

**ETHOFUMESATE FOR CONTROL OF ANNUAL BLUEGRASS  
ON GOLF COURSE FAIRWAYS  
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Annual bluegrass control has been and continues to be a major hurdle for golf course superintendents to overcome. Ethofumesate has shown in the past and continues to show that it is effective for annual bluegrass control. Prograss is a herbicide that selectively controls annual bluegrass. This paper will discuss some recent research conducted at Michigan State University and also compare several past studies to the recent research.

### **MULTIPLE APPLICATIONS**

In September of 1990 a study was initiated with additional applications in October, November and/or April at Detroit Golf Club. Only two rates were used in this study 0.75 and 1.5 lbs a.i./A. All combinations of 0.75 and 1.50 lbs a.i./A gave significant control of annual bluegrass from the control treatments (Table 1).

All treatments with one or more 1.50 lbs rate(s) gave significant control of annual bluegrass, but the percent ground cover would be unacceptable in a fairway turf. With the 0.75 lbs September + 1.50 lbs October treatment being the only exception.

The April applications gave the most surprising results. The percentages of annual bluegrass in the April treatments were less when compared to the equivalent Sept., Oct., and/or Nov. treatments.

Injury was severe on treatments with 2 or more 1.50 lbs applications and is not recommended. Injury was rated on a 1-9 scale with 1 being completely dead and 9 showing no injury. The spring injury rating was evaluated before greenup had started and all injury had recovered by the end of April.

Multiple Prograss applications of 0.75 lbs a.i./A with 3 applications in the fall and 1 application in the spring significantly controlled annual bluegrass.

## RENOVATION

This study has been repeated for several years and continues to reaffirm what we have seen in the past. Two injury ratings were taken, one in the fall of 1990 and the other in the spring of 1991 (Table 2), using the same injury scale explained earlier. The treatments gave no unacceptable injury (<6), and noticeable injury to the turf recovered by the first part of May.

Evaluating the safety of Prograss on newly established bentgrass was only one objective of this study. The other was to control the re-invasion of annual bluegrass (Table 3). All treatments resulted in significantly less annual bluegrass than the control plots, with 0.38 2 WAG (week after germination) +0.75 5 WAG on the first seeding date being the only exception.

Again this year we had more annual bluegrass in our early seeding dates than in our late seeding dates. The recommendation from Michigan State University in the past has been to begin fairway renovation in mid-August so that there's a well established stand of turf before annual bluegrass germination in September. One possible explanation for better annual bluegrass control on the later seeding dates is that Prograss has only little preemergence activity. As the early seeding dates are treated annual bluegrass hasn't yet germinated. When the later seeding dates are treated annual bluegrass has germinated making the treatments a post application therefore giving more activity on these seeding dates. Another explanation may be the need for cold temperatures prior to Prograss applications. The early seeding received Prograss applications by the first of September before any cold temperatures were encountered and most of the final applications on the early seeding dates went down prior to cold temperatures.

Again this year our best results were 0.75 lbs a.i./A at 4 WAG with an additional application. All treatment combinations did give us significant control of annual bluegrass and no unacceptable injury, but the control of annual bluegrass was not as good as the 0.75 lbs a.i./A at 4 WAG. Some treatments combinations also had a ground cover below an acceptable level for a fairway situation. Ground cover ratings were based on the amount of developed turf. An acceptable level of ground cover would be anything above 97%.

## PREEMERGENCE CONTROL

In the fall of 1987 a study was initiated to evaluate Prograss as a preemergence control. This study gave us excellent results. All rates of Prograss gave good control of annual bluegrass in comparison to the check plot (Table 4).

In the fall of 1990 we initiated a study to develop a preemergence strategy for annual bluegrass control. A fairway type area was used and the turf was kept in the most natural state. First the preemergence herbicides were applied and then watered in. Then evaluation circles 1 1/2 inches in diameter were killed with Roundup. There were two purposes for the circles. One was for evaluation purposes because every two weeks we would count the number of new germinants in these circles and then respray with Roundup. The second reason was to keep the turf in a natural state and not dramatically effect the microclimate, moisture level, and/or ultraviolet rays reaching the soil surface and affecting the preemergence barrier. Results showed little or no control of annual bluegrass was achieved with Prograss under these conditions (Table 5).

