Title: Comparing "Weed and Feed" Combinations to Fertilizer and Overseeding for Weed Control in Home Lawns

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This is a final report for work performed from 2006 to 2007.

Introduction
Tall fescue is the most commonly planted turfgrass in California. This is a cool season grass but is popular in most of California due to its ability to maintain its green color throughout the year. There are many varieties that were developed for specific uses such as lower water use, fine blades, and ability to tolerate heat.

Nitrogen fertilizer should be applied to tall fescue in coastal southern California when it is beginning to grow actively in March followed by another application in May. Fall applications of a complete fertilizer are done in October and November (Henry et al., 2002). Three to 6 lb N/1000ft^2/year is recommended, divided up evenly among the application times. Green et al. (2005) conducted an extensive study to determine appropriate nitrogen application rates to minimize nitrate leaching and optimize fescue performance. This study recommended that 4-6 lb N/1000ft^2/year be used. Fertilizers were applied in March, May, August, and October. Turf quality in most plots including the untreated plots decreased in February and May. A summary of homeowners' fertilization practices reported in Understanding Watershed Behavior (Anon., 1996) found that homeowners apply fertilizer from 1.7 to 3.2 times per year with spring being at least one of those times.

Scotts Brand products are among the leading fertilizer products sold in the U.S. (Scotts, 2005). The granular weed and feed product sold in the spring is primarily for prevention of crabgrass (Scotts Turf Builder With Halts Crabgrass Preventer (30-3-4 + 1.7% pendamethalin) and later in the spring and summer Scotts Turf Builder With PLUS 2 Weed Control for postemergent control of broadleaf weeds (28-3-3 + 0.21% 2,4-D, 0.61% Mecoprop). The latter has label directions that state that it should not be applied more than twice per year. They also sell as liquid formulation for postemergent control of broadleaf weeds (Scotts Liquid Turf Builder with Plus 2 Weed Control (25-1-2 + 2,4-D 2.29%, Mecoprop 1.15%, Diclorprop 1.13%). Presumably these products are attractive to the consumer because he or she can do two tasks with only one product and in only one step.

Although these products do provide a measure of weed control and are good turf fertilizers they may not be as effective as they could be for weed management.

A major cause of poor weed control by herbicides is improper timing. Herbicides are less effective if applied too early, for example if a postemergence herbicide is applied before the peak of emergence, or applied too late such as in the case where the first flush of emerged weeds have already started flowering or even more detrimental, producing seeds (Yelverton, 1996).

According the Pest Note for crabgrass (Elmore, 2002), cool season turf should be fertilized during periods of active growth in order to enhance the competitiveness of the turf. For tall fescue, that is March-June and October-December. This coincides well with the fertilizer recommendations from Green et al. (2005) and Henry et al. (2002). However, *preemergence herbicide treatments* for crabgrass are best applied in mid-January in southern areas of the state and early March in cooler areas (Elmore, 2002) in order to have the herbicide on the ground prior to spring weed germination. Additionally, postemergent control of weeds is best accomplished when the weeds are small but actively growing.

Weeds in lawns are best managed by maintaining a vigorous, healthy turf (LeStrange and Reynolds, 2004). Although herbicides can be used effectively for controlling weeds in lawns, long term control is only accomplished by modifying the habitat such that it is difficult for weeds to become established and spread. Despite these statements, which are generally recognized as the mantra for weed control in lawns and other low to moderate use turf sites, little research has been conducted to demonstrate its effectiveness. In fact, the great majority of research for weed management in turf is in the efficacy of herbicides. For example, of 80 turf weed control reports from North Carolina in 2004, only two focused on cultural management for weed control in turf (NCSU, 2005). Ecological studies such as those used to develop predictive weed emergence models are done primarily for recommending when the most effective time is to apply an herbicide (Masin et al., 2005).

Long term weed control in turf depends on the competitive ability of the turf species and on reducing vegetation gaps (Caruso, 1970, Larsen et al., 2004). It follows that the methods to improve the competitive ability of the turf and decrease the size and number of gaps would make the site less susceptible to weed invasion. From an integrated pest management standpoint, which stresses prevention of the pest, cultural practices such as proper fertilization to encourage a vigorously growing turf as well as overseeding to reduce gaps are better approaches than use of herbicides to restore the turf once invaded.

The primary objective of this study was to evaluate the effect of overseeding and fertilizing at recommended intervals on percent weed cover in tall fescue turf and compare these treatments to commercial weed and feed products.

