Evaluation of Herbicides for Control of White Clover in Athletic Turf Grass

A Research Study
Presented for the
Master of Science
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The University of Tennessee, Martin

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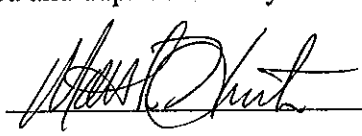
Author: 

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ABSTRACT

White clover (*Trifolium repens*) has the ability to overtake athletic turf from small colonies, making it one of the most challenging problems in commercial athletic turfgrass management. Turfgrasses are susceptible to further weed invasion because of stress factors caused by broadleaf weeds such as white clover. Timely control of white clover is an essential part of athletic turfgrass management.

This study was conducted in the fall of 2007 on the main campus at Walters State Community College in Morristown, Tennessee. The purpose of this study was to evaluate three herbicides for control of white clover plants on athletic turfgrass fields with the aim of providing a recommendation to the grounds management team at Walters State Community College to aid in control of white clover plants on athletic turfgrass fields. The three herbicides used in this study were Confront® (triclopyr and clopyralid) applied at a rate of 10.69 mL/L; Speedzone® (dichlorprop, dicamba and carfentrazone) applied at a rate of 5.33 mL/L; and Strike 3® (dichlorprop and dicamba) applied at a rate of 7.13 mL/L. An untreated control was also included. A completely randomized design with five replications was used. Each herbicide was applied twice, once in late August and again in mid-October of 2007. There were no significant differences ($P \leq 0.005$) among the three chemicals used for mean number of clover plants after treatment. However, the mean number of white clover plants for the control was significantly greater that the means for each herbicide. After the second application of herbicides, the mean number of white clover plants was reduced to zero in the treated plots.

Based on the results from this study and a per application cost of each herbicide, Strike 3® was recommended to the Walters State Community College's grounds management team.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LITERATURE REVIEW

Since 1792, America's favorite pastime has been baseball. The love of the game and its ability to spark the interest of all ages has helped to form organized baseball as America's National pastime (Wikipedia, 2009). Until the early 1900's, the playing surface for baseball was most often a dirt field. It wasn't until the mid-1920's that athletic turfgrass began to be used on ball fields. Continuing efforts throughout history have been made to perfect athletic playing surfaces to improve play and to create an aesthetically pleasing setting. Many universities and teaching colleges have conducted research to promote the perfection of "best" management practices for athletic turfgrasses (Weidner, 2004). Annual economic and environmental improvements to turfgrass management promote a growing industry and profession. Agricultural chemical companies continue to develop turfgrass herbicides that are more economical for the user as well as being environmentally safer.

Agricultural chemical companies develop herbicides with a single active ingredient or a combination of active ingredients that control most broadleaf weeds that populate athletic turfgrass playing surfaces, such as baseball fields, golf courses, football and soccer fields, etc (Hall, 1976). Dichlorprop, clopyralid, triclopyr, dicamba and carfentrazone are active ingredients of herbicides currently marketed by different companies and sold under different trade names. Some trade names of chemicals that contain those active ingredients include Confront®, Speedzone® and Strike 3® (Landschoot, 2004).

Dichlorprop has a similar chemical structure to that of 2,4-D and is effective for white clover (*Trifolium repens*) control in athletic turfgrasses (Dow AgroSciences, 2009). Clopyralid and triclopyr are both active ingredients of the commercial herbicide, Confront®. Confront® is no longer registered for residential use because it accumulates to phytotoxic levels in compost.

Triclopyr is especially effective for penetration of “waxy” leaves. Dicamba has both pre- and post-emergence activity for white clover control in athletic turfgrasses (PBI/Gordon Corporation, 2009). Carfentrazone is a triazolinone herbicide that is especially effective for control of white clover.

Broadleaf weed infestations create a need for herbicides on athletic turfgrasses (Dernoeden et al., 1993). White clover plants have the ability to overtake athletic turf from small colonies, making it one of the most challenging problems in commercial athletic turfgrass management. Without proper control practices, turfgrasses are susceptible to weed invasion because of stress factors caused by broadleaf weeds such as white clover.

