

Weed Management Programs for 1998

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If you had to choose, which weeds would you consider the most troublesome on your golf course? In this issue of PACE Insights, we have selected the twelve weeds that appear to dominate management practices on California golf courses, and have provided a synthesis of the most successful control methods -- both old and new, both cultural and chemical that should be of use as you plan your management programs for 1998 and beyond.

So many herbicides, so little time...

With a plethora of herbicide products on the market, and with so many weeds occurring in so many different situations, presentation of technical information can get murky fast. In attempt to be as uncluttered as possible, the twelve weeds highlighted here were selected because by managing them, other more minor weeds are also managed. The wide variety of products labeled for use on golf course turf are listed in two enclosed tables, and are organized two ways: alphabetically by active ingredient (Table 1), and alphabetically by the trade or product name (Table 2). In the discussion on control of each weed, however, we have restricted ourselves to describing those herbicides that are known to work most effectively, based either on our personal observations, or based upon data presented in refereed scientific journals. If there are products that we have omitted that have worked well for you, please let us know. Finally, descriptions of each weed are not presented here, but in the **References** section at the end of this Insights, we direct you to several very good books and internet sites for weed identification.

Cultural control

As most of you have probably heard *ad nauseum*, production of a healthy dense stand of turf is your best defense against invasion by any type of weed. For this reason, anything you do to increase turf health (higher mowing heights, decreased disease and insect pressure, aerification and top dressing to decrease compaction, traffic management to decrease compaction, correction of irrigation coverage problems, selection of turfgrass varieties that grow best in your area, improved fertility) will also reduce weed problems. In addition, reduction of shade due to trees will also reduce weed populations, since less than three hours of direct sunlight per day will decrease turfgrass vigor, and allow weed encroachment.

We are firm believers in the many benefits offered by aerification programs, but some superintendents have expressed concerns that deep tine aerification may decrease the effectiveness of pre-emergence

herbicides by disrupting the soil barrier they form to newly germinated weed seedlings. However, research

conducted by B.J. Johnson of the University of Georgia and others indicates that the turf vigor/weed control benefits of aerification far outweigh any negative impact on herbicide efficacy. So while there are many hurdles to a good aerification program, fear of herbicide inactivity shouldn't be one of them.

Finally, a word about herbicide rates. Data has been presented by several researchers indicating that in many cases, full rates of herbicides are not needed after the first year of application. Rate reductions of 25-75%, depending on the herbicide, have been reported in the 2nd year of an herbicide program without any loss in activity. It is believed that successive yearly applications may decrease the density of the target weed enough that full strength rates are not necessary. This is an intriguing concept that we would like to explore further under California conditions before recommending that you try it on a large scale, however.

Grasses and Sedges

Annual bluegrass, *Poa annua* is the most exasperating winter annual weed on golf greens, and one of the most widespread weeds throughout the golf course. It causes problems due to production of numerous seedheads, lighter green color, and poor heat and salinity tolerance. A more in-depth review of *poa* control was presented in the May, 1997 edition of PACE Insights. The long residual activity (2-4 months) of pre-emergence herbicides such as benefin, bensulide, dithiopyr, oryzalin, oxadiazon, prodiamine or simazine allows superintendents to achieve long-term control on tees and fairways, especially if split applications (one in September and another in February) are utilized. On fairways overseeded with ryegrass, an alternate strategy involves the use 1-2 post-emergence applications of ethofumesate during November and December. However, for use on greens, only products containing bensulide and dithiopyr are registered, and these have produced erratic results, possibly due to their decreased level of activity on perennial biotypes. In addition, dithiopyr can damage some creeping and Colonial bentgrass varieties, Tifgreen bermudagrass and some fine fescues. For this reason, herbicide control of *poa* on greens is frequently not possible, and superintendents are left with the option of vigilant hand weeding, or concession to the reality of *poa* greens.

Smooth crabgrass (*Digitaria ischaemum*) and large crabgrass (*Digitaria sanguinalis*) are probably responsible for more pre-emergence herbicide applications than any other turf weed. Because high

light intensity is necessary for germination of crabgrass, dense and healthy turf which shades the soil is one of your best defenses against invasion. As annuals that germinate all summer, the best herbicide control strategy involves the use of pre-emergence herbicides applied 7-10 days before seeds begin to germinate. Determining exactly when germination occurs is a bit of a trick, with the scientific literature somewhat confused on the point -- citing average air temperatures of 55° F, or average soil temperatures of 53 - 58° F, or average air temperatures of 55° F for two weeks as the trigger point for application. As a result of this lack of more specific information, applications are made anywhere from January to March in California. Split applications of pre-emergence herbicides are a good strategy, due to the long period in which crabgrass germinates. For example, an application in February could be followed by a second application approximately 3 months later, depending on the herbicide used. In 1997 field trials conducted by PTRI, prodiamine, dithiopyr and pendimethalin provided excellent control of crabgrass for a 4 month period. These products are labeled for use on tees and fairways. On greens, the only pre-emergence product available is bensulide.