The detailed objectives of this research were to:

1) Evaluate effectiveness of overseeding to fill in gaps (micro or macro) as a stand-alone weed control method

2) Evaluate effectiveness of fertilization at recommended intervals and amounts as a stand-alone weed control method

3) Evaluate effectiveness of (1) and (2) above in combination.

4) Evaluate weed control and turf appearance as affected by two weed and feed formulations

Materials and Methods

Treatments and Experimental Design: This study was conducted at the UC South Coast Research and Extension Center in Irvine. Each plot was 12'X24' (288 ft^2) planted with established tall fescue (*Festuca arundinacaea*) of mixed varieties. Plots were irrigated by turf sprinklers using an irrigation controller. Plots were irrigated to maintain 100% $ET_{cool\text{-}season\ turf}$ replacement and mowed at 1 ½ inch height as needed, generally every 1-2 weeks. Weeds observed at initiation of the study included cudweed, cinquefoil, spotted spurge, woodsorrel, sweet yellow clover, fleabane, and crabgrass. Weed pressure at the initiation was low to moderate and turf quality (on a scale of 1-9 with 1 being very poor and 9 being excellent) was rated as 3 to 5.

The experimental design was completely randomized design with 6 treatments[1]:

1. Untreated control

2. Scotts Turfbuilder Lawn Fertilizer plus 2% Iron, 29-3-4 applied at 6lb N/1000ft^2 per year, applied in March, May, August, and October

3. Scotts Turf Builder With PLUS 2 Weed Control, 28-3-3 + 0.21% 2,4-D, 0.61% Mecoprop, applied in May and October applied at 2lb N/1000ft^2 per year (Note: amount of N that was applied was constrained by the herbicide in the formulation)

4. Scotts Liquid Turf Builder with Plus 2 Weed Control, 25-1-2 + 2,4-D 2.29%, Mecoprop 1.15%, Diclorprop 1.13%, applied in May and October applied at 3.2lb N/1000ft^2 per year (Note: amount of N that was be applied was constrained by the herbicide in the formulation)

5. Overseed with Scotts Turf Builder Tall Fescue Blend in late fall (October/November)

6. Overseed with Scotts Turf Builder Tall Fescue Blend in late fall (October/November) + Scotts Turfbuilder Lawn Fertilizer plus 2% Iron, 29-3-4 applied at 6lb N/1000ft^2 per year, applied in March, May, August, and October

Turf quality and weed control: All weeds in each plot were identified and noted for presence/absence. Weed cover was rated on a scale of 1-5 where 1=no weeds, 2=1-10% cover, 3=11-30% cover, 4=31-60% cover, 5= >60% weed cover. Turf quality was accessed at the same time by visually scoring the turf in for color and vigor using a 1-9 scale where 1=the worst quality (plants brown or dead), 5= minimally acceptable and 6-9 are increasing levels of turf quality and

[1] Scotts products were selected because they are a leading brand available to home users.

vigor with 9 being deep green, dense turf with no weeds. Since turf quality is rather subjective, we also used a Turf Color Meter (TCM 500, Spectrum Technologies) to quantitatively determine turf color at some of the evaluation dates. However, because we did have Turf Color Meter data for all the measurement dates, that information is not included here.

Additionally, each quarter, weeds were identified and counted at 6" intervals along a 16 ft transect line in each plot. Fertility was tested 6 times each year to determine the N-P-K levels in the soil.

Gap analysis: Gaps in turf are difficult to measure and we could not find any provided information regarding measuring gaps on a very small scale. We used high resolution digital photos of the turf and processed the images using SigmaScan Pro 5 software (SPSS Software) to identify and measure gaps.

Species richness: Species richness (S) was calculated from the presence/absence data of plant species in each plot.

Statistical Analysis: Effect of the treatments on each variable by date were analyzed using the Analysis of Variance (SigmaStat Software). Means were compared at the 95% level using LSD separation.

Results and Discussion

A. Nitrogen Fertility- None of the treatments provided adequate nitrogen to the turf (Figure 1). There were significant differences at the 0.05 level only on the 1/26/07 sampling date where Liquid Turfbuilder + Weed Control and Scotts Turfbuilder + 2% iron had the greatest soil N (NO_3) (Table 1). These results highlight the need for additional fertilizer to maintain adequate soil fertility for good plant health. Approximately 10X more N (NO_3) would have to be in the soil for adequate turf quality in most cases. None of the treatments reached a level of soil N (NO_3) that is recommended for good turf maintenance.