Herbicides with multiple active ingredients are effective for the control of white clover plants in athletic turfgrasses. These herbicides applied in multiple applications during the fall are useful for white clover management in athletic turfgrasses (Hall, 1976). If this management practice is combined with other methods for the maintenance of healthy stands of athletic turfgrasses, the overall percentage of broadleaf weeds will decline. Based on current research, the combination of dicamba and carfentrazone and the combination of triclopyr and clopyralid applied in late fall can be effective methods for controlling white clover plants on athletic turf (Landschoot, 2004). This is largely due to the synergistic effects of the active ingredients. Carfentrazone is a fast-acting material that causes disruption of the chlorophyll synthesis process; this leads to yellowing of white clover plants. By itself carfentrazone does not completely kill white clover, but when combined with dicamba, white clover mortality is high. Materials containing dicamba and dichlorprop as active ingredients often result in elimination of white clover plants in athletic turf (Hall, 1976).

The current project was designed to evaluate herbicides for control of white clover plants in athletic turfgrasses. The results of this study will be used to provide a recommendation to personnel conducting grounds maintenance at Walters State Community College, Morristown, Tennessee to aid in the control of white clover plants on athletic turf fields.

MATERIALS AND METHODS

This study was conducted at Walters State Community College (WSCC) from August through October, 2007. The location of the research was on the baseball field adjacent to the main campus. A completely randomized design with four treatments and five replications was used for the study. Plots were 5.49 by 7.32 meters (0.20 A) of established turfgrass fescue (*Festuca arundinacea*) for a total of 20 plots (Figure 1).

Treatments

Treatments consisted of the herbicides Speedzone® (dichlorprop, dicamba and carfentrazone), Confront® (triclopyr and clopyralid) and Strike 3® (dichlorprop and dicamba) and an untreated control. Herbicides were applied on August 24 and again on October 13, 2007. Weather conditions are listed in Table 1.

Table 1. Weather conditions at the time of herbicide application.

	Application Date	
	08/24/2007	10/13/2007
Time of Day	5:00pm	1:00pm
Air Temperature	31°C	18°C
% Relative Humidity	35%	30%
Wind Velocity	0 km/hr	0 km/hr
Dew Presence	none	none
% Cloud Cover	0%	0%

All herbicide applications were made with a pull type sprayer attached to a John Deere LT120 lawnmower. Tank size of the sprayer was 90.85 L, and boom width was 121.92 cm. Nozzles were placed 54.61 cm apart with a TeeJet® 80ozVP nozzle spraying a 53.34 cm "flat fan" pattern. Total boom coverage was 162.56 cm. The sprayer was calibrated to deliver 503.46 mL/acre. The herbicide mixture rate for Speedzone® was 53.38 mL/L (6.84 oz/gal); Confront® was 26.77 mL/L (3.43 oz/gal); and Strike 3® was 35.66 mL/L (4.57 oz/gal).

