# EXECUTIVE SUMMARY

*Establishment and management of seeded bermudagrass in the transition zone*

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Several high-quality seeded bermudagrass (*Cynodon dactylon*) cultivars have been recently introduced to the turf market. These genetic advances will likely increase the utilization of seeded bermudagrasses on golf turf surfaces. This research effort addresses two significant problems impeding the wide-spread use of seeded bermudagrass cultivars in the transition zone - weed control and first-year winter survival. The objectives of our studies are to: 1) determine how post-emergence and pre-emergence herbicides may effectively be used to control weeds in newly-established seeded bermudagrass 2) Determine the effects of seeding date and seeding rate on morphology and freeze tolerance of newly seeded bermudagrass and 3) determine the effects of N fertilizers and growth regulators on the morphology and freeze-tolerance of newly seeded bermudagrass. All studies were conducted at the UofA Research and Extension Center, Fayetteville and included the seeded bermudagrass cultivars Princess, Jackpot, Mirage, Mohawk and Nu-Mex Sahara and the experimental line, OKS 91-11, unless otherwise indicated. All studies will be repeated during the 2001 growing season.

A post-emergence herbicide study was initiated on June 1, 2000, using the bermudagrass cultivar, 'Princess'. At 7, 14, and 28 days after seedling emergence, individual plots were treated with one of seven post-emergent turf herbicides at recommended rates, including MSMA, dicamba, metsulfuron, 2,4-D, chlopyralid, diclofop, quinclorac, and an untreated control. Significant herbicide injury was observed with diclofop, metsulfuron, dicamba, and 2,4-D over the first 14 days after application. However, the injury was ephemeral and had completely dissipated by 30 days after treatment. The first-year data from this study suggest that common post-emergence herbicide programs can be effectively used on newly seeded bermudagrasses, but some injury can be expected from specific chemicals such as diclofop, 2,4-D, dicamba, and metsulfuron.

A pre-emergent herbicide study was also completed during the 2000 growing season. This establishment study was unique, in that the seeds were applied in rows with 12 inches between rows. The main objective was to determine whether a band of activated charcoal, applied directly on the soil surface above the seed row, could effectively deactivate pre-emergent herbicides and allow germination in the seed row to occur. Three herbicides were examined in this study, including oxadiazon, prodiamine, and diuron. Charcoal planting was an effective means of germinating bermudagrass seeds in the presence of pre-emergence herbicides and the rows of bermudagrass produced a significant cover in approximately 6 weeks. Plots that were seeded without charcoal banding and treated with the same herbicides failed to germinate. There were subtle differences in the various herbicides tested, as diuron-treated plots produced better results than prodiamine and oxadiazon. Although not yet confirmed by research, these results suggest that prodiamine and oxadiazon may not be as tightly bound to the activated charcoal as diuron and subsequently retain some of their herbicidal activity.

Studies were also initiated to examine the effects of planting rate, planting date, and post-planting management on morphology and freeze tolerance of seeded bermudagrasses. All cultivars mentioned above were evaluated in the seeding rate and date trials, while 'Princess' was used in the post-planting, management study. All studies were successfully established during the 2000 growing season and are nearing complete dormancy at the time of this writing. However, the critical data on morphology and freeze tolerance will be collected over the next 4 months and will be reported in the 2001 summary.

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**Objective:**

The overall goal of this project is to generate a set of best-management practices for establishing seeded bermudagrasses in the transition zone. Towards this goal, several hypotheses are being tested. This summary will go through each hypothesis, studies attempted to date, and current status of proposed research.

## General Overview

All studies were conducted at the University of Arkansas Research and Extension Center, Fayeteville, AR (USDA Hardiness Zone 6, Captina silt loam soil, typic hapludults, pH 6.2). Prior to establishing all studies, the soil was treated with methyl bromide (67%) / chloropicrin (33%) at a rate of 392 kg•ha$^{-1}$ to produce a weed-free site. Unless otherwise indicated, the cultivars Princess, Jackpot, Mirage, and Arizona Common and experimental lines, OKS 95-1 and OKS 91-1 were used based on their documented cold tolerance and their performance in recent turf trials. All studies will be repeated over 2 growing seasons.