Figure 1. Effect of treatments on NO_3-N.

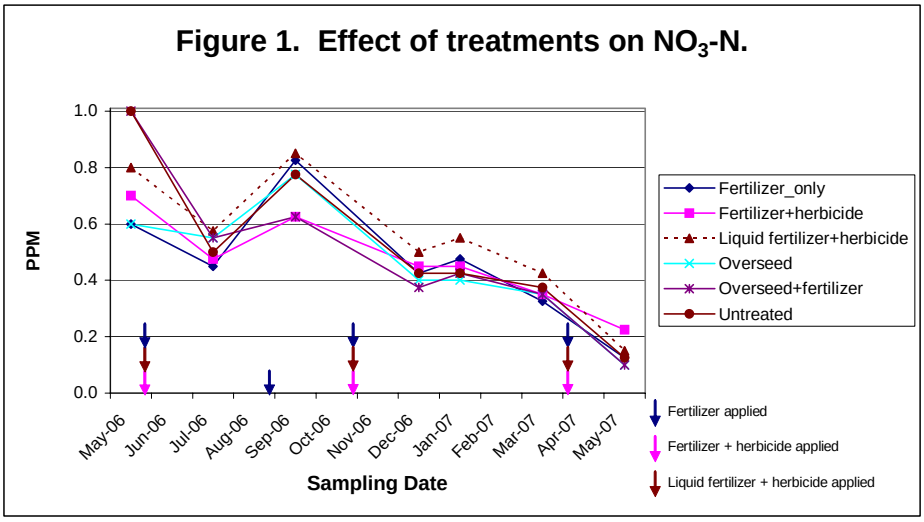


Table 1. Multiple Comparisons for sample by treatment for nitrogen in the soil. There were no significant differences for P or K on any date.

	NO3-N (ppm)						
Treatment	**5/25/2006**	**7/25/2006**	**9/22/2006**	**12/8/2006**	**1/26/2007**	**3/22/2007**	**5/3/2007**
Fertilizer_only	0.600	0.450	0.825	0.425	0.475ab	0.325	0.125
Fertilizer+herbicide granular	0.700	0.475	0.625	0.450	0.450b	0.350	0.225
Fertilizer+herbicide liquid	0.800	0.575	0.850	0.500	0.550a	0.425	0.150
Overseed	0.600	0.550	0.775	0.400	0.400b	0.350	0.100
Overseed+fertilizer	1.000	0.550	0.625	0.375	0.425b	0.350	0.100
Untreated	1.000	0.500	0.775	0.425	0.425b	0.375	0.125

*Means followed by the same letter are not significantly different at the p=0.05 level.

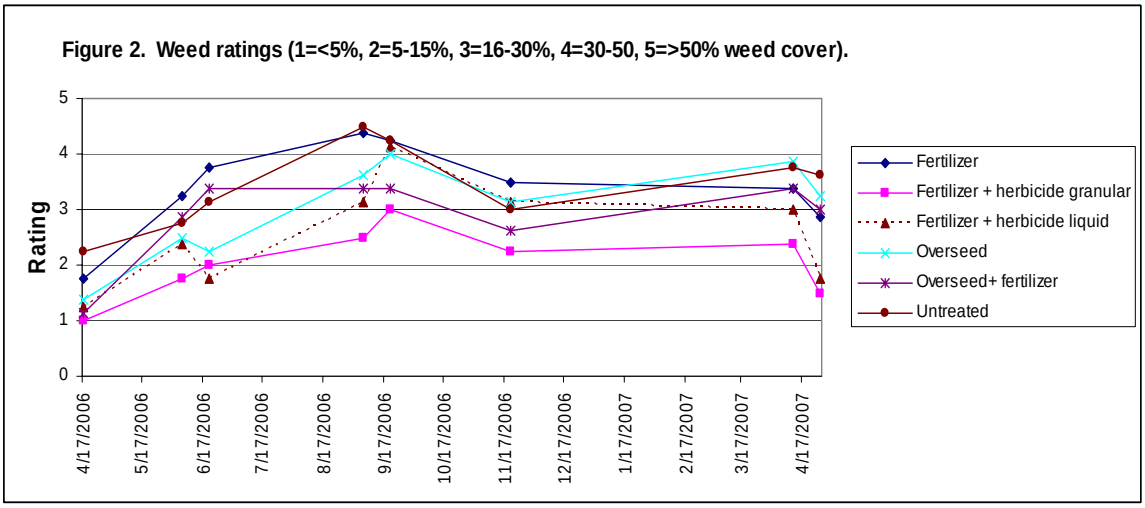
B. Effect of Treatments on Weed Control - The best treatments were those where herbicide was applied but there were significant differences at the 0.05 level only on the 6/20/06 and 4/26/07 evaluation dates (Table 2). As shown in Figure 2, overseeding alone did not provide adequate weed control. However, there appears to be a trend towards decreased weed cover if combined with fertilizing. As noted above, the test plots never reached sufficient N fertility level but this combination or overseeding alone may show improvement if tested under higher soil fertility.

