Weed Control Programs That Utilize Less Herbicides

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Bermudagrasses are widely used on golf courses throughout the southern United States. Bermudagrass has the potential to provide a high quality turfgrass on greens, tees, and fairways. However, a good turfgrass management program with particular emphasis on weed control must be followed to maintain the desirable quality.

Crabgrass and goosegrass are common problem summer annual weeds that infest most bermudagrass turfs during the spring and summer. When weeds are not controlled, turf quality and density is poor. An effective weed control program begins with proper management practices that encourage a dense, thriving turf (11). A dense turf will have fewer weeds than a thin turf (13), and a properly fertilized turf will have less weeds than a poorly fertilized turf (6, 7, 12). However, on most sites, herbicides must be supplemented to maintain level of weed control that is obtained with good cultural practices. Herbicide selection depends on turfgrass tolerance and the susceptibility of the various weed species, and the ability of the herbicide to maintain consistent control by the herbicide.

Crabgrass and goosegrass can be effectively controlled with recommended rates of preemergence (PRE) (1, 9, 14), and postemergence (POST) herbicides (2, 8, 10). However, with increasing environmental and regulatory pressures, it may be necessary to reduce the total quantity of herbicides used for weed control in turfgrasses. When low herbicide rates are evaluated for full-season weed control, there are at least four application strategies to consider: a) sequential applications of the same PRE herbicide applied at reduced rates, b) sequential applications of reduced PRE and POST herbicides applied at different dates, c) tank-mixes of reduced rates of PRE and POST herbicides applied as a single application after the weeds have emerged, and d) multiple year PRE herbicide treatments where the herbicides are applied at a recommended rate the first year and followed by reduced rates the following years. However, programs that utilize low herbicide rates may not always consistently control weeds.

It is possible that herbicide usage in the future may be restricted to reduced rate application strategies. Therefore, we have evaluated several programs that utilize reduced herbicide rates for large crabgrass and goosegrass control in common bermudagrass turf. Studies were conducted on weedy sites in Georgia from 1991 through 1994.

**Sequential reduced rate PRE herbicide treatments.**

Ronstar (G), pendimethalin (WDG) (various trade names), Barricade (WDG), and Dimension (EC) were applied to separate plots at reduced rates in two sequential applications for large crabgrass control in common bermudagrass turf. The initial application was made in late February, and the second application was made 8 weeks later. Large crabgrass control in common bermudagrass was as effective when Ronstar
was applied at one-fourth (1.0 lb ai/A) rate in each of two applications (93%) as when applied at the full (4.0 lb ai/A) rate in a single application (97%). The control was 81% when Ronstar was applied twice at 0.75 lb ai/A. The difference in control between 81 and 93% may be acceptable in some instances, but not always. However, the 93% control from the total 2.0 lb ai/A rate would almost always be acceptable. In this program, the maximum labeled Ronstar rate was reduced by 50%, and commercially acceptable large crabgrass control was maintained.

Pendimethalin applied at one-third (1.0 lb ai/A) rate in each of two applications controlled 90% large crabgrass. The control from the total 2.0 lb ai/A rate was equivalent to a single 3.0 lb ai/A recommended rate. Therefore, pendimethalin rate can be reduced by 33%.

Dimension applied at a one-fifth rate (0.1 lb ai/A) in each of two applications controlled ≥85% large crabgrass over a 2-year period. The control from the sequential applications that total 0.2 lb ai/A was consistently higher than from a single application at 0.25 lb ai/A (33% in 1993; 86% in 1994). Large crabgrass control was ≥92% during the same period when Barricade was applied twice at 0.15 lb ai/A at each application. There was no difference in control from the sequential Barricade treatment that totaled 0.3 lb ai/A, when compared with a single application at a one-half rate (0.38 lb ai/A). When the control from the sequential herbicide applications was compared with labeled recommended rate (0.5 lb ai/A for Dimension and 0.75 lb ai/A for Barricade), the rate for both herbicides can be reduced by 60%. These results show that PRE herbicide rates can be reduced 33 to 60% for large crabgrass control in common bermudagrass by using two applications (late February and late April) for Ronstar, pendimethalin, Dimension, and Barricade.

**Sequential reduced rate PRE and POST herbicide treatments.**

PRE and POST herbicides at reduced rates were sequentially applied for large crabgrass and goosegrass control in common bermudagrass. Ronstar, pendimethalin, Dimension, Barricade, and Surflan (AS) were applied in late February. POST herbicides evaluated with MSMA (L) for large crabgrass control and MSMA + Sencor (DF) and Illoxan (EC) for goosegrass control. POST herbicides were applied in late spring to early summer.