The same type of study was repeated in 1991 much like the 1990 study. Again a fairway like turf area was used. The herbicides were applied and watered in. Evaluation circles were again used for evaluation purposes. This year we had no significant control of annual bluegrass when compared to our check plot (Table 6).

This raises the question of why was Prograss so effective in the bare soil study but gave little control in the fairway turf studies. The bare soil study area was rototilled, incorporating the thatch layer into the top 4-6 inches of soil and brought soil to the surface. In the fairway turf study the turf was left in a natural state. In the bare soil study, there was little organic matter on the soil surface. Thus, the presence of organic matter may be binding the Prograss making it ineffective for preemergence control.

## SUMMARY

Post emergence application of Prograss has shown to give excellent control of annual bluegrass. Multiple Prograss applications of .75 lbs a.i./A with 3 applications in the fall and 1 application in the spring showed significant control of annual bluegrass with little if any undesirable effects. Using Prograss in renovation has consistently given us annual bluegrass control leaving predominantly creeping bentgrass plots. Our best results have been at 0.75 lbs a.i./A at 4 WAG with an additional 1 or 2 applications. Preemergence applications with Prograss for annual bluegrass control haven't been as successful as postemergence applications. Bare soil applications of Prograss gave excellent control. The fairway turf study showed that Prograss was not as effective at controlling annual bluegrass as in the bare soil study. This may be due to the presence of organic matter at the soil surface.

**Table 1. MULTIPLE PROGRASS APPLICATIONS**

| Prograss Rates (lbs AI/A) and Timing <sup>1</sup> | 11/6/90 3/21/91 |            | 5/9/91     |             | 5/23/91    |            |
|---|-----------------|------------|------------|-------------|------------|------------|
|   | Injury          |            | % Poa      | % Cover     | % Poa      | % Cover    |
| Control   | 9.0             | 8.0        | 53         | 100         | 62         | 100        |
| 0.75 Sept & 0.75 Oct                              | 7.0             | 6.3        | 23         | 99          | 43         | 100        |
| 0.75 Sept & 0.75 Oct & 0.75 Nov                   | 7.0             | 5.3        | 8          | 100         | 13         | 100        |
| 0.75 Sept & 0.75 Oct & 0.75 Nov & 0.75 Apr        | 6.7             | 5.3        | 5          | 99          | 7          | 99         |
| 0.75 Sept & 0.75 Oct & 0.75 Apr7.0                | 7.0             | 6.0        | 17         | 99          | 22         | 100        |
| 0.75 Sept & 1.50 Oct                              | 7.0             | 4.0        | 13         | 99          | 25         | 100        |
| 0.75 Sept & 1.50 Oct & 0.75 Nov                   | 6.3             | 2.3        | 6          | 94          | 13         | 99         |
| 0.75 Sept & 1.50 Oct & 1.50 Nov                   | 7.0             | 2.3        | 2          | 92          | 7          | 97         |
| 0.75 Sept & 0.75 Oct & 1.50 Nov                   | 6.7             | 4.3        | 6          | 98          | 7          | 100        |
| 0.75 Sept & 1.50 Oct & 0.75 Apr                   | 7.0             | 4.0        | 12         | 97          | 17         | 100        |
| 0.75 Sept & 1.50 Oct & 0.75 Nov & 0.75 Apr        | 6.3             | 3.0        | 1          | 96          | 3          | 98         |
| 0.75 Sept & 1.50 Oct & 1.50 Nov & 0.75 Apr        | 6.7             | 1.7        | 1          | 88          | 2          | 95         |
| 0.75 Sept & 0.75 Oct & 1.50 Nov & 0.75 Apr        | 6.7             | 4.0        | 3          | 97          | 3          | 99         |
| 1.50 Sept & 1.50 Oct                              | 4.0             | 3.0        | 3          | 94          | 13         | 97         |
| 1.50 Sept & 1.50 Oct & 0.75 Nov                   | 4.0             | 3.0        | 4          | 93          | 5          | 97         |
| 1.50 Sept & 1.50 Oct & 1.50 Nov                   | 4.0             | 2.0        | 2          | 87          | 3          | 94         |
| 1.50 Sept & 1.50 Oct & 0.75 Nov & 0.75 Apr        | 4.0             | 2.3        | 0          | 82          | 1          | 93         |
| 1.50 Sept & 1.50 Oct & 0.75 Apr                   | 4.0             | 3.7        | 8          | 87          | 5          | 94         |
| 1.50 Sept & 0.75 Oct & 1.50 Nov                   | 4.0             | 3.3        | 1          | 86          | 4          | 97         |
| 1.50 Sept & 1.50 Oct & 1.50 Nov & 0.75 Apr        | 4.0             | 1.7        | 0          | 63          | 2          | 83         |
| 1.50 Sept & 0.75 Oct & 1.50 Nov & 0.75 Apr        | <u>4.0</u>      | <u>2.7</u> | <u>1</u>   | <u>85</u>   | <u>1</u>   | <u>94</u>  |
| <b>LSD (P= 0.05)</b>                              | <b>0.7</b>      | <b>1.4</b> | <b>6.8</b> | <b>12.3</b> | <b>7.2</b> | <b>5.7</b> |