Table 2. Weed cover ratings where significant differences were found among treatments. Weed cover was rated on a scale of 1-5 where 1=no weeds, 2=1-10% cover, 3=11-30% cover, 4=31-60% cover, 5= >60% weed cover.

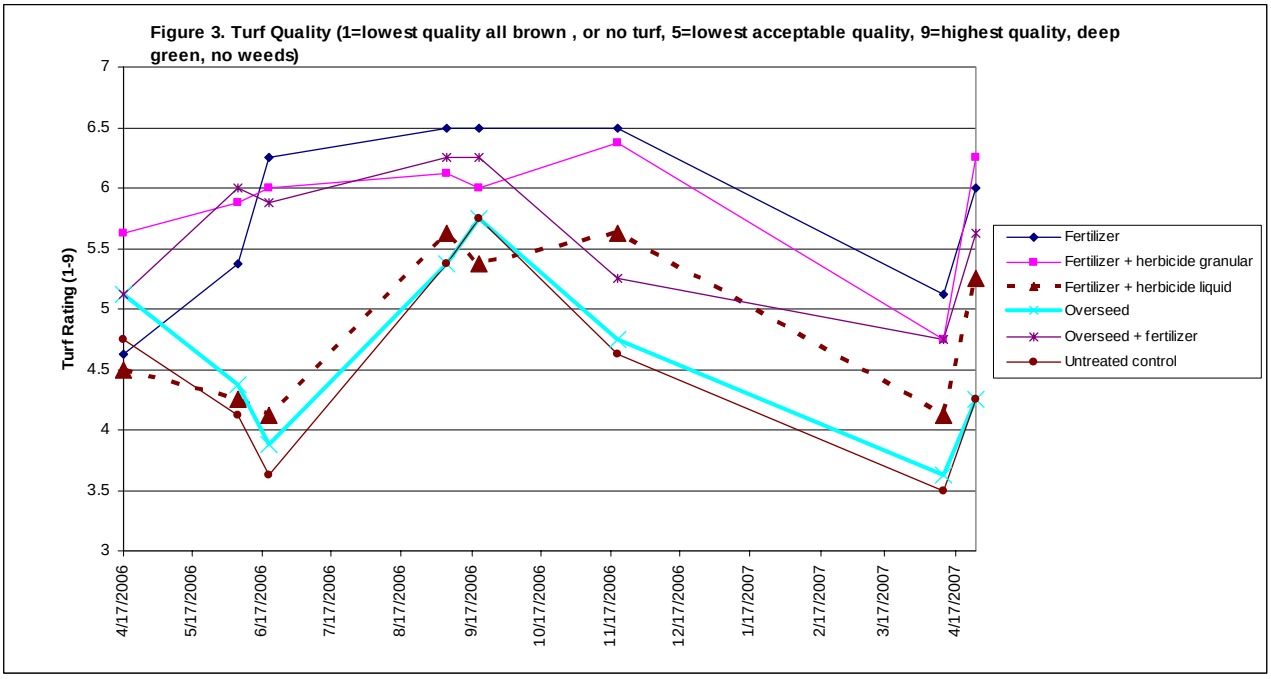
Treatment	**4/17/2006**	**6/6/2006**	**6/20/2006***		**9/6/2006**	**9/20/2006**	**11/20/2006**	**4/12/2007**	**4/26/2007***	
Fertilizer	1.75	3.25	3.75	a	4.38	4.25	3.50	3.38	2.88	a
Fertilizer + herbicide granular	1.00	1.75	2.00	cd	2.50	3.00	2.25	2.38	1.50	b
Fertilizer + herbicide liquid	1.25	2.38	1.75	d	3.13	4.13	3.13	3.00	1.75	b
Overseed	1.38	2.50	2.25	bcd	3.63	4.00	3.13	3.88	3.25	a
Overseed+ fertilizer	1.13	2.88	3.38	ab	3.38	3.38	2.63	3.38	3.00	a
Untreated	2.25	2.75	3.13	abc	4.50	4.25	3.00	3.75	3.63	a

*Means followed by the same letter are not significantly different at the p=0.05 level.