**Large crabgrass control.** The control of large crabgrass in common bermudagrass turf was excellent (97%) during the summer when Ronstar was applied at the full (4.0 lb ai/A) rate. Ronstar applied alone at a one-fourth rate controlled large crabgrass through July, but not in late August. MSMA (2.0 lb ai/A) applied as a single application did not control large crabgrass effectively at any time during late spring and summer.

Large crabgrass control was 95% from a sequential application of Ronstar at a one-fourth (1.0 lb ai/A) rate and MSMA at 2.0 lb ai/A. The control from this sequential reduced rate application was similar to that obtained with Ronstar applied at the full (4.0 lb ai/A) rate. Other PRE herbicides applied at reduced rates and followed by timely application of MSMA controlled large crabgrass as effectively as PRE herbicides applied alone at the
full rates. The treatments were: pendimethalin applied at a one-third (1.0 lb ai/A) followed by MSMA at 2.0 lb ai/A; Dimension applied at a one-half (0.25 lb ai/A) rate followed by MSMA at 2.0 lb ai/A; Barricade applied at a one-third (0.25 lb ai/A) rate followed by MSMA at one-fourth (0.5 lb ai/A) rate; and, Surflan applied at one-third (0.67 lb ai/A) rate followed by MSMA at a one-fourth (0.5 lb ai/A).

In some instances, PRE herbicides applied at a reduced rate may effectively control large crabgrass throughout the summer. When this occurs, the POST MSMA application can be eliminated. This was observed with Barricade in one of two years. In 1994, Barricade applied at one-third (0.75 lb ai/A) rate controlled 80% large crabgrass and a MSMA application was not needed. However in 1993, Barricade at this low rate provided only 60% large crabgrass control and it was necessary to apply MSMA. Therefore, MSMA treatment was needed only in 1993.

**Goosegrass control.** Dimension applied at a full (0.75 lb ai/A) rate did not effectively control goosegrass in common bermudagrass. The control was 38% in 1991 and 78% in 1992. Goosegrass control was <55% when Dimension was applied at a one-half (0.38 lb ai/A) rate either year. However, the control was 84% in 1991 and 96% in 1992 from sequential treatments of Dimension applied at a one-half rate followed by MSMA + Sencor at 2.0 + 0.12 lb ai/A. There was consistent goosegrass control in 1991 from the sequential applications. Neither Barricade nor Surflan consistently controlled goosegrass (<65%) when applied at full labeled rates during 1993 and 1994. However, the control was consistent (≥87%) in both years from sequential applications of Barricade at one-third rate (0.25 lb ai/A) rate and followed by MSMA + Sencor at 2.0 + 0.12 lb ai/A, or from Surflan applied at one-half (1.5 lb ai/A) rate and followed by MSMA + Sencor at 1.0 + 0.12 lb ai/A. Therefore, the use of a PRE herbicide at a reduced rate followed by MSMA + Sencor not only improved the consistency in goosegrass control, but also reduced the PRE herbicide rate. Sequential applications of Ronstar at a one-fourth (1.0 lb ai/A) rate and MSMA + Sencor at 2.0 + 0.12 lb ai/A also controlled goosegrass as effectively during 1992 as did Ronstar applied alone at a full (4.0 lb ai/A) rate.

Illoxan applied alone at 1.0 lb ai/A as POST in June controlled goosegrass ≥95% during 1991 and 1992. There was no increase in goosegrass control from sequential programs of PRE herbicides and Illoxan, when compared with Illoxan alone. Goosegrass control from Illoxan (0.25 to 1.0 lb ai/A) alone was generally as good as when applied in sequence with Barricade and Surflan in 1993 and 1994.

These Georgia studies indicate that large crabgrass and goosegrass can be effectively controlled in common bermudagrass with sequential applications of herbicides at reduced rates. In most instances, the PRE herbicide rate can be reduced from one-half to two-thirds the normal rate and maintain an acceptable level of control. This low rate approach will not only be construed as beneficial to the environment, but will lower herbicide costs for the Superintendent. To utilize these programs, the timing of the POST herbicide application is exceedingly important. Reduced rates of PRE herbicides should be applied at the normal date for large crabgrass and goosegrass control, and followed by a timely application of a POST herbicide at the seedling to early-tillering weed growth stage.
Therefore, effective scouting of the turfgrass site will determine the success or failure of the reduced rate approach. Scouting should be done at weekly intervals from mid-spring to early summer months. In Georgia, POST treatments are generally needed sometime between mid-May and late June. Do not apply POST herbicides before weeds emerge, or wait until the weed growth is too large for effective POST herbicide activity. There will be times when the PRE herbicides applied at reduced rates will control weeds without the POST treatment. When this occurs, POST treatments are not needed.