Goosegrass, *Eleusine indica*, is a summer annual sometimes confused with crabgrass. However, it germinates a little later than crabgrass (2 - 8 weeks later), is darker green and grows in more distinct tufts than crabgrass. Presence of goosegrass often indicates areas where soil oxygen is low due to compaction and heavy traffic. As for crabgrass, high light intensity is necessary for germination of goosegrass, and therefore dense and healthy turf, which shades the soil, is one of your best defenses against invasion. Chemical control strategies for goosegrass usually rely on the same program used for control of crabgrass, and once again, split applications appear to work best by providing longer-term control. However, because goosegrass is harder to control than crabgrass, the best pre-emergence products (which include oxadiazon, pendimethalin and prodiamine) provide only 80-90% control. If infestations are severe, application with post-emergence herbicides (MSMA or glyphosate for spot applications) may be necessary.

Dallisgrass, *Paspalum dilatatum*, is a perennial that spreads by seed and by very short rhizomes and grows most actively during the late spring and summer months. Sometimes known as bunchgrass because of its clumpy growth habit, small infestations are best removed by digging. When removing dallisgrass by digging, always cut outside all plant parts and at least 2 inches deep. Selective herbicides that are safe for desirable turfgrass aren't available, with the exception of MSMA, which should be used in repeated post-emergence treatments (3 applications, at 7 - 10 day intervals; if one application is missed, the sequence must start over from the beginning) on higher mown

bermudagrass, bluegrass and zoysiagrass. Applications should begin in late June when the weed is most actively growing. The product will work best when air temperatures are warm (85-90°F). Turf may yellow for 4 - 6 weeks after application. Bentgrass, fescues, and St. Augustinegrass can be damaged by MSMA applications. The alternative to MSMA are sequential spot treatments, made every 7-10 days with a post-emergence product such as glyphosate. Glyphosate works best in warm weather, and when soil is moist and weeds are growing actively.

Kikuyugrass, *Pennisetum clandestinum*: Introduced into California for erosion control in 1918, kikuyugrass has now spread through a good part of the state via seed, rhizomes and stolons, except where frost and cold temperatures limit the growth of this subtropical perennial. It is also a serious weed of turf in Hawaii, Australia, the Mediterranean and parts of Mexico. Although cultivated as a desirable fairway turf on several California golf courses, it is more often viewed as a weed due to its aggressive growth, light green color and coarse texture. On bermudagrass, Kentucky bluegrass and zoysiagrass fairways, control of kikuyugrass relies on monthly applications (generally May-August) of the post-emergence herbicide MSMA. For other turf varieties, there are no registered products available that will control kikuyugrass but will not injure the turf. In these cases, sequential spot treatments, made every 7-10 days with a post-emergence product such as glyphosate, are the only alternative. Glyphosate works best in warm weather, and when soil is moist and weeds are growing actively.

Yellow nutsedge, *Cyperus esculentus* and purple nutsedge, *Cyperus rotundus*, are perennial weeds that spread by seeds and by tubers. The tubers are sometimes mistakenly referred to as "nuts" or "nutlets" due to their small (1/2 inch in diameter or less) rounded shape as they grow on the underground rhizomes. Yellow and purple nutsedge, as well as green kyllinga (see below) are categorized as sedges, and are not grasses, despite their similar appearance. To identify a sedge, grasp the plant stem and note that stems are three sided with sharp angles (thus the saying, "sedges have edges"). Also note that leaves arise from all three sides of the stem, while on grass plants, leaves arise from only two sides of the stem.

Yellow nutsedge is found throughout California, but purple nutsedge is found only in the warmest southern areas where the soils rarely freeze. Both are most likely to establish in areas that are waterlogged due to overwatering, poor irrigation coverage, or poor drainage, but once established will tolerate normal conditions or even drought. Both species grow best during the warm summer months. Until the recent introduction of the systemic, post-emergence herbicide halosulforn, there were few effective options for control of sedges. However, good control can be achieved on

cool and warm season tees, fairways and roughs when this product is applied at the 3-8 leaf stage of growth, in combination with a non-ionic surfactant. A follow up treatment, made 6-10 weeks later, may be necessary. Ideally, turf should not be mowed 2 days before or after application, and irrigation should be withheld for 8 hours after application.