Figure 2. Weed ratings (1=<5%, 2=5-15%, 3=16-30%, 4=30-50, 5=>50% weed cover).



C. Effect of Treatments on Turf Quality – Turf quality was generally highest where fertilizer (with or without herbicide) was applied and lowest in treatments where no fertilizer was applied (untreated control and overseeding alone) (Figure 3). The use of products containing herbicide did not improve turf quality over that of fertilizing alone.



D. Effect of Treatment on Green Cover – Treatments which included fertilizer improved the green cover and consequently, deceased open patches. There were two dates where there were significant differences among the treatments (Table 3). In general, treatments which included fertilizer had a bigger impact than overseeding. There was no difference between those treatments that included herbicides versus fertilizer alone.

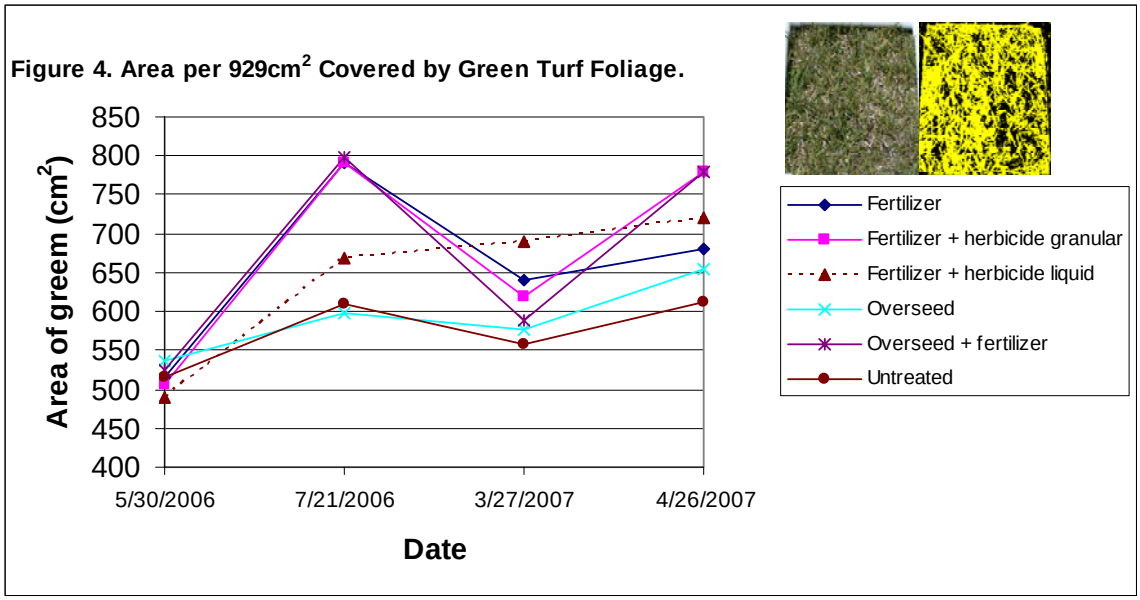
Table 3. Area covered by green turf foliage per 929cm^2 (1 ft^2).

	Area (cm^2) of green turf foliage				
Treatment	**5/30/2006**	**7/21/2006***		**3/27/2007**		**4/26/2007**
Fertilizer	515.87	790.15	a	639.63	ab	680.58
Fertilizer + herbicide granular	505.89	792.02	a	619.61	ab	778.82
Fertilizer + herbicide liquid	489.14	668.41	ab	689.59	a	720.47
Overseed	537.58	598.87	b	575.86	b	653.33
Overseed + fertilizer	525.97	799.16	a	589.3741	b	778.95
Untreated	514.64	609.45	b	557.60	b	612.88

*Means followed by the same letter are not significantly different at the p=0.05 level.

However, there appears to be a trend towards increasing green area in those plots that were overseeded as well as the liquid fertilizer + herbicide treatment (Figure 4).

Figure 4. Area per 929cm^2 Covered by Green Turf Foliage.