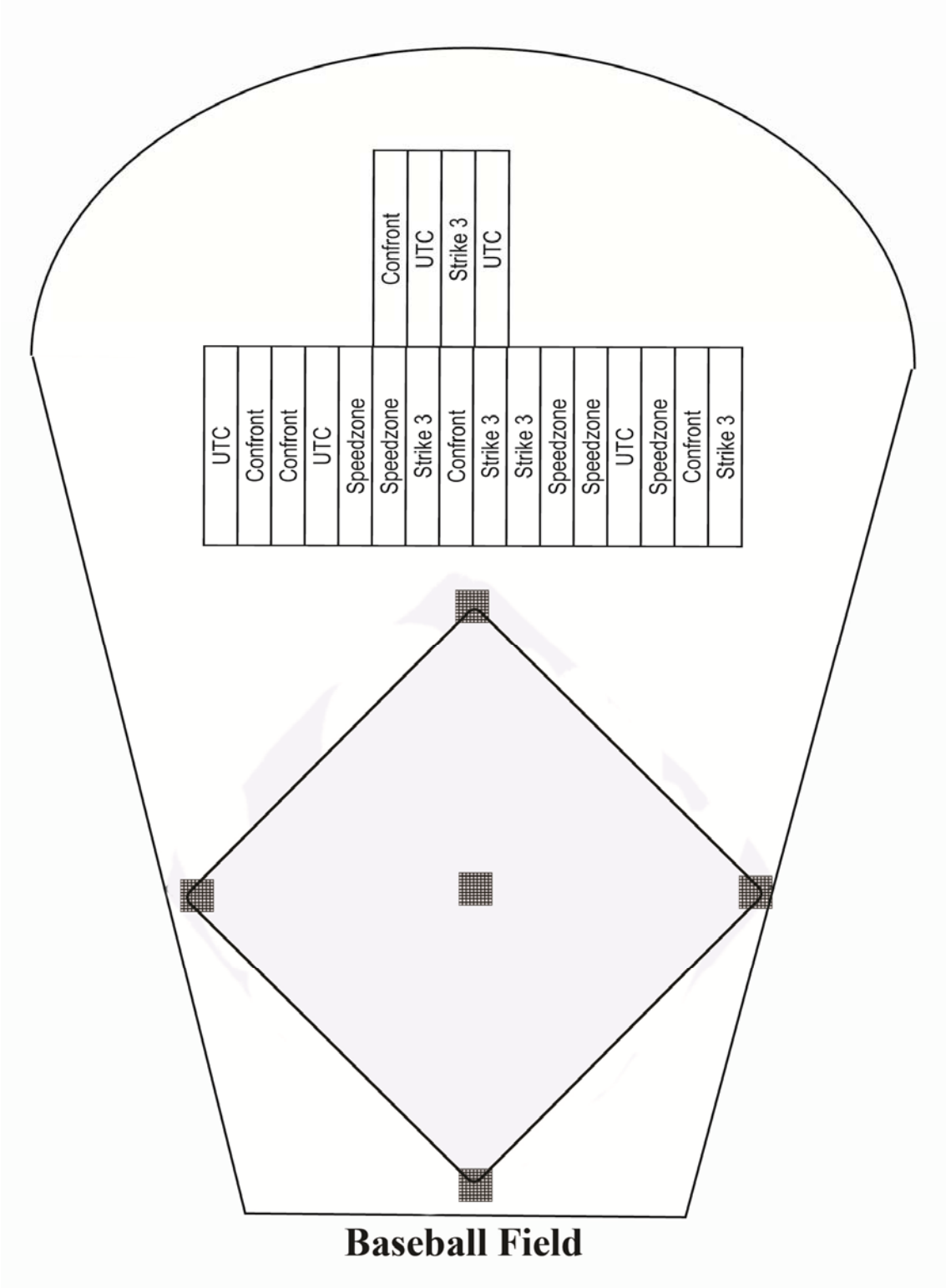

Figure 1. Layout of research plots within the baseball field, using a completely randomized design.

Data Collection

Two weeks following the application of herbicides, the number of white clover plants present per grid opening in each plot was recorded. A 60.96 by 40.64 cm wire mesh screen with 64 blocks each measuring 7.62 by 5.08 cm was tossed randomly into each plot. At the point where the screen impacted the plot, the number of remaining white clover plants was recorded using the diagonal blocks in an "X" pattern over the mesh screen (Figure 2).

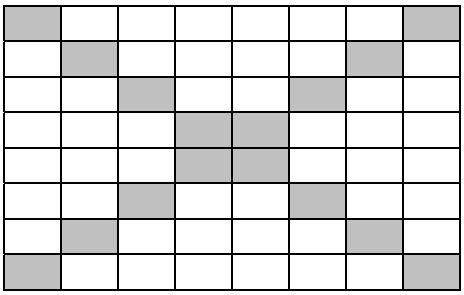

Figure 2. Diagram of mesh screen used for counting white clover plants.

Statistical Analysis

Data collected from both herbicide application dates were subjected to analysis of variance using the Statistical Analysis Software (SAS). Data were analyzed as a completely randomized design and means for each treatment were separated using the Least Significant Difference (LSD) test with $P \leq 0.05$.

RESULTS

When plots were observed following the initial application of herbicides, the turf was dominated by fescue plants and the number of white clover plants had visibly declined. No single application of any of the three herbicides completely eliminated white clover. Initial observations of the plots after the first application of herbicides (Table 2) indicated differences among treatments. This was reflected in the significant differences ($P \leq 0.0001$) observed in the analysis of variance (Table 3). When data were collected after the second application (Table 2), it was obvious that very few white clover plants remained in the treated plots and significant differences ($P \leq 0.0001$) among treatments were observed again (Table 4).

After the first herbicide application, there were no significant differences ($P \leq 0.05$) among the three chemicals used but the mean number of clover plants for the control was significantly greater than the means for each herbicide (Figure 3). Similar differences were observed on November 6, 2007 (Figure 4). By this time, the mean number of clover plants in the control had increased to 11.3 (from 4.8 on September 7), while the mean number of plants in the herbicide treated plots had been reduced to zero (Figure 4).

Using current costs of each herbicide, total costs per treatment were calculated based on a three acre turfgrass field. From these calculations, Strike 3® was the most economical herbicide using the application rates stated in this study (Figure 5).

