TADS 14776, Manor, Kerb and Corsair Herbicides for Use as Spring Transition Aids in Overseeded Common Bermudagrass Turf

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Abstract

Spring transition of overseeded turf has become a major challenge to turfgrass managers in the southern United States. Turf-type ryegrasses which exhibit increased mowing and heat tolerance have made the return of bermudagrass problematic, especially in common bermudagrass. Herbicides were evaluated for use as a Spring transition agent to decrease ryegrass competition/enhance bermudagrass. Treatments of TADS 14776 experimental herbicide, Manor, Kerb and Corsair were applied to overseeded common bermudagrass on may 6, 2001. Application of TADS experimental herbicide at all rates above 0.21 ounce/product increased bermuda enhancement over Kerb, Corsair and Manor, by 29 June 2001. When applied with extra fertilizer applications, the 0.21 ounce rate of TADS was greater than that of Kerb, Corsair and Manor for bermuda transition. TADS applied at the highest rate of 0.64 ounce (+) fertilizer, and TADS @ 0.42 ounce (+) GENAPOL 150 surfactant and extra plot fertilizer, were the first treatments to exhibit total necrosis of the perennial ryegrass overseed by 4 June (1 month after treatment). However, these treatments created a poorer quality turf, compared to other treatments. TADS @ 0.42 ounce (+) extra plot fertilizer ranked highest in bermudagrass plot cover, with five times as much bermudagrass present than untreated controls on 29 May. This same treatment continued with this trend, achieving 100% bermudagrass cover by 29 June (highly desirable). This treatment resulted in a brief decrease in turfgrass quality at 9 and 16 days after treatment (14 May, 21 May). With that in mind, TADS @ 0.42 ounce (+) extra plot nitrogen proved to be the best treatment that produced acceptable levels of turf quality throughout the transition, yielding the fastest re-establishment of the underlying common bermudagrass. At the close of the test on 10 July, TADS @ 0.21 ounce (+) fertilizer and TADS @ 0.42 ounce (+) fertilizer closed with 88% and 99% bermudagrass cover, and mean quality scores of 6.0 and 7.0 respectively.

At the close of the test, untreated overseeded common bermudagrass yielded unacceptable turf quality, 19% bermudagrass cover, 14% living green ryegrass cover, with the remainder being dead ryegrass (straw).

Introduction

Spring transition is the period when perennial ryegrass is declining, which should yield to the competitive advantage of bermudagrass during the onset of warm weather. The almost ubiquitous use of more heat tolerant perennial ryegrass germplasm in blends and mixtures has aggravated spring transition in the last 10-15 years. Greater tolerance to heat, close mowing, and even moderate drought has decreased the effective growing season of

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bermudagrass. Poor spring transitions can include any of the following (1) prolonged appearance of perennial ryegrass (2) sudden loss of ryegrass turf, (3) lack of bermudagrass cover and/or slow regrowth. Traditional management practices of using lower mowing heights, vertical mowing, and aerification are not always effective, nor can they be practiced regularly due to club schedules and year-round golfers' expectations. With that in mind, an herbicide test was conducted to test select materials for their ability to enhance spring transition.

Materials and Methods

Aventis TADS 14776 experimental compound was evaluated as eight application treatments, either applied alone, applied with GENAPOL 150 (commercial proprietary surfactant), with or without additional water soluble nitrogen applied to the turf during transition. Commercially available products of Manor 60 WP, Kerb 50 WP and Corsair 75 WP were also included. TADS was applied in rates of product/1000 ft^2.

The test site was a ten year old stand of common bermudagrass which was overseeded the fall of 2000 with "Bullseye" perennial ryegrass at 650 lbs PLS/1000 ft^2. The turf was mowed 3x weekly at 5/8" using a tri-plex mower. The site was irrigated to avoid moisture stress using ET from an on-site weather station. All treatments were applied to 5x10' plots using a CO_2 back-pack sprayer on May 6, 2001. Plots received regular mowing and irrigation throughout the transition rating period (May 14 to July 10, 2001). The entire test received a total of 1.5 lbs N, 10 ounces of Ferromec, l.5 lbs. magnesium, and 0.36 ounces of manganese per 1000 ft^2 on May 9, May 30 and June 26. Plots receiving extra –N- for increased transition received 1.0 lb.N/M on three extra occasions (May 9, May 30, June 26) for an additional total of an extra 3 lbs. –N/M for bermuda enhancement.

