica* Newman, in creeping bentgrass, *Agrostis stolonifera* L., were determined. Our results indicate that monthly use of trinexapac-ethyl or paclobutrazol on creeping bentgrass mowed at golf fairway height is unlikely to increase or decrease problems with turf-infesting caterpillars. Conclusions could not be made for effects on *P. japonica* because of low numbers of grubs at our study site.

**Additional Work for This Objective:**

**Does Use of Organic Fertilizers Encourage Outbreaks of Black Turfgrass Ataenius on Golf Courses?** D. A. Potter, D.W. Held, J. Gels, and M. Rogers. *(an oral paper on this work will be given at the 2000 meeting of the Entomological Society of America)*

This project, started in 2000, was initiated in response to an outbreak of black turfgrass ataenius (BTA) that occurred on putting greens at Pendleton County Country Club (PCCC) near Falmouth, KY. Milorganite was being used as a slow-release fertilizer the infested sites. BTA and other Aphodiine scarabs behave as dung beetles or scavengers in nature, often infesting sites rich in manure or compost. It therefore was important to determine if this sporadic, but severe pest is attracted to organic fertilizers used on golf courses. Treatments were replicated six times in each of two perennial ryegrass fairways, and an additional set of six replicates was run in fairway cut creeping bentgrass at the UK research farm. Plots were treated monthly, beginning in April, with one of three organic fertilizers: Milorganite (made from municipal sewage sludge stabilized through anaerobic digestion), Sustane (made from composted poultry manure), or Nature Safe (a blend of animal and plant meals mainly from rendered byproducts from slaughterhouses), or with urea. All fertilizers were applied at 1 lb AI/1000 ft<sup>2</sup> per application. Open pitfall traps (five per plot) were operated to monitor for attraction/activity of BTA adults, and grub populations were sampled and compared among plots after each flight period. There was a robust BTA infestation (100 to 150 grubs per ft<sup>2</sup>) at PCCC. Adult captures and first-generation (June) grub populations *were significantly higher* in plots treated with two of the three organic fertilizers than in urea-treated or control plots. In an effort confirm this phenomenon, two additional sites, each with six additional replicates of all treatments, were established on different golf holes. Thus, there were 24 replicates of each

of the five treatments across four sites at PCCC to sample for the second (August) generation. Surprisingly, however, the expected second generation of BTA (which is documented in earlier literature) never materialized at the PCCC site. Reasons for this are unknown. This test will be repeated in 2001 to determine the consistency of the observed pattern. However, based on our existing data, it seems that use of certain organic fertilizers does encourage higher BTA grub populations. This potential negative side-effect can be counteracted by applying a short-residual pyrethroid as a preventive if abundant adult BTA are observed on putting greens.

## PUBLICATIONS AND PRESENTATIONS

The following are publications from USGA-funded research for 1998-2000. Previous scientific papers were listed in earlier progress reports. All publications include acknowledgment of USGA funding.

### A. Book, Book Chapters, Refereed Scientific Papers

#### Book:

Potter, D. A. 1998. *Destructive Turfgrass Insects: Biology, Diagnosis, and Control*. D. A. Potter. 366 pages, incl. 32 color plates. For ordering information, contact: Ann Arbor Press, 121 S. Main St., Chelsea, MI 48118; 1-800-858-5299 or GCSAA/PLCAA Bookstores

#### Book Chapters:

1. Potter, D. A. 1999. Environmentally responsible management of white grubs and cutworms on golf courses. In: Clark, J. M. and M. P. Kenna (eds.). *Fate of Turfgrass Chemicals and Pest Management Approaches*; American Chemical Society, ACS Books, *In Press*.
2. Potter, D.A. 2000. The Japanese beetle. CAB International Global Crop Protection Compendium, Wallington, UK (electronic, published on CD)
3. Potter, D.A. and D.W. Held. 2001. June Beetles (*Phyllophaga* spp.) Encyclopedia of Insects, Academic Press. *In Press*.
4. Held, D.W. and D.A. Potter. 2001. The Japanese beetle. Encyclopedia of Insects; Academic Press. *In Press*.