Table 2. Mean number of white clover plants in an established fescue turf on an athletic field at Walters State Community College in Morristown, TN after post-emergence herbicide application in the fall. Confront® applied at 26.77 mL/L, Speedzone® 53.38 mL/L and Strike 3® at 35.66 mL/L.

Plot #	Treatment	September 7, 2007	November 6, 2007
103	*Confront®*	0.31	0
202	*Confront®*	0.63	0
303	*Confront®*	0.63	0
402	*Confront®*	0.06	0
504	*Confront®*	0.25	0
101	*Control*	6.25	17.88
204	*Control*	4.06	9.31
301	*Control*	4.63	9.81
404	*Control*	6.38	12.19
501	*Control*	2.56	7.5
102	*Speedzone®*	1.75	0
203	*Speedzone®*	2.31	0
302	*Speedzone®*	0	0
403	*Speedzone®*	1.38	0
502	*Speedzone®*	0.31	0
104	*Strike 3®*	0.25	0
201	*Strike 3®*	0.19	0
304	*Strike 3®*	0.69	0
401	*Strike 3®*	3.88	0
503	*Strike 3®*	0.56	0

Table 3. ANOVA for evaluation for white clover control on athletic turfgrass for first application of herbicides.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	58.82892000	19.60964000	13.09	0.0001
Error	16	23.96356000	1.49772250		
Corrected Total	19	82.73248000			

Table 4. ANOVA for evaluation for white clover control on athletic turfgrass for second application of herbicides.

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	482.0634150	160.6878050	39.74	<0.0001
Error	16	64.7014800	4.0438425		
Corrected Total	19	546.7648950			