Plots were assigned visual scores of turfgrass color, and overall quality using the 1-9 NTEP scale system (1=dead, 6=acceptable fairway, 9=best possible). Ryegrass injury was assigned to plots using a 1-6 visual scale where 1=no injury, 2=slight injury, 3=slight/moderate, 4=moderate, 5=moderate/severe, 6=severe/death. Plot composition values were assigned to plots on a weekly basis as the percentage of plot cover as 1) bermudagrass, 2) living green ryegrass, 3) straw/dead ryegrass, were applicable. All data collected were subjected to the analysis of variance technique, using a randomized complete block design using four replications. Least significant difference values were used as the mean separation statistic when the F value for the treatment main effect was significant at P=0.05, or less. For continuity and ease of interpretation, response variables will be discussed as trends related to treatments, noting the most extreme effects (both desirable and undesirable).

Results and Discussion

Turfgrass Color:

On all nine evaluation dates, the "treatment" affect was highly significant. Untreated ryegrass turf maintained a very dark green color in early to mid-May, and a dark overall color (as expected) until mid-June. Color then faded, starting on 24 June, and yielded very poor color by the end of June, and at the close of the test on July 10, 2001 (Table 1).

TADS @ 0.21 ounce produced color scores somewhat less than that of the controls, showing a definite response to the herbicide at the lowest rate. When fertilizer was added to this rate, the color response was enhanced starting on June 19, carrying through to July 10 (end) compared to the same rate without extra nitrogen. On 29 June and 10 July, turfgrass color for TADS @ .21 ounce + fertilizer had darker color turf than that of the control (Table 1).

TADS @ 0.42 ounce yielded color scores lower than that of the 0.21 ounce rate from May 29 to 19 June, after which there was no difference in color for these two treatments. TADS @ 0.42 ounces yielded poor color scores in early June (June 4) up to and including 19 June (color=3.5), when untreated turf averaged a color score of 6.3 (Table 1).

The addition of GENAPOL x 150 surfactant to the 0.42 ounce decreased color scores initially from the period of May 14 to 4 June, compared to the same rate without the surfactant. Still, both treatments (regardless of surfactant or not) at 0.42 ounces had unacceptable turf color from May 29 to 19 June, with scores ranging from 3.8 to 4.5 during that period (Table 1).

When applied at the high rate of 0.64 ounces, turf color was low from 21 May to 19 June, with average color scores of 4.3 to 4.8. The addition of extra fertilizer caused enhanced loss of color at this same rate, especially during the early stages of transition (14 May to 4 June). Color scores were 3.5 to 4.8 at that period, and were most injurious to the ryegrass (Table 1).

At the 0.64 ounce rate/TADS produced color scores similar or greater to the untreated controls of bermudagrass, as opposed to dead ryegrass straw in July. Manor, Kerb, and Corsair had color scores equal to that of the untreated controls during the course of the test (Table 1).

Injury to Ryegrass:

Untreated ryegrass showed slight to moderate injury from heat stress alone on June 11, which became extreme by 29 June (mean=4.8 out of 6.0). By 10 July, the untreated ryegrass was essentially completely dead. Treatments which induced a quick injury response to the ryegrass included TADS 0.42 (+) GENAPOL 150 (+) fertilizer, and TADS 0.64 (+) fertilizer. These treatments acted quickly, exhibiting mean injury scores to ryegrass of 3.0 to 4.0 (moderate injury) by 14 May. These same treatments caused severe injury to essential death of the ryegrass by 4 June (Table 2).

By 19 June all TADS 14776 treatments, with the exception of the 0.21 ounce rate (alone) caused severe injury, and or death of the ryegrass (means of 5.8-6.0) (Table 2).

Manor, Kerb, and Corsair caused injury scores no greater than did that of heat stress alone on the untreated control plots. There was no statistical difference between any of these three treatments and that of the untreated control plots for apparent visible injury to ryegrass turf.