**Hypothesis 1** -*Post-emergent herbicides may be effectively used to control weeds in newly-established seeded bermudagrasses.*

'Princess' bermudagrass was seeded in a prepared seedbed on June 1, 2000 and emergence was observed within 10 days. The post-emergence turfgrass herbicides MSMA, metsulfuron, diclofop, clopyralid, dicamba, 2,4-D, and quinclorac were applied to the newly seeded grass at 1, 2, and 4 weeks after emergence. The herbicides were applied at label rates with a $CO_2$ powered sprayer equipped with flat fan nozzles delivering 30 gpa. Visual injury ratings were collected at 3, 5, 7, 15, 30, and 60 days after treatment and percentage turfgrass cover was collected at 30DAE.

A uniform germination had occurred at 10 days after planting and spray applications began 1 week after emergence. Significant injury was observed with most herbicides at 1, 2, and 4 WAE timings (Figure 1 - 2WAE not shown). At all application timings, metsulfuron and diclofop generally produced the highest levels of herbicide injury, although significant injury was also observed with dicamba and 2,4-D. Although the injury that was observed at each timing was considered deleterious, the turf quickly recovered from the injury and plots that were sprayed with metsulfuron and diclofop were only slightly distinguishable from other treatments at 30 days after treatment (Fig. 1). First-year results indicate that several post-emergence herbicide programs will be available for establishing bermudagrass from seed. These include both grass- and broadleaf- specific chemicals. This study will be repeated during the 2001 growing season.