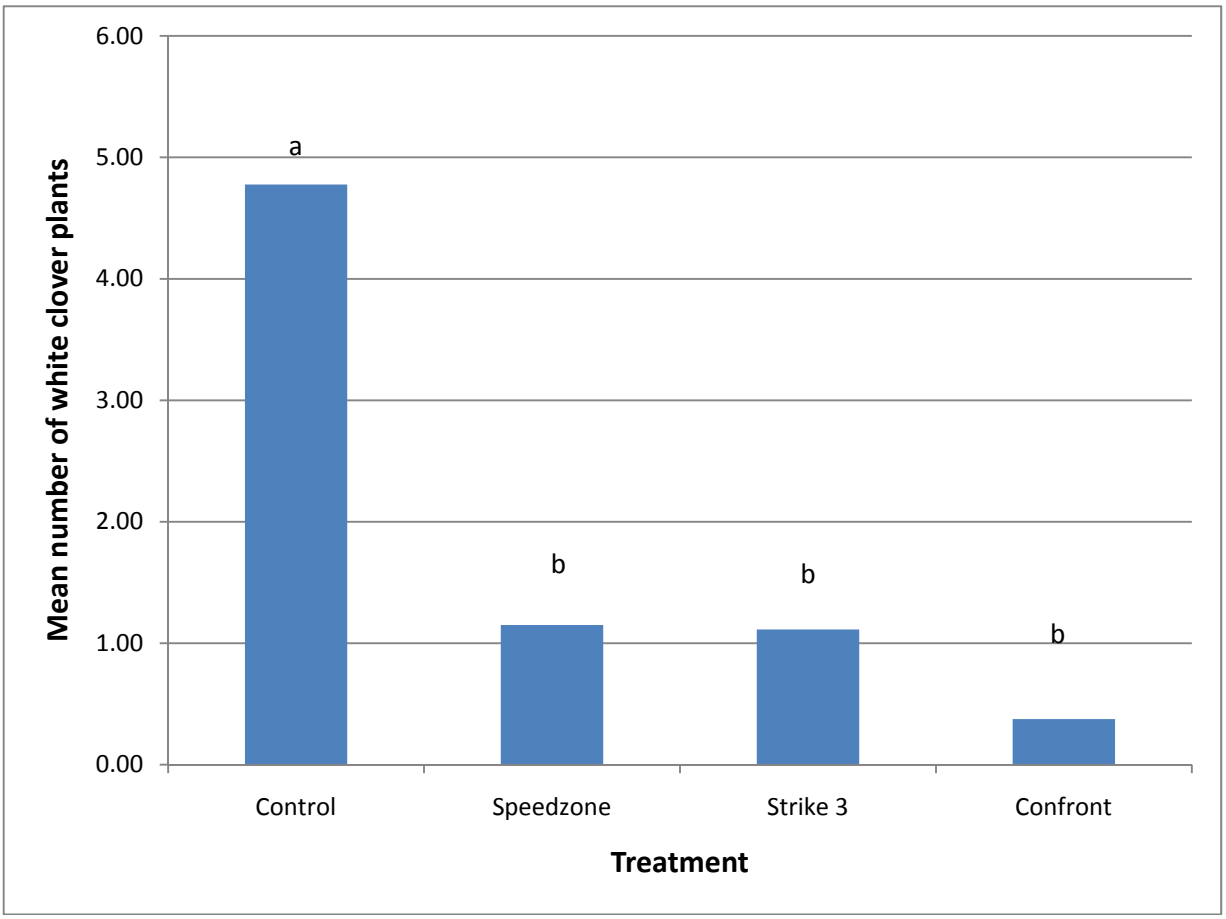

Figure 3. Mean number of clover plants per grid for each treatment on September 7, 2007. Bars with the same letter are not significantly different according to Fisher's least significant difference test ($P \leq 0.05$).

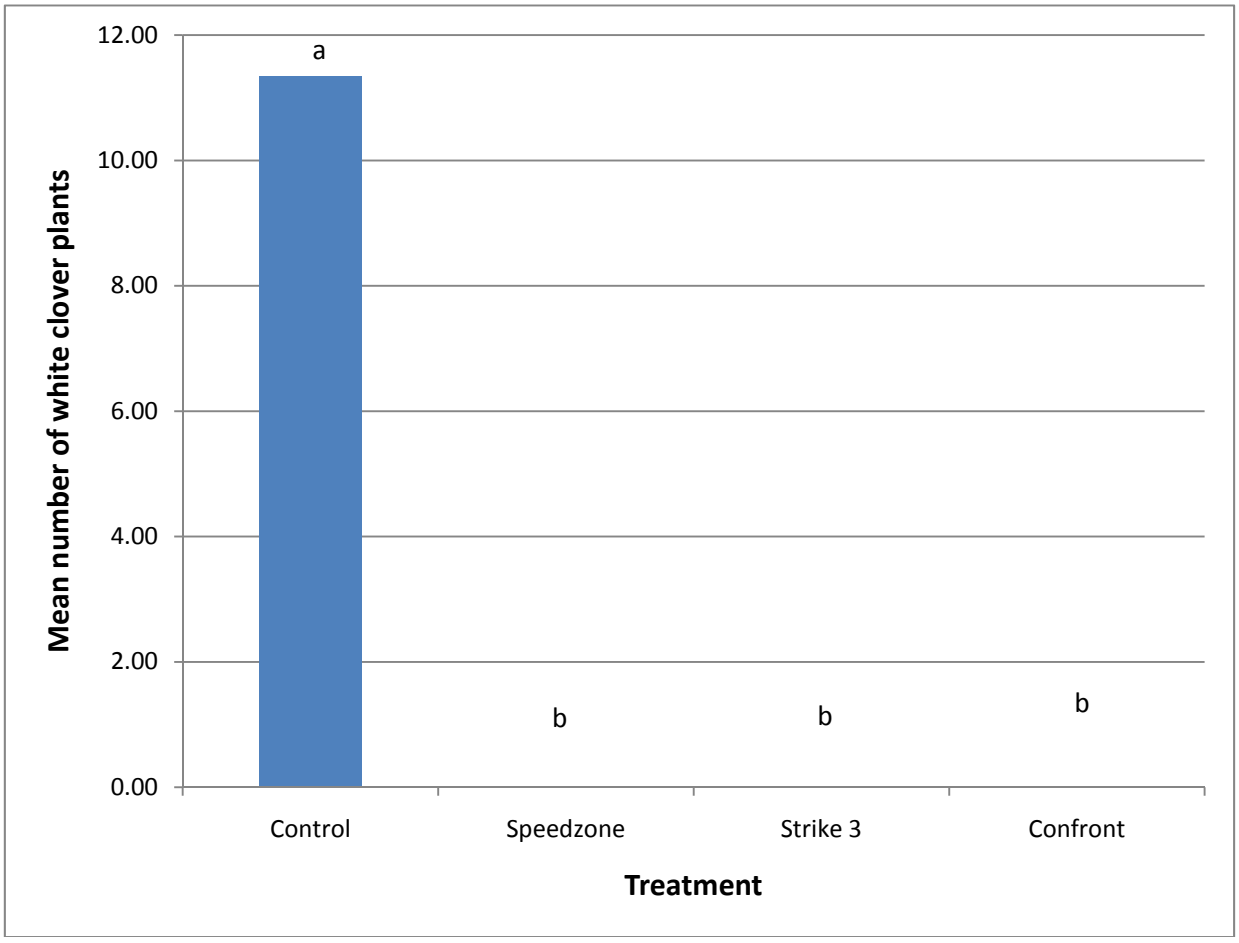

Figure 4. Mean number of clover plants per grid for each treatment on November 6, 2007. Bars with the same letter are not significantly different according to Fisher's least significant difference test ($P \leq 0.05$).