Plot Composition - Percent living ryegrass:

Untreated ryegrass slowly decreased from 96% cover composition to 85% from 21 May to 11 June. Having 85% ryegrass in almost early June is worrisome agronomically, but not at all atypical with overseeded common bermudagrass. By 19 June, the control showed 70% ryegrass alive, which decreased sharply by 24 June (46%) and 29 June (13%) (Table 3)

There was no living ryegrass essentially on 19 June from the following treatments, TADS @ 0.64 ounce, TADS @ 0.42 (+) Fertilizer, TADS @ 0.42 (+) GENAPOL 150 (+) Fertilizer, TADS @ 0.64 ounce + Fertilizer, and TADS @ 0.42 + GENAPOL 150 surfactant (Table 3)

At the low rate of TADS @0.21, the addition of extra fertilizer readily assisted in the removal of ryegrass from May 21 to June 11. The addition of extra plot nitrogen also increased the onset of bermudagrass as well (see below).

Manor ended up producing the same amount of living ryegrass as the untreated controls throughout the test. Kerb and Corsair reduced the amount of living ryegrass plot cover by June 19, with Kerb having more effect than Corsair on this date (25% vs. 51% rye cover, respectively). Kerb was more active in eliminating live ryegrass cover by 24 June also, having about one-half as much living ryegrass as compared to Manor and Corsair at that time (Table 3) Still, these three treatments had much less ryegrass control than the TADS treatments overall, and these three treatments also produced an unacceptable amount of dead (straw) ryegrass and only a moderate amount of bermudagrass cover by 10 July.

Straw/Dead Ryegrass:

The untreated control plots had 81% dead ryegrass plot cover on July 10. The least amount of dead straw ryegrass plot cover produced throughout the test was that of TADS @ 0.42 (+) fertilizer. This treatment had a maximum of 18% straw ryegrass cover on 19 June, which was then overgrown by oncoming bermudagrass. After this date, dead ryegrass was 4% or less (Table 4).

TADS @ 0.42 ounces (+) fertilizer (+) GENAPOL 150 surfactant followed closely, but this treatment was slightly less in overall turf quality (see below).

TADS @ 0.21 had less straw ryegrass cover when fertilizer was added than without fertilizer at the same rate. The addition of fertilizer also increased bermudagrass cover (see below) and enhanced turf quality also (see below).

Without the addition of extra plot fertilizer, TADS @ 0.21 and TADS @ 0.42 ounces product both produced lots of ryegrass straw on July 10, compared to the same rates with fertilizer (Table 4).

Manor, Kerb and Corsair at rates tested here produced large amounts of dead ryegrass straw compared to the TADS treated turf by the close of the test on July 10. Manor developed this condition slowly from 19% (on 19 June) to a 45% maximum of 29 June. Kerb developed dead ryegrass straw 6 weeks after treatment (48% on 19 June), which peaked at 55% dead ryegrass on 24 June. Corsair was intermediate for ryegrass straw development by mid-June (20%), which slowly progressed to a 55% maximum amount by 29 June. The amount for Kerb, Manor and Corsair was the same (38% - 41%) at the end of the test on 10 July (Table 4). These three treatments did not receive the extra 3.0 lbs. of fertilizer for transition.

Bermudagrass Cover:
The "treatment" effect for bermudagrass cover was statistically significant on all eight evaluation dates. The untreated control plots averaged 4% bermudagrass cover on 21 May, which slowly peaked at 19-23% at the end of the test. This demonstrates the persistence of perennial ryegrass and its late spring effects after necrosis imposed on common bermudagrass. The first treatment to achieve 75% or more bermudagrass cover was TADS @ 0.42 (+) fertilizer on June 19 (81%) (Table 3). In comparison with untreated turf, there was a five-fold difference between treated plots versus the control on 29 May, 4 June and 11 June.

The "quickest acting" treatment for conversion to bermudagrass was that of TADS @ 0.42 ounce (+) fertilizer. It produced 69% mean bermuda cover by 11 June, 82% by 19 June and 96% by 24 June (Table 5).