**Tank-mixed reduced rate PRE and POST herbicides.**

Tank-mixtures of PRE herbicides at reduced rates and POST herbicides at labeled rated were applied as a single application in May for large crabgrass and goosegrass control in common bermudagrass. For this program to be effective, the POST herbicides must control emerged weeds and the PRE herbicides must provide residual, full-season control. In this study, Dimension and pendimethalin were the PRE herbicides; MSMA was the POST herbicide used for large crabgrass control, and MSMA + Sencor and Illoxaon were the POST herbicides used for goosegrass control.

**Large crabgrass control.** Dimension applied at 0.5 lb ai/A in May controlled 71 to 73% large crabgrass at two test locations in 1992. MSMA applied at 2.0 lb ai/A controlled 46 to 47% large crabgrass. When Dimension was tank-mixed at a one-half (0.25 lb ai/A) rate with MSMA at 2.0 lb ai/A, large crabgrass control increased to 93% at the Georgia Station. This was 22% higher than Dimension applied alone at 0.5 lb ai/A and 13% higher than Dimension applied alone at 1.0 lb ai/A. At the Beaver Lake location, large crabgrass control was similar from a tank-mix of Dimension at 0.25 lb ai/A with MSMA at 2.0 lb ai/A and Dimension applied alone at either 0.5 or 1.0 lb ai/A. However, the rate of Dimension in the tank-mix treatment was 50 to 75% less than when Dimension was applied alone. A tank-mix of pendimethalin at a one-half (1.5 lb ai/A) rate with MSMA at 2.0 lb ai/A also effectively controlled large crabgrass.

**Goosegrass control.** Illoxaon applied as POST does not always consistently control goosegrass. The control from Illoxaon at 1.0 lb ai/A was 36 and 62% for 1991 and 1992, respectively. The low control from Illoxaon in this tank-mix study, as opposed to the higher goosegrass control obtained in the sequential PRE and POST herbicide study was probably related to larger goosegrass plants at the time of the tank-mix application. Goosegrass control was ≤50% when Dimension was applied alone at 1.0 lb ai/A. A tank-mix of Dimension at 0.38 lb ai/A with Illoxaon at 1.0 lb ai/A controlled 81% goosegrass in 1991, but only 52% in 1992. When the rate of Dimension was increased to 0.5 lb ai/A and tank-mixed with Illoxaon at 1.0 lb ai/A, the control was ≥77% both years. Tank-mixes of Dimension with MSMA + Sencor did not control goosegrass consistently.

This study shows that the POST activity from tank-mixes of Dimension and Illoxaon on goosegrass was higher than when MSMA + Sencor was tank-mixed with any PRE herbicide. The poor control from MSMA + Sencor tank-mix with PRE herbicides was probably related to the lack of an additional MSMA + Sencor application. Previous research has shown that two applications of MSMA + Sencor are needed to control
goosegrass (3). The inconsistent goosegrass control from most tank-mixed PRE and POST herbicides indicates that additional herbicide applications are needed. PRE and POST herbicide tank-mixes are not as effective for goosegrass control as they are for large crabgrass control. When tank-mixes are used, it may necessitate the use of repeated POST herbicide treatments following the initial tank-mixed application. A better goosegrass control program would be the use of reduced rates of PRE herbicides applied at the normal date, followed by an early-season application of a POST herbicide.

**Multiple year PRE herbicide treatments.**

Large crabgrass. Ronstar and bensulide (EC) (various trade names) controlled large crabgrass effectively (>90%) over a 3-year period (1977-1979), when each herbicide was applied at the recommended rate the initial year (Ronstar at 4.0 lb ai/A; bensulide at 10.0 lb ai/A), and followed by one-half rates the succeeding 2 years. To maintain a similar level of control with Balan (G), it was necessary to apply the full rate (3.0 lb ai/A) for two consecutive years before the rate could be reduced by one-half.