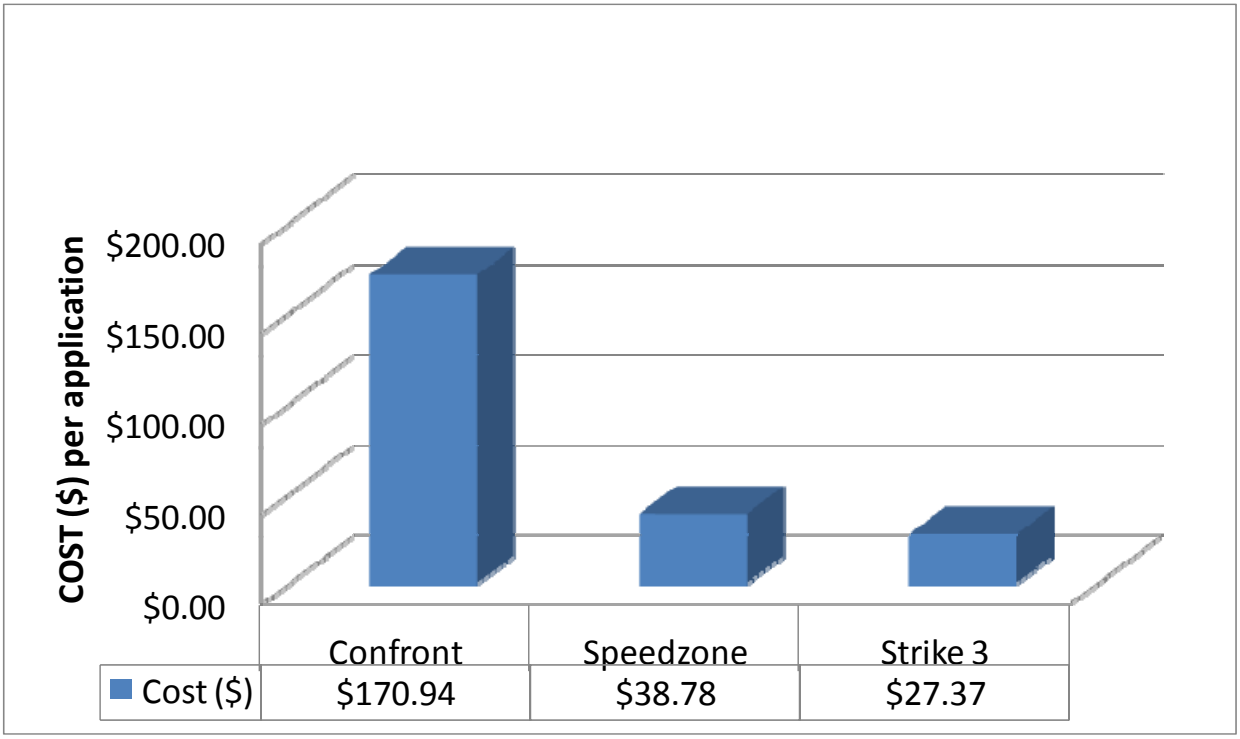

Figure 5. Total cost of herbicide per application based on a three acre athletic turf field.

DISCUSSION AND CONCLUSIONS

Based on results from this study, there are no significant differences between treatments of the herbicides Speedzone®, Strike 3® or Confront®. Furthermore, a second application of any of the herbicides, Speedzone®, Strike 3® or Confront® following an initial fall application, eliminated most white clover plants from established turfgrass fescue on an athletic field. These results would only be conclusive for athletic turf fields located in the eastern part of Tennessee.

RECOMMENDATIONS

Based on the results of this study, it is recommended that the grounds management team at Walters State Community College use two fall applications of either Speedzone®, Strike 3® or Confront® to control white clover plants on athletic turf fields. Strike 3® would be the most economical choice using application rates documented in this study.

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