TADS @ 0.42 (+) fertilizer produced more bermudagrass cover than the same rate with GENAPOL 150 surfactant, and more so than GENAPOL 150 (+) fertilizer at the same rate. Performance was almost 50% greater than versus the same (0.42 ounce) rate when applied alone, with surfactant, or with both fertilizer and surfactant. Without fertilizer at this rate, the addition of GANEPOL 150 surfactant generally increased bermudagrass transition over the same rate of 0.42 ounces alone (Table 5).

TADS @0.42 ounces produced more bermudagrass cover (up to June 29) when GENAPOL 150 and fertilizer was used, than with just the simple addition of GENAPOL 150 alone. Once again, TADS @0.42 ounce (+) fertilizer was the leading treatment for transition compared to all other additions (surfactant, and/or extra fertilizer) at that same rate (Table 5).

At the high rate of TADS @ 0.64 ounces, there was no significant difference for bermudagrass transition when applied alone, or with the addition of fertilizer.

Manor, Kerb and Corsair produced lesser amounts of bermudagrass, which was no different when compared to TADS 0.21 ounces (lowest ate) without fertilizer. When fertilizer was added to TADS @ 0.21 ounces, its performance essentially doubled (up to 24 June) over TADS @ 0.21 ounce, alone (Table 5).

Tads @ 0.21 ounce (+) fertilizer always produced greater amounts of ryegrass than the industry standard (Kerb), and the new re-releases of Manor (metsulfuron) and Corsair (chlorosulfuron), alone.

Turfgrass Quality:
Overall turfgrass quality is an assessment of overall appearance of the plot. To receive fully acceptable quality scores (6.0 or better), the turf must have a large degree of living ground cover (perennial ryegrass and/or bermudagrass), not excessively stressed grass (rye or bermudagrass), and not more than 5-10% dead (straw) turf. These responses change over time with individual treatments, and it is highly desirable to have acceptable ranges of these components at the onset, during and in full transition.

Untreated perennial ryegrass started declining in overall quality on 19 June (mean = 5.5), and continued to decline rapidly afterwards, and was on the verge of total failure on 10 July (mean = 2.7). (Table 6) As noted before, the predominant cover for untreated turf was that of straw (dead) ryegrass cover from 29 June onward (Table 4).

Both TADS treatments which included GENAPOL 150 surfactant (0.42 ounce), with or without the addition of extra fertilizer, had quite low quality scores, starting as early as the middle of May. It was not until 24 June that these two treatments yielded quality scores greater than that of the controls (which scored mean values of 4.3, 4.0 and 2.7 for 24 June, 29 June and 10 July, respectively) (Table 6).

Early on, TADS @ 0.21 ounces (+) fertilizer had lower quality scores than the same rate without fertilizer, but after 19 June, the addition of fertilizer at this rate produced better overall quality turf (Table 6).

TADS @ 0.42 ounce (+) fertilizer produced better turf scores than TADS @ 0.42 (+) GENAPOL 150 past 11 June. TADS @ 0.42 ounces (+) GENAPOL 150 (+) fertilizer did not produce acceptable quality turf until 24 June (mean quality = 5.8) (Table 6).

TADS @ 0.64 ounce produced substandard quality turf from 21 May to 19 June (3.8 - 4.8 range), which then rebounded with acceptable turf quality from 24 June onwards (6.0 – 6.5).

TADS @ 0.64 ounce (+) fertilizer produced poor quality turf also, starting earlier (May 14 mean = 4.3) and lasting until 19 June also. Therefore, the addition of extra nitrogen alone at the high rate did not increase quality during the transition phase, nor did it increase the amount of bermudagrass present (Table 6).

Manor, Kerb and Corsair produced essentially the same quality turf as that of the untreated controls, which become unacceptable by 24 June. (Table 6) Recall that these treatments ended with large amounts of dead (straw) ryegrass cover, and 62% or less bermudagrass cover on 10 July (end of study) (Tables 4,5).

Mean Quality scores for the best transition agent treatment occurred for TADS @ 0.42 ounce (+) fertilizer. This treatment had decreased quality at 2 and 3 weeks after treatment (May 21 – 29), but was moderately acceptable for overall quality from 29 May to 11 June (Table 6). By 24 June, this treatment produced the best appearing turf (6.3 – 7.0), due to the greatest amount and oldest population of “new” spring bermuda, as desired.