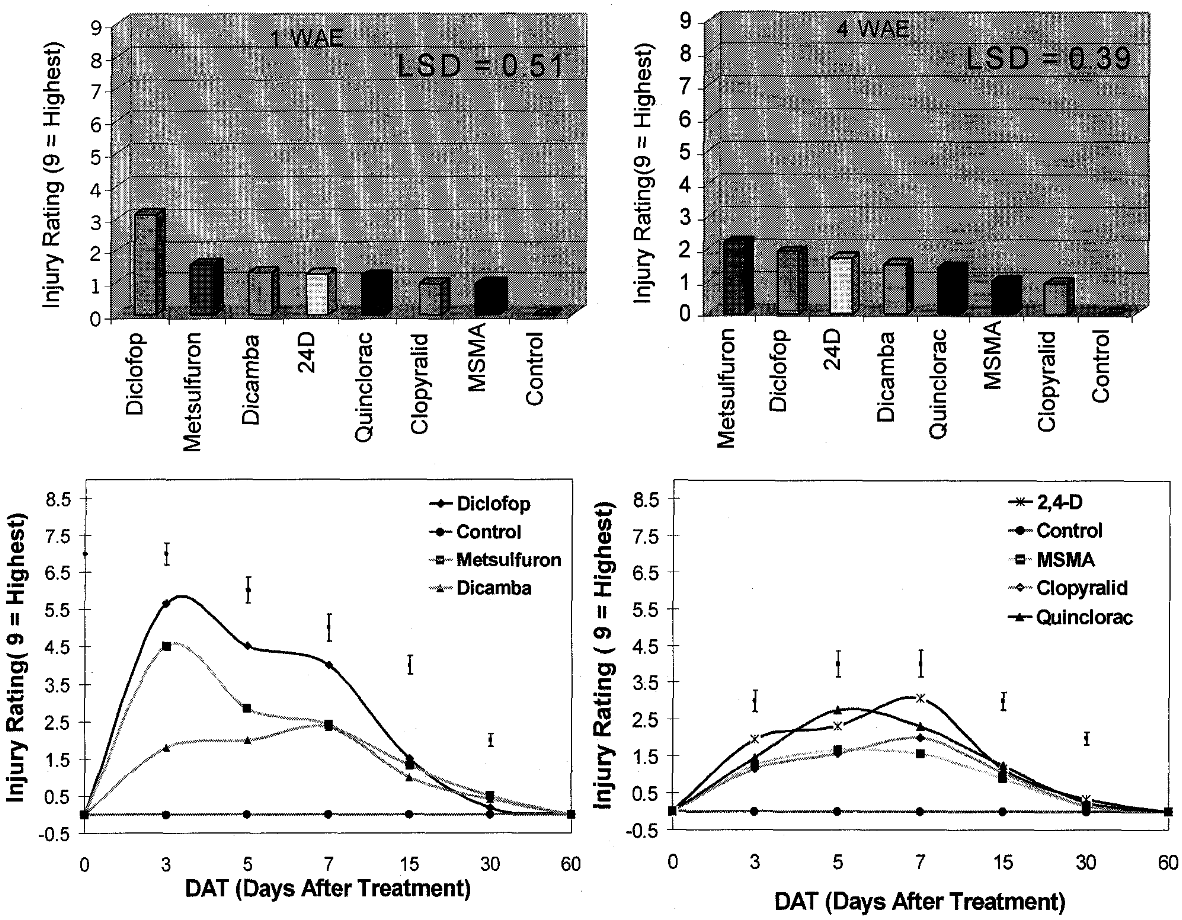


**Fig. 1 - Visual injury of seven common turf herbicides on 'Princess' seeded bermudagrass, as affected by application timing (top) and days after treatment**

Hypothesis 2 - *Charcoal banding will allow the use of pre-emergent herbicides to establish seeded bermudagrass*

This study involved row-planting bermudagrass seed (cultivar 'Princess') on 12-inch centers and using activated charcoal sprayed into the drill row as a safener to allow the use of preemergence herbicides for establishment weed control. The trial was planted with a 48" Gandy Dethatcher / Overseeder® and flowable charcoal (De-Tox) was applied as a 1 inch band over the seed row at a rate of 1 lb per 150 sq ft. using a modified $CO_2$ powered sprayer. Prodiamine, oxadiazon, and diuron were broadcast-applied at recommended label rates immediately after planting. Data collected included visual establishment ratings at 3, 5, and 7 days after emergence (data not shown), and percent turfgrass cover was measured weekly after emergence using digital image analysis (Richardson et al., 2000). Rooting of bermudagrass stolons was evaluated at 45 days after emergence. Although this study was successfully established on 26 July 2000, 2 earlier attempts failed because the Gandy seeder was not delivering the seed at the proper place in the drill row and therefore, the charcoal was ineffective at protecting the seed from the herbicides. A different seeder will be used during the 2001 growing season.

Activated charcoal successfully protected seeds from all pre-emergent herbicides (Table 1). Bermudagrass roots showed minimal damage due to herbicide applications (data not shown). Using digital image analysis, there was a highly significant difference between charcoal treatments and non-charcoal treatments across all rating dates and all herbicides showed significant differences across most evaluation dates with the exception of 1 WAE (Table 1). Although we were only able to attain approximately 60% cover in the best plots due to the late planting date, we believe that 6 weeks of proper growing conditions should be sufficient to attain full cover using this technique. An interesting aspect of our studies was that diuron-treated plots performed better than oxadiazon and prodiamine. These results suggest that herbicides may bind differentially to the activated charcoal. Experiments to test this hypothesis will be conducted this winter.

Table 4. Percent turfgrass coverage, as determined by digital image analysis of 'Princess' bermudagrass plots treated with activated charcoal and various pre-emerge herbicides..

| | 1WAE* | 2WAE | 3WAE | 4WAE | 6WAE |
|---|---|---|---|---|---|
| **Charcoal** | | | cover (%) | | |
| Control | 1.20 | 10.00 | 20.30 | 33.98 | 44.20 |
| Diuron | 1.29 | 7.50 | 20.35 | 35.73 | 51.28 |
| Oxadiazon | 0.47 | 3.00 | 5.80 | 10.06 | 23.65 |
| Prodiamine | 0.92 | 7.25 | 10.63 | 19.50 | 34.88 |
| LSD (0.05) | 1.72 | 5.74 | 10.29 | 16.73 | 20.06 |
| **Non-Charcoal** | | | | | |
| Control | 0.30 | 2.75 | 9.13 | 20.18 | 33.98 |
| Diuron | 0 | 0 | 0 | 0 | 0 |
| Oxadiazon | 0 | 0 | 0 | 0 | 0 |
| Prodiamine | 0 | 0 | 0 | 0 | 0 |
| LSD (0.05) | 0.20 | 1.20 | 3.94 | 7.28 | 19.36 |

* WAE - weeks after emergence

**Hypothesis 3** - *Seeding date has a significant impact on morphology and freeze tolerance of newly seeded bermudagrass*

The overall approach for this study was to plant a replicated test containing all the seeded bermudagrasses mentioned above on a monthly basis through the growing season. The experiment was successfully planted near April 15, May 15, June 15, July 15, and Aug. 15. Each plot was seeded at 0.5 pound of seed per 1000 $ft^2$. A uniform stand was attained for each planting date and data collected on germination, stand establishment and turf quality (data not shown). These plots will be evaluated in the coming months for morphological development and freeze tolerance, as outlined in the original proposal. In addition, winter-kill and spring recovery of field plots will be assessed for 2 months in the 2001 growing season and reported in next year's summary.