<sup>1</sup>Applied 9/17/90, 10/11/90, 11/6/90 and 4/11/91

**Table 2. 1990 FAIRWAY RENOVATION WITH PROGRASS**

|                                       | Injury       |             |             |             |             |             |
|---------------------------------------|--------------|-------------|-------------|-------------|-------------|-------------|
|                                       | 11/30/90     |             |             | 4/16/91     |             |             |
|                                       | Seeding Date |             |             |             |             |             |
|                                       | <u>8/16</u>  | <u>8/31</u> | <u>9/13</u> | <u>8/16</u> | <u>8/31</u> | <u>9/13</u> |
| 0.50 at Seeding + 30 DAT <sup>1</sup> | 8.3          | 9.0         | 9.0         | 9.0         | 9.0         | 8.7         |
| 0.75 at Seeding + 30 DAT              | 9.0          | 9.0         | 9.0         | 9.0         | 8.7         | 8.7         |
| 0.38 2 WAG + 0.75 5 WAG <sup>2</sup>  | 8.0          | 8.0         | 9.0         | 7.0         | 8.7         | 8.3         |
| 0.75 4 WAG + 0.75 8 WAG               | 8.3          | 8.0         | 8.3         | 9.0         | 8.7         | 8.0         |
| 0.75 6 WAG + 0.75 10 WAG              | 7.0          | 7.0         | 8.3         | 7.0         | 6.7         | 8.0         |
| 0.50 4 WAG + 0.50 6 WAG + 0.50 8 WAG  | 7.3          | 7.3         | 8.3         | 9.0         | 8.3         | 8.3         |
| 0.75 2 WAG + 0.75 5 WAG + 0.75 8 WAG  | 7.7          | 8.3         | 8.7         | 9.0         | 9.0         | 8.0         |
| 0.75 4 WAG + 0.75 8 WAG + 0.75 12 WAG | 7.7          | 8.0         | 7.7         | 7.3         | 8.7         | 8.0         |
| 0.75 4 WAG + 0.75 6 WAG + 0.75 8 WAG  | 7.0          | 8.3         | 7.0         | 8.7         | 8.7         | 7.0         |
| 0.75 4 WAG + 1.25 6 WAG               | 8.0          | 8.3         | 8.0         | 9.0         | 9.0         | 8.0         |
| 1.50 2 WAG + 1.50 5 WAG               | 8.3          | 8.7         | 8.3         | 9.0         | 8.7         | 8.0         |
| Control                               | <u>8.3</u>   | <u>9.0</u>  | <u>9.0</u>  | <u>7.0</u>  | <u>7.3</u>  | <u>8.3</u>  |
| LSD (P= 0.05)                         | 0.4          | 0.4         | 0.4         | 0.7         | 0.7         | 0.7         |