Among treatments which produced the best overall quality turf, with the best bermudagrass transition, were TADS @ 0.21 ounce (+) fertilizer; TADS @ 0.42 ounce (+) fertilizer. The treatment of TADS @ 0.42 ounce (+) fertilizer yielded numerically the greatest amount of bermuda the quickest, and produced numerically in rank the best turf quality by the third week in June (Tables 5, 6).

If some slight loss in quality is acceptable for 2-3 weeks after an early May application, with the goal of escorting in the greatest amount of bermudagrass, then TADS 0.42 ounce (+) fertilizer is the treatment of choice. This treatment produced a maximum of 18% dead ryegrass, which occurred on 19 June (Tables 4, 5, 6).

If somewhat greater quality is necessary throughout May, then TADS @ 0.21 (+) fertilizer is fully acceptable, which yielded a slower transition to bermuda. Note that the TADS @ 0.42 ounce plus fertilizer program yielded 100% bermudagrass cover by 29 June, which is highly desirable and beneficial in the battle to sequester ryegrass and promote full bermudagrass growth for 10 weeks of use before the next overseed season (Table 5).

Conclusions

(1) Application of TADS experimental herbicide at all rates above 0.21 ounce/product increased bermuda enhancement over Kerb, Corsair and Manor, by 29 June 2001.

(2) When applied with extra fertilizer applications, the 0.21 ounce rate of TADS was greater than that of Kerb, Corsair and Manor for bermuda transition.

(3) The addition of -N- at the 0.21 ounce rate of TADS caused a slight decrease in overall quality for up to six weeks after treatment, which increased afterwards (due to more bermudagrass present). Conversely, turf treated with TADS @ 0.21 ounce (without additional plot fertilizations) was unaffected by the single May 6 application. Quality of the turf decreased later on (24 June), due solely to the loss of ryegrass which largely died, leaving little bermudagrass underneath.

(4) TADS applied at the highest rate of 0.64 ounce (+) fertilizer, and TADS @ 0.42 ounce (+) GENAPOL 150 surfactant and extra plot fertilizer, were the first treatments to exhibit total necrosis of the perennial ryegrass overseed by 4 June (1 month after treatment). However, these treatments created a poorer quality turf, compared to other treatments.

(5) All TADS applications (regardless of select additions of either GENAPOL 150 surfactant and/or extra plot nitrogen fertilizations) caused the quickest incidence of ryegrass necrosis by 19 June. The exception was TADS @ 0.21 ounces, applied alone, without the surfactant or additional plot nitrogen applications.

(6) TADS @ 0.42 ounce (+) extra plot fertilizer ranked highest in bermudagrass plot cover, with five times as much bermudagrass present than untreated controls on 29 May. This same treatment continued with this trend, achieving 100% bermudagrass cover by 29 June (highly desirable). This treatment resulted in a brief decrease in turfgrass quality at 9 and 16 days after treatment (14 May, 21 May).

(7) With that in mind, TADS @ 0.42 ounce (+) extra plot nitrogen proved to be the best treatment that produced acceptable levels of turf quality throughout the transition, yielding the fastest re-establishment of the underlying common bermudagrass.

(8) As a moderate trade-off, TADS @ 0.21 ounce (+) extra plot nitrogen yielded slightly better turf quality for the first half of the transition (than the above treatment), but produced about 15% less bermudagrass plot cover than TADS @ 0.42 (+) fertilizer.

(9) At the close of the test on 10 July, TADS @ 0.21 ounce (+) fertilizer and TADS @ 0.42 ounce (+) fertilizer closed with 88% and 99% bermudagrass cover, and mean quality scores of 6.0 and 7.0 respectively.

(10) Kerb, Manor and Corsair waned in transition efficacy compared to TADS. There treatments did not receive extra nitrogen application.

(11) Kerb, Manor and Corsair generally paralleled turfgrass quality of the untreated controls good initially, and unacceptable later as ryegrass failed naturally). Large amounts of dead ryegrass straw was realized at the end of the test (37 – 41%) on 10 July.