In a study conducted in 1993 and 1994, large crabgrass control in 1994 was >92% when Barricade, Surflan, pendimethalin, or Dimension were applied to the same plots at one-half rates for two consecutive years. Large crabgrass control was also excellent when treated with full (2.0 lb ai/A) rate of Surflan in 1993, and followed by one-half (1.0 lb ai/A) rate in 1994. The full rate for each herbicide was 0.75 lb ai/A for Barricade, 2.0 lb ai/A for Surflan, 3.0 lb ai/A for pendimethalin, and 0.5 lb ai/A for Dimension. The control was >82% when each herbicide was applied at one-half rate in 1993 followed by one-fourth rate in 1994.

Goosegrass control. Ronstar applied at full (4.0 lb ai/A) rate in 1977, and followed by one-half rate in 1978 and 1979, controlled goosegrass throughout the 3-year period. In 1979, goosegrass control was 87% in plots treated with the full (3.0 lb ai/A) rate of Balan in 1977 and 1978, and followed by one-half rate in 1979.

Goosegrass control during 1994 varied among the PRE herbicides and rates of application during 1993 and 1994. Dimension was the only herbicide that controlled >90% goosegrass during 1994 after treatments for two consecutive years. This high level of control was obtained in plots treated at a full (0.75 lb ai/A) rate in 1993 and followed by one-half rate in 1994, or when one-half rate was applied each year. Goosegrass control during 1994 was 83% when pendimethalin was applied at full (3.0 lb ai/A) rate in 1993, and followed by one-half rate in 1994. However, the control was reduced to 47% when pendimethalin was applied at a one-half rate for two consecutive years. In contrast, Ronstar applied at one-half (1.5 lb ai/A) rate for two years controlled 86% goosegrass during the same period.

Goosegrass control during 1994 was not as good from reduced rates of Barricade and Surflan during 1993 and 1994, when compared with the control obtained from Dimension, pendimethalin, and Ronstar. Barricade applied at a full (0.75 lb ai/A) rate in
1993, and followed by a one-half rate in 1994 provided 77% goosegrass control. Surflan applied at a full (3.0 lb ai/A) the first year, and followed by one-half rate the second year provided only 62% control.

These studies indicate that full PRE herbicide rates are not needed in all years for effective large crabgrass and goosegrass control in common bermudagrass turf. However, herbicide selection is important when using reduced rates.

Turfgrass injury. PRE herbicides applied at normal rates in late winter, while bermudagrass was dormant for large crabgrass and goosegrass control delayed early spring growth (4, 5). The degree of growth retardation depended on herbicides and rates of application, but varied with years. In some years, the early growth was not affected while the growth was moderately affected in other years. In most instances when growth of turfgrass was delayed from PRE herbicide, 4 to 6 weeks were needed for complete recovery. When POST herbicides were applied at a normal rate during late spring or summer, bermudagrass was moderately injured for 2 to 3 weeks after treatment (8). However, throughout the last 4-year period, there has been little or no appreciable injury to common bermudagrass from reduced rates of PRE herbicides. With few exceptions, turfgrass injury from combinations of PRE and POST herbicides was not any higher than POST herbicides applied alone. In one of three tank-mix experiments, common bermudagrass injury was higher when MSMA + Sencor (2.0 + 0.12 lb ai/A) was applied with Dimension (1.0 lb ai/A) than when either herbicide was applied alone. The higher injury from the combination treatments was evident for 4 weeks. Similar results occurred when pendimethalin (1.5 lb ai/A) was tank-mixed with MSMA + Sencor.

Summary.

Four weed control programs utilizing reduced herbicide rates for large crabgrass and goosegrass control in bermudagrass turf have been evaluated in Georgia. These programs and level of efficacy are:

a) Sequential applications of the same PRE herbicide applied at reduced rates can effectively control large crabgrass. The initial treatment was made at the normal PRE application date, followed by second application 8 weeks later.

b) Sequential applications of reduced PRE and POST herbicide applied at different dates effectively controlled large crabgrass and goosegrass. The PRE herbicide is applied at the normal date and POST herbicide applied once in late spring or early summer. Scouting will be needed at weekly intervals from mid-May until early July.

c) Tank-mixes of PRE and POST herbicides applied as a single application will control large crabgrass. The treatments were made after weeds emerge, but before the weeds reduced a growth stage not controlled from the POST herbicide. Tank-mixed herbicides controlled large crabgrass better than goosegrass.
d) Multiple year PRE herbicide treatment with reduced rates after the first year. Herbicides applied at full labeled rates the first year and followed by reduced rates the following years have shown good control of large crabgrass and goosegrass.

LITERATURE CITED