<sup>1</sup>DAT - Days after treatment

<sup>2</sup>WAG - Weeks after germination

Table 3. 1990 FAIRWAY RENOVATION WITH PROGRASS

|                                       | % Poa annua  |           |           |           |           |           | % Ground Cover |            |            |            |            |            |
|---------------------------------------|--------------|-----------|-----------|-----------|-----------|-----------|----------------|------------|------------|------------|------------|------------|
|                                       | 5/7/91       |           |           | 5/27/91   |           |           | 5/7/91         |            |            | 5/27/91    |            |            |
|                                       | Seeding Date |           |           |           |           |           | Seeding Date   |            |            |            |            |            |
|                                       | 8/16         | 8/31      | 9/13      | 8/16      | 8/31      | 9/13      | 8/16           | 8/31       | 9/13       | 8/16       | 8/31       | 9/13       |
| 0.50 at Seeding + 30 DAT <sup>1</sup> | 6            | 3         | 3         | 8         | 3         | 1         | 99             | 97         | 97         | 100        | 100        | 98         |
| 0.75 at Seeding + 30 DAT              | 3            | 1         | 0         | 3         | 0         | 0         | 98             | 93         | 92         | 100        | 96         | 94         |
| 0.38 2 WAG + 0.75 5 WAG <sup>2</sup>  | 50           | 18        | 8         | 47        | 10        | 7         | 100            | 100        | 99         | 100        | 100        | 100        |
| 0.75 4 WAG + 0.75 8 WAG               | 8            | 12        | 0         | 11        | 17        | 1         | 100            | 100        | 98         | 100        | 100        | 100        |
| 0.75 6 WAG + 0.75 10 WAG              | 18           | 1         | 9         | 42        | 10        | 3         | 99             | 99         | 99         | 100        | 100        | 100        |
| 0.50 4 WAG + 0.50 6 WAG + 0.50 8 WAG  | 22           | 4         | 2         | 32        | 7         | 1         | 99             | 100        | 97         | 100        | 100        | 100        |
| 0.75 2 WAG + 0.75 5 WAG + 0.75 8 WAG  | 10           | 1         | 0         | 15        | 1         | 0         | 98             | 98         | 92         | 100        | 99         | 97         |
| 0.75 4 WAG + 0.75 8 WAG + 0.75 12 WAG | 15           | 3         | 2         | 10        | 6         | 1         | 99             | 100        | 99         | 100        | 100        | 100        |
| 0.75 4 WAG + 0.75 6 WAG + 0.75 8 WAG  | 6            | 1         | 0         | 18        | 2         | 0         | 98             | 99         | 97         | 100        | 100        | 99         |
| 0.75 4 WAG + 1.25 6 WAG               | 18           | 3         | 2         | 35        | 4         | 2         | 98             | 100        | 99         | 100        | 100        | 100        |
| 1.50 2 WAG + 1.50 5 WAG               | 15           | 0         | 0         | 13        | 0         | 0         | 93             | 89         | 82         | 96         | 95         | 94         |
| Control                               | <u>55</u>    | <u>43</u> | <u>48</u> | <u>65</u> | <u>57</u> | <u>52</u> | <u>100</u>     | <u>100</u> | <u>100</u> | <u>100</u> | <u>100</u> | <u>100</u> |
| LSD (P= 0.05)                         | 13.3         | 13.3      | 13.3      | 14.6      | 14.6      | 14.6      | 2.8            | 2.8        | 2.8        | 4.5        | 4.5        | 4.5        |

<sup>1</sup>DAT - Days after treatment<sup>2</sup>WAG - Weeks after germination

**Table 4. Annual bluegrass control with preemergence application of Prograss on bare soil.**

| Prograss<br>lbs AI/A | % Annual Bluegrass |                |
|----------------------|--------------------|----------------|
|                      | <u>4/12/88</u>     | <u>5/20/88</u> |
| 2.0                  | 0.3                | 2.0            |
| 1.5                  | 0.3                | 4.0            |
| 1.0                  | 1.0                | 4.0            |
| 0.5                  | 4.0                | 18.0           |
| Control              | 50.0               | 63.0           |
| LSD (P= 0.05)        | 9.0                | 11.0           |

**Table 5. 1990 Annual Bluegrass control with preemergence application of Prograss on fairway turf.**

| Prograss<br>lbs AI/A | Percent Control |
|----------------------|-----------------|
|                      | <u>10/22/90</u> |
| 2.0                  | 16.9            |
| 1.5                  | 13.2            |
| 1.0                  | 9.3             |
| 0.5                  | 29.8            |
| Control              | 0.0             |
| LSD (P= 0.05)        | 16.3            |

**Table 6. 1991 Annual Bluegrass control with preemergence application of Prograss on fairway turf.**

| Prograss<br>lbs AI/A | Percent Control |
|----------------------|-----------------|
|                      | <u>10/22/90</u> |
| 1.5                  | 33.3            |
| 0.75                 | 33.3            |
| Control              | 0.0             |
| LSD (P= 0.05)        | 46.9            |