Green kyllinga, *Kyllinga brevifolia*: Although not yet a major problem in Western turf, incidences of green kyllinga infestations have been increasing over the past few years. This perennial sedge (closely related to yellow and purple nutsedge) prospers in highly maintained, frequently irrigated turf. The culms can fruit below 1/2 inch, which allows establishment on tees, fairways and possibly greens. Green kyllinga grows most actively at the same time as warm season turf such as bermudagrass, and is quite frequently unintentionally controlled via February/March pre-emergence applications of dithiopyr or oxadiazon made against crabgrass, annual bluegrass or goosegrass. In addition, suppression (but not control) of green kyllinga can be achieved via applications of the post-emergence herbicide, halosulfuron, when the weed is most actively growing, March through October.

BROADLEAF WEEDS

Dandelion, *Taraxacum officinale*, is a low growing perennial with large taproot that enables it to survive even when leaves, and up to 2 inches of taproot are removed. The fact that dandelion tolerates close mowing makes it even more difficult to control. This weed is spread primarily by airborne seeds which germinate in spring and fall. The best defense against dandelion invasion is healthy and dense turf, and frequent mowing to remove flowers and thus reduce the production and spread of seeds. Pre-emergent control can be achieved via application of isoxaben (fairways and roughs only) and post-emergent control with products containing 2,4-D are also effective (multiple applications may be required). However, 2,4-D has been known to damage bentgrass, so beware!

English daisy, *Bellis perennis*: This low growing, perennial weed spreads by short stolons and is most actively growing between April and October. It is a problem primarily in cooler coastal locations. Control is accomplished through post-emergence herbicide applications with products containing dicamba; usually, several applications are necessary for control. Applications to bentgrass should be avoided.

Spotted spurge, *Euphorbia maculata* and prostrate spurge, *Euphorbia supina* are common summer annuals that germinate in open spaces between March and October. The formation of mats of spurge in late spring causes particular problems in low mown turf. Seeds are produced in late spring and germinate throughout the summer. Spurge is frequently unintentionally controlled via

crabgrass/goosegrass/poa control programs that rely on pre-emergence herbicide applications of dithiopyr, pendimethalin, prodiamine, oryzalin, benefin plus oryzalin, and benefin plus trifluralin. Pre-emergence control with isoxaben applications made February - March is also a control option.

Oxalis (creeping woodsorrel), *Oxalis corniculata*:

A perennial that prefers shade and well maintained turf areas, this weed grows year round in California and spreads via running rootstocks. There are no known cultural controls. Pre-emergence herbicide applications of benefin plus trifluralin, dithiopyr or pendimethalin that are made for control of crabgrass/goosegrass/poa will also provide good control of oxalis.

White clover, *Trifolium repens*: This perennial weed has the ability to spread at low mowing heights, allowing it to thrive in many situations. It competes well in turf that is low in nitrogen, and can be partly avoided by keeping nitrogen fertilization adequate, particularly in spring and fall. Pre-emergence herbicide control with isoxaben applications made in February - March are reported to be effective, as are post-emergence herbicide treatments with ethofumesate.

Summary

Examination of Table 3, which summarizes the information presented above, graphically illustrates some key points regarding weed management:

- Pre-emergence herbicide applications made in either February or March will control 8 of the 12 key weeds discussed above. For this reason, selection of the best product for your particular situation, accurate timing, and optimum conditions for herbicide activity (including the mandatory requirement for post-application irrigation) will have a significant impact on the success of your weed management program.
- The use of split applications of pre-emergence herbicides can lengthen the period of control and can help avoid repeated applications of post-emergence herbicides. This is particularly important in California, where many weeds are active almost year-round.
- For the most part, control of broadleaf weeds, particularly dallisgrass, kikuyugrass, sedges, and English daisy can only be accomplished by post-emergence herbicide applications. Mixtures of post-emergence herbicides such as 2,4-D plus dicamba may be more effective and have a broader spectrum of control than either product use singly. These active ingredients are frequently sold as pre-mixes.
- With the exception of products based on the pre-emergence herbicides bensulide and dithiopyr,

there are few turf herbicides labeled for use on golf course greens. As a result, different weed control strategies have evolved on greens, including hand weeding, vigilant scouting for the first signs of weed infestations followed by spot treatments using propane torches or post-emergence herbicides, and good weed control on the rest of the golf course (particularly collars) to avoid infestation via foot traffic or machinery.

- When developing a multiple year weed management plan, try to avoid using the same product year after year. By rotating products from one year to the next, the chances of weed resistance to herbicides can be decreased. In addition, since each herbicide has a characteristic group of weeds that it controls, repeated use of a single herbicide can lead to establishment of those weeds not controlled by that product. In contrast, rotations of herbicides, by targeting slightly different groups of weeds, may help prevent unexpected establishment of new weeds.

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- University of California Statewide IPM Web Page (<http://www.ipm.ucdavis.edu>): select "Pest Management and Identification" and then select "Pests of Commercial Turf" to access photos of key California weeds, a table of weed and turf varietal sensitivity to herbicides and lists of registered products.

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