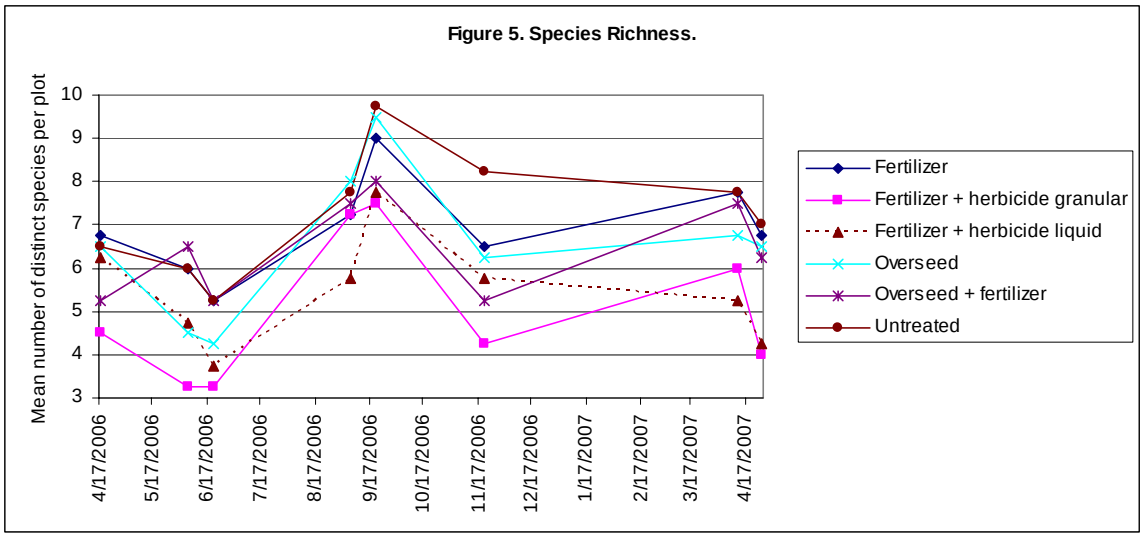


E. Species richness – there were no significant differences in species among treatments until nearly one year after the study was initiated (Figure 5). At the last two evaluation dates (April 12 and 26, 2007) only the treatments that included herbicides had lower species diversity that the other treatments (Table 4). Note that this paramenter does not take in account which speices are present, nor the relative abundance of each species. Nevertheless, it is useful as a single parameter to determine how close an area is to a monoculture (S=1) if or there is a trend towards a monoculture. Figure 5 shows that in the limited time of the study that there may be a cyclical pattern of species richness, peaking in late summer and then decreasing until late fall and then increasing again in early spring. Interestingly, only the liquid weed and feed and untreated control treatments did not show an increase in species diverity in the spring althought the untreated control was not significantly different than the other non-herbicide treatments.

Table 4. Mean Species Richness (S) resulting from each treatment. Higher numbers represent more diversity of plant species.

Treatment	4/17/2006	6/6/2006	6/20/2006	9/6/2006	9/20/2006	11/20/2006	4/12/2007*	4/26/2007*
Fertilizer	6.75	6.00	5.25	7.25	9.00	6.50	7.75a	6.75a
Fertilizer + herbicide granular	4.50	3.25	3.25	7.25	7.50	4.25	6.00bc	4.00c
Fertilizer + herbicide liquid	6.25	4.75	3.75	5.75	7.75	5.75	5.25c	4.25bc
Overseed	6.50	4.50	4.25	8.00	9.50	6.25	6.75ab	6.50a
Overseed + fertilizer	5.25	6.50	5.25	7.50	8.00	5.25	7.50a	6.25ab
Untreated	6.50	6.00	5.25	7.75	9.75	8.25	7.75a	7.00a

*Means followed by the same letter are not significantly different at the p=0.05 level.



Conclusions and impact for weed control in turf:
Where weeds are established in turf using solely cultural controls such as fertilizing and overseeding will not control the weed population. There may be a trend towards lower species diversity in the long term under these conditions if a program of weed and feed treatments are used to reduce the existing weed population and follow it by overseeding and fertilizing alone. Fertilizing or fertilizing with overseeding will improve turf quality and reduce gaps in turf which will reduce the chance of new weeds becoming established but additional work should be done to explore this using higher fertility plots. We are still in the process of analyzing the data; therefore, the results may be modified as we explore the data further.

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