(12) Chemical transition is a viable option for removing perennial ryegrass overseed at fairway height (5/8") from common bermudagrass. Untreated turf yielded 81% dead ryegrass straw by 10 July. Turf managers with low amounts of common bermudagrass cover on fairways would otherwise spend most of the remaining summer trying to produce a bermudagrass cover, which may not adequately mature before the next overseeding operations.

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Table 1. Average Visual COLOR①, TADS 14776, Spring 2001 transition study. University of Arizona.

	14-May	*21-May*	*29-May*	*4-Jun*	*11-Jun*	*19-Jun*	*24-Jun*	*29-Jun*	*10-Jul*
Treatments②									
Control	8.0	9.0	7.3	7.5	7.3	6.3	5.8	4.0	3.0
TADS @ 0.21 oz.	6.3	6.3	6.5	6.3	6.0	4.5	5.5	4.5	3.5
TADS @ 0.42 oz.	6.3	5.8	5.5	4.8	4.0	3.5	5.3	5.8	5.5
TADS @ .42+ X150	5.8	5.0	4.5	4.3	4.0	3.8	5.3	6.3	6.0
TADS @ 0.64 oz.	5.8	4.5	4.8	4.0	4.0	4.3	6.0	6.8	6.3
TADS @ .21+ Fert	5.8	6.3	6.3	5.5	6.0	5.0	5.8	5.8	5.8
TADS @ .42+ Fert	4.8	4.8	5.3	4.8	5.0	6.3	6.5	6.3	5.3
TADS@42+X150+Frt	4.3	3.8	4.8	3.8	4.3	5.3	5.3	6.3	5.7
TADS @ .64+ Fert	4.8	3.8	4.3	3.5	4.0	4.5	5.5	6.5	6.0
Manor 60 @ .4 oz	6.5	6.5	7.3	7.0	6.8	6.5	5.8	4.8	4.8
Kerb 50 @1# ai/A	8.0	8.5	7.0	6.3	6.0	5.7	5.3	4.8	5.0
Corsair 75@1oz/A	6.8	6.8	7.0	6.5	6.5	6.3	5.7	5.0	4.3
test mean③	6.1	5.9	5.9	5.3	5.3	5.1	5.6	5.5	5.1
LSD④	0.74	1.05	1.21	1.06	1.60	2.00	1.45	1.47	1.47

① Color 1-9. 1=dead, 6=acceptable, 9=darkest green possible. Values are the mean of four replications.
② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.
③ Test mean = mean of all treatments and controls on each evaluation date.
④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.

Table 2. Average Visual QUALITY①, TADS 14776, Spring 2001 transition study. University of Arizona.

	14-May	*21-May*	*29-May*	*4-Jun*	*11-Jun*	*19-Jun*	*24-Jun*	*29-Jun*	*10-Jul*
Treatments②									
Control	7.3	7.5	6.8	7.3	6.7	5.5	4.3	4.0	2.7
TADS @ 0.21 oz.	6.0	5.5	7.3	5.8	5.8	5.0	4.7	4.0	4.5
TADS @ 0.42 oz.	6.0	5.3	5.5	4.8	4.0	3.5	4.8	5.3	6.0
TADS @ .42+ X150	5.5	4.3	5.0	3.8	3.5	3.5	4.8	5.8	6.0
TADS @ 0.64 oz.	6.0	4.8	4.5	3.8	3.5	3.8	6.0	6.5	6.0
TADS @ .21+ Fert	5.8	4.8	6.3	5.5	5.3	5.0	5.5	6.0	6.0
TADS @ .42+ Fert	4.5	4.0	5.3	4.8	5.0	5.7	6.3	6.7	7.0
TADS@42+X150+Frt	4.0	3.0	4.0	3.8	4.0	4.3	5.8	6.3	6.3
TADS @ .64+ Fert	4.3	3.3	3.8	3.3	3.3	3.8	5.5	5.8	6.0
Manor 60 @ .4 oz	6.0	6.3	7.3	6.8	7.0	6.0	5.0	4.5	4.3
Kerb 50 @1# ai/A	7.3	7.3	7.0	6.0	6.0	4.7	4.7	4.0	4.3
Corsair 75@1oz/A	6.5	7.0	6.8	6.3	6.3	6.0	4.8	4.3	4.3
test mean③	5.8	5.2	5.8	5.1	5.0	4.7	5.2	5.2	5.3
LSD④	0.93	0.99	0.98	1.15	1.40	1.85	1.70	1.53	1.08

① Quality 1-9. 1=dead, 6=acceptable, 9=darkest green possible. Values are the mean of four replications.
② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.
③ Test mean = mean of all treatments and controls on each evaluation date.
④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.

Table 3. Average Visual Ryegrass INJURY①, TADS 14776, Spring 2001 transition study. University of Arizona.

	14-May	*21-May*	*29-May*	*4-Jun*	*11-Jun*	*19-Jun*	*24-Jun*	*29-Jun*	*10-Jul*
Treatments②									
Control	1.3	1.3	2.3	1.8	3.0	3.0	3.8	4.8	5.8
TADS @ 0.21 oz.	2.3	2.3	2.3	1.8	2.7	4.5	5.3	5.8	6.0
TADS @ 0.42 oz.	2.8	3.3	4.0	4.5	5.0	5.8	5.8	6.0	6.0
TADS @ .42+ X150	3.0	4.0	4.8	5.0	5.8	6.0	6.0	6.0	6.0
TADS @ 0.64 oz.	2.5	3.8	4.8	5.3	5.8	6.0	6.0	6.0	6.0
TADS @ .21+ Fert	3.0	3.0	3.0	3.0	4.0	5.0	5.5	6.0	6.0
TADS @ .42+ Fert	3.5	4.3	4.8	5.3	5.7	6.0	6.0	6.0	6.0
TADS@42+X150+Frt	4.5	5.0	5.0	6.0	5.8	6.0	6.0	6.0	6.0
TADS @ .64+ Fert	4.0	5.3	5.5	6.0	6.0	6.0	6.0	6.0	6.0
Manor 60 @ .4 oz	2.3	1.5	1.8	1.5	2.3	3.3	3.8	5.0	5.5
Kerb 50 @1# ai/A	1.3	1.3	2.0	2.5	3.0	4.0	4.7	5.8	5.8
Corsair 75@1oz/A	1.5	1.3	1.5	2.3	2.3	3.8	4.3	5.5	5.5
test mean③	2.6	3.0	3.5	3.7	4.3	4.9	5.2	5.7	5.9
LSD④	1.0	0.8	1.2	1.1	1.5	0.9	1.2	0.8	ns

① Injury Score, 1-6. 1 = none, 2 = slight, 3 = slight/moderate, 4 = moderate, 5 = moderate/severe, 6 = severe/death. Values are the mean of four replications.

② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.

③ Test mean = mean of all treatments and controls on each evaluation date.

④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.

Table 4. Average Visual Bermudagrass (%)[①], TADS 14776, Spring 2001 transition study. University of Arizona.

	21-May	*29-May*	*4-Jun*	*11-Jun*	*19-Jun*	*24-Jun*	*29-Jun*	*10-Jul*
Treatments[②]								
Control	3.5	11.8	10.8	15.0	13.3	16.7	23.3	19.0
TADS @ 0.21 oz.	10.8	13.3	12.5	23.8	31.3	32.5	50.0	62.5
TADS @ 0.42 oz.	12.0	17.5	16.8	27.5	35.0	57.5	68.8	80.0
TADS @ .42+ X150	15.3	21.3	25.5	31.3	42.5	72.5	86.3	95.0
TADS @ 0.64 oz.	15.8	22.5	32.5	40.0	47.5	75.0	90.0	95.8
TADS @ .21+ Fert	9.5	22.5	25.8	50.0	58.8	75.0	84.5	88.3
TADS @ .42+ Fert	15.0	50.0	51.7	68.8	81.7	96.0	100.0	98.3
TADS@42+X150+Frt	13.3	28.8	37.5	45.0	71.3	89.5	95.8	96.7
TADS @ .64+ Fert	10.8	20.0	26.3	37.5	46.3	80.0	88.8	96.5
Manor 60 @ .4 oz	11.3	16.3	13.5	21.3	21.3	33.8	43.8	58.8
Kerb 50 @1# ai/A	6.5	13.3	13.3	30.0	26.7	33.3	45.0	60.0
Corsair 75@1oz/A	10.5	11.3	12.5	15.0	21.3	33.8	41.3	62.5
test mean[③]	11.2	20.7	23.2	33.8	41.4	58.0	68.1	76.1
LSD[④]	6.5	13.1	14.5	20.4	26.3	27.5	24.4	21.2

① Percent plot covered with bermudagrass (0-100%). Values are the mean of four replications.
② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.
③ Test mean = mean of all treatments and controls on each evaluation date.
④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.

Table 5. Average Visual Living Green Ryegrass (%)[1], TADS 14776, Spring 2001 transition study. University of Arizona.

	21-May	*29-May*	*4-Jun*	*11-Jun*	*19-Jun*	*24-Jun*	*29-Jun*
Treatments[2]							
Control	96.5	84.5	89.3	85.0	70.0	46.3	13.8
TADS @ 0.21 oz.	89.3	86.8	87.5	76.3	20.0	11.7	7.5
TADS @ 0.42 oz.	88.0	81.3	83.3	72.5	5.0	2.5	0.0
TADS @ .42+ X150	84.8	72.5	74.5	68.8	1.3	1.3	0.0
TADS @ 0.64 oz.	84.3	71.3	67.5	60.0	0.0	0.0	1.3
TADS @ .21+ Fert	90.5	75.8	74.3	50.0	10.0	3.8	1.3
TADS @ .42+ Fert	85.0	40.0	48.3	31.3	0.0	0.0	0.0
TADS@42+X150+Frt	86.8	50.0	62.5	55.0	0.0	0.0	0.0
TADS @ .64+ Fert	89.3	56.3	73.8	62.5	1.3	0.0	0.0
Manor 60 @ .4 oz	88.8	83.8	86.5	78.8	61.3	35.0	11.3
Kerb 50 @1# ai/A	93.5	86.8	86.8	70.0	25.0	11.7	3.8
Corsair 75@1oz/A	89.5	86.3	87.5	85.0	51.3	32.5	3.8
test mean[3]	88.8	72.9	76.8	66.3	20.4	12.0	3.5
LSD[4]	6.5	12.6	14.5	20.4	22.1	17.3	9.7

① Percent living ryegrass canopy cover (0-100%). Values are the mean of four replications.
② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.
③ Test mean = mean of all treatments and controls on each evaluation date.
④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.

Table 6. Average Visual Straw/Dead Ryegrass (%)[①], TADS 14776, Spring 2001 transition study. University of Arizona.

	29-May	*19-Jun*	*24-Jun*	*29-Jun*	*10-Jul*
Treatment[②]					
Control	3.8	5.0	31.7	60.0	81.0
TADS @ 0.21 oz.	0.0	48.8	55.0	35.0	37.5
TADS @ 0.42 oz.	1.3	60.0	40.0	31.3	20.0
TADS @ .42+ X150	6.3	56.3	26.3	13.8	5.0
TADS @ 0.64 oz.	6.3	52.5	25.0	8.8	4.3
TADS @ .21+ Fert	1.8	31.3	21.3	14.3	11.8
TADS @ .42+ Fert	10.0	18.3	4.0	0.0	1.7
TADS@42+X150+Frt	21.3	28.8	9.0	4.3	3.3
TADS @ .64+ Fert	23.8	52.5	20.0	11.3	3.5
Manor 60 @ .4 oz	0.0	18.8	31.3	45.0	41.3
Kerb 50 @1# ai/A	0.0	48.3	55.0	51.3	40.0
Corsair 75@1oz/A	2.5	27.5	33.8	55.0	37.5
test mean[③]	6.4	37.3	29.3	27.5	23.9
LSD[④]	10.2	28.3	31.1	27.5	21.2

① Percent of canopy with straw/dead ryegrass. Values are the mean of four replications.
② Herbicides applied May 6, 2001. Fertilizer applications 1.0 lb./N/M applied each on May 9, My 30, June 26. TADS applied in ounces product/M. Corsair and Manor applied in ounces/product/acre. Kerb applied lbs. ai/acre.
③ Test mean = mean of all treatments and controls on each evaluation date.
④ LSD = least significant difference mean separation statistic. Means which differ in absolute values greater than the LSD value are statistically different from each other in performance.