#### Refereed papers:

1. Kunkel, B.A., D.W. Held, and D.A. Potter. 1999. Impact of halofenozide, imidacloprid, and bediocrb on beneficial invertebrates and predatory activity in turfgrass. *J. Econ. Entomol.* 92: 922-930.
2. Lopez, R. and D.A. Potter. 2000. Ant predation on eggs and larvae of the black cutworm (Lepidoptera: Noctuidae) and Japanese beetle (Coleoptera: Scarabaeidae) in turfgrass. *Environ. Entomol.* 29: 116-125.
3. Lopez, R., D.W. Held, and D.A. Potter. 2000. Management of a mound-building ant, *Lasius neoniger* Emery, on golf putting greens and tees using delayed-action baits or fipronil. *Crop Science* 40: 511-517.



4. Bauerfeind, R.J., K.F. Haynes, and D.A. Potter. 2000. Responses of three *Cyclocephala* (Coleoptera: Scarabaeidae) species to hexane extracts of *Cyclocephala lurida* sex pheromone. *J. Kansas Entomol. Soc.* 72: 246-247.
5. Walston, A. T., D. W. Held, N. R. Mason, and D. A. Potter. 2000. Absence of interaction between endophytic perennial ryegrass and susceptibility of Japanese beetle grubs to *Paenibacillus popilliae*. *J. Entomol. Sci. In Press.*
6. Rogers, Michael E., D.W. Held, D.W. Williams, and D.A. Potter. 2001. Effects of two plant growth regulators on suitability of creeping bentgrass for black cutworms and sod webworms. *Internat. Turfgr. Soc. Res. J. In Press.*
7. Kunkel, B.A., D.W. Held, and D. A. Potter. 2000. Lethal and sublethal effects of bendiocarb, halofenozide, and imidacloprid on *Harpalus pennsylvanicus* DeGeer (Coleoptera: Carabidae) following different modes of exposure in turfgrass. *J. Econ. Entomol. In Press.*
8. Potter, D.A. and D.W. Held. 2001. Biology and management of the Japanese beetle. *Annual Review of Entomology.* Invited, In progress. Manuscript due in early 2001.

Invited Technical Articles in National Trade Journals (all originate from my laboratory):

1. Potter, D.A. 1999. Novel chemicals provide new grub control options. *Grounds Maintenance* 34(4): 12-17. (Full-Cover Feature Article)
2. Potter, D.A. and R.Lopez. 1999. Baits target nuisance ants. *Golf Course Management* August 1999: 64-67.
3. Potter, D.A. 1999. Spring is the best time for ant control. *Turfax*, March-April, pp. 6-7.
4. Potter, D.A. and M.F. Potter. 1999. Managing biting and stinging pests on golf courses. *September 1999*: 53-58.
5. I am one of four Contributing Editors for the *Turfax International Turf Newsletter*. During 1999-2000 I published nine, 2-page articles on topics ranging from recent developments in insecticide chemistry, to managing grub-eating varmints in turf.

**USGA-funded research was featured in presentations at:**

American Chemical Society Symposium, 1998  
 National Turfgrass Research Conf., 1998 & 2000  
 Entomological Society of America, 1998, 1999  
 KY Landscape and Nursery Industries Winter Conference, 1997 & 1998  
 KY Turfgrass Council, 1997 & 1998  
 Cincinnati/Northern KY Golf Course Superintendents Meeting, 1998  
 Six Regional Golf Management Seminars in Midwestern cities, 1999  
 UK Turfgrass and Landcape Field Day, 1997 & 1998  
 Ontario Turfgrass Symposium, 2000  
 PLCAA Green Industry Expo  
 GrubFree nation-wide free, live, interactive internet seminar