**Hypothesis 4** - *Seeding rate has a significant impact on morphology and freeze tolerance of newly seeded bermudagrass.*

The six bermudagrass cultivars were seeded on July 15 at either 0.25, 0.50, or 1.0 lbs. seed per 1000 $ft^2$. The late planting date was again the result of heavy June rains which washed out the first attempt at this study. A uniform stand was attained for each planting rate and data was collected on germination, stand establishment and turf quality (data not shown). These plots will be evaluated in the coming months for morphological development and freeze tolerance, as outlined in the original proposal. In addition, winter-kill and spring recovery of field plots will be assessed for 2 months in the 2001 growing season and reported in next year's summary.

**Hypothesis 5** - *Post-emergent applications of fertilizers and growth regulators has a significant impact on morphology and freeze-tolerance of newly seeded bermudagrass*

A field study to examine the effects of nitrogen fertilization and the use of trinexapac-ethyl on morphological development and cold tolerance of seeded bermudagrasses was initiated on a newly seeded 'Princess' bermudagrass (planted May 25). Nitrogen was applied as urea and repeated monthly through August, monthly through September, or monthly through October. The trinexapac-ethyl treatments included: 1) monthly applications at 0.38 oz / 1000 $ft^2$ , 2) bi-weekly applications at 0.19 oz. / 1000 $ft^2$ or 3) no growth regulator. Data on turf quality and turf cover were collected throughout the growing season, with N and growth regulator both having a significant effect on turf quality and cover. In addition, both N and trinexapac-ethyl delayed the dormancy of the turf (data not presented). These plots will be evaluated in the coming months for morphological development and freeze tolerance, as outlined in the proposal. In addition, winter-kill and spring recovery of field plots will be assessed for 2 months in the 2001 growing season and reported in next year's summary.

**Hypothesis 6** - *Post-planting growing degree day units correlate to morphological development and cold tolerance in seeded bermudagrass*

Data on morphology and freeze tolerance collected from the seeding date study will be used to develop a growing-degree-day model regarding planting date for seeded bermudagrasses. Although preliminary work on this model will begin following data collection this winter, this will likely not be completed until data from both years is collected.

**Reference cited**

Richardson, M.D., D.E. Karcher, and L.A. Purcell. Using digital image analysis to quantify turfgrass cover. Crop Science (submitted)

Appendix to 2000 USGA Summary - Richardson, Boyd, and Karcher

Projected plan of work for this project, as submitted in the original proposal. As noted in the above summary text, all components of this project are currently at the expected point in the work plan

| | 2000 | | | | | | | | | | | | 2001 | | | | | | | | | | | | 2002 | | | | | | | | | | | |
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| | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D |
| Planning / Field Prep | | ■ | ■ | | | | | | | | | | | ■ | ■ | | | | | | | | | | | | | | | | | | | | | |
| Weed Control Studies | | | | | ■ | ■ | ■ | ■ | | | | | | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| Seeding Rate Study | | | | | ■ | ■ | ■ | ■ | | | | | | | | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| Seeding Date Study | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| Management Studies | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | |
| Management Treatments | | | | | | ■ | ■ | ■ | ■ | ■ | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | |
| Assess Morphology | | | | | | | | | | | | ■ | ■ | | | | | | | | | | | ■ | ■ | | | | | | | | | | | |
| Cold Tolerance Tests | | | | | | | | | | | | | ■ | ■ | | | | | | | | | | | ■ | ■ | | | | | | | | | | |
| GDD Model | | | | | | | | | | | | | | | ■ | ■ | ■ | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | | | | |
| Present Data (ASA meeting) | | | | | | | | | | | ■ | | | | | | | | | | | | ■ | | | | | | | | | | | ■ | | |
| Progress Reports | | | ■ | | | | | | | | ■ | | | | | | ■ | | | | | | ■ | | | | ■ | | | | | | | | ■ | |
| Popular and Scientific Publications | | | | | | | | | | | ■ | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |