Final Report
Application Placement Technologies for Vegetation Management on North Carolina Roadsides

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16. Abstract

Research experiments were designed and initiated to determine if application placement technologies offer a viable solution for vegetation management along North Carolina Roadsides. Select equipment was evaluated for broomsedge (*Andropogon virginicus*) control in centipedegrass rights of way as well as for plant growth regulator applications along tall fescue (*Festuca arundinacea*) or bahiagrass (*Paspalum notatum*) roadsides in North Carolina. Research experiments were repeated in time. Evaluated application placement technologies included equipment which incorporated mowing into the pesticide or plant growth regulator application as well as equipment that only wiped the foliage.

Much important data were collected and will aid in devising a more complete vegetation management program for North Carolina Roadsides. Additionally, through this research, control options which incorporate application placement technologies were identified for broomsedge control along North Carolina roadsides. This is extremely important for NC DOT as control options had not been identified prior to completing this research. It appears Burch Wet Blade (also known as Diamond Wet Blade) would be the best fit for broomsedge control along centipedegrass roadsides in North Carolina. With glyphosate (2 qt/a) applied through Burch Wet Blade at one gallon per acre mown at four inches, we were able to obtain 90% broomsedge control through one year after treatment. As for plant growth regulator applications along tall fescue or bahiagrass roadsides with application placement technologies, in no instance were application placement technologies advantageous to a conventional broadcast spray application. These data indicate application placement equipment would be beneficial to certain aspects of vegetation management along North Carolina roadsides.

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SUMMARY

Research experiments were designed and initiated to determine if application placement technologies offer a viable solution for vegetation management along North Carolina Roadsides. Select equipment was evaluated for broomsedge (*Andropogon virginicus*) control in centipedegrass rights of way as well as for plant growth regulator applications along tall fescue (*Festuca arundinacea*) or bahiagrass (*Paspalum notatum*) roadsides in North Carolina. Research experiments were repeated in time. Evaluated application placement technologies included equipment which incorporated mowing into the pesticide application as well as equipment that only wiped the foliage.

Much important data were collected and will aid in devising a more complete vegetation management program for North Carolina Roadsides. Additionally, through this research, control options which incorporate application placement technologies were identified for broomsedge control along North Carolina roadsides. This is extremely important for North Carolina Department of Transportation - Roadside Environmental Unit as control options had not been identified prior to completing this research.

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INTRODUCTION

Centipedegrass (*Eremochloa ophiuroides*) comprises approximately 10% of the roadside turf in North Carolina, mostly in the coastal plain region (1999 North Carolina Turfgrass Survey). Bahiagrass (*Paspalum notatum* L.) was the preferred standard along roadsides in the coastal plain of North Carolina; however, the high mowing frequency and the presence of seedheads which obstruct motorist's vision throughout the summer led North Carolina Department of Transportation personnel to evaluate other species for a possible fit into the vegetation management program along North Carolina roadsides. With centipedegrass, there is a high potential for maintenance savings due to fewer inputs required. Centipedegrass requires no more that 44 pounds of nitrogen per acre per year and requires infrequent mowing. Additionally, it is adapted to a wide range of soil conditions but prefers sandy, acidic soils with pH ranging from 4.0 to 6.1 (Waddington 1992). These preferences of centipedegrass make it well suited for use along roadsides in eastern North Carolina, relative to other species including tall fescue (*Festuca arundinacea* Schreb.) or bahiagrass. More importantly, with centipedegrass as a primary turf in adapted regions, with its inconspicuous seedheads and reduced foliar height, motorist's visibility is not obstructed as with bahiagrass or tall fescue, hence, increasing motorist safety. Although well adapted to the coastal plain region of North Carolina, centipedegrass is suspect to become infested with broomsedge (*Andropogon virginicus*). Broomsedge is a clump-forming perennial grass species which can reach mature vegetative heights of 18 to 36 inches along roadsides which is objectionable because it is aesthetically unpleasing and obstructs motorist's view, hence, decreasing motorist safety. Broomsedge is extremely troublesome along roadsides as no selective herbicide exists for control along centipedegrass roadsides. The only current option for broomsedge control or suppression is mechanically mowing the areas contaminated with broomsedge. This practice only reduces the foliar growth temporarily and does not offer long term control of broomsedge.

Recently, there have been several equipment manufacturers which had developed application placement technology equipment. Commercially available equipment available at the time this research was initiated which utilizes this technology includes Burch Wet Blade, Weedbug, and Brown Brush Monitor. The Burch Wet Blade is currently available as "Wet Blade" by Diamond Mowers and the Brown Brush Monitor is available from Brown Manufacturing Corporation while the Weedbug is not currently available in the United States. Our research utilized Burch Wet Blade; therefore, it will be referred to as Burch Wet Blade within this report.

The Burch Wet Blade as well as the Weedbug function based on a height differential between the target weed species and the desired turf. The Burch Wet Blade uses a pump which supplies a pesticide solution though the drive shaft onto the cutting surface through ported holes. As the Burch Wet Blade mows, it applies a pesticide solution onto the cut plant surface with the aid of a Dickey John metering system. The Weedbug uses a series of discs which is comprised of wicks on the underside. The discs rotate at a speed such that pesticide solution does not leave the wicks but the rotation allows more uniform coverage of the pesticide solution onto the plant surface. The Weedbug only wipes foliage and does not mow. The Brown Brush Monitor does not use

the height differential; rather it combines mowing and herbicide treatment in a single pass using a typical rotary cutter which has a chamber on the rear of the deck. Within the chamber, there are spray nozzles which spray a pesticide or plant growth regulator solution onto a series of brushes which wipe the cut foliage after mowing in a single pass.

As mentioned earlier, broomsedge will reach mature vegetative heights of 18 to 36 inches while centipedegrass only reaches heights of four to eight inches, indicating the height differential is present in this situation. The Burch Wet Blade and Weed Bug may offer a solution to broomsedge control in centipedegrass; however, no published data is currently available either supporting or opposing this claim.

Tall fescue and bahiagrass roadsides comprise 38% and 25%, respectively of managed turf along roadsides in North Carolina (1999 North Carolina Turfgrass Survey). As previously mentioned, tall fescue and bahiagrass produce seedheads which obstruct motorist's vision while traveling through North Carolina. However, plant growth regulators have been implemented in recent years and provide complete season-long vegetative and seedhead suppression. With the use of plant growth regulators, not only is motorist safety increased, but maintenance budgets are significantly reduced as mowing cycles are reduced. Plant growth regulators have been broadcast applied in the past; however, it may be possible to apply plant growth regulators through application placement technologies. Since the pesticide solution is applied to a cut leaf surface, it may be possible for increased efficacy compared to broadcast applications as the plant growth regulator would not be as dependent on absorption for efficacy. This could potentially impact the use of plant growth regulators along roadsides as broadcast applications are dependent on environmental conditions to a degree due to limited activity when plants are under environmental stress. The prime example of this is many plants under drought stress fail to uptake and translocate herbicides and plant growth regulators resulting in limited or no results. The application placement technologies could possibly prevent absorption from being a limiting factor. Also, the potential exists for additional savings if you are able to use reduced rates of pesticides and plant growth regulators and receive similar results. It is feasible you could use reduced rates as the product is not relying on absorption. Again, no published data either supporting or opposing this claim is available.

The objectives of this research were to determine if application placement technologies offer a viable solution for broomsedge control along centipedegrass roadsides as well as to determine if this equipment were advantageous for plant growth regulator applications along tall fescue or bahiagrass roadsides. The data collected from these research trials will contribute to devising a sound vegetation management plan for North Carolina roadsides.

MATERIALS AND METHODS

Broomsedge Control along North Carolina Roadsides with Application Placement Technologies. Experiments were conducted to evaluate selective and non-selective herbicides applied through application placement technologies for broomsedge control along North Carolina roadsides. Field experiments were initiated in Nash County on September 04 2002 and August 04 2004, Alamance County on August 13 2003 and August 23 2005, and Guilford County on August 24 2005 for a total of five research trials

over four years (Table 1). Experiments were arranged in a randomized complete block design and were replicated three times. Evaluated application placement technologies included Brown Brush Monitor, Burch Wet Blade, and Weedbug. Application placement technologies were compared to conventional wick applications and mowing for broomsedge control as this has been the NC DOT standard prior to this research. Research trial sites were selected based on uniform populations of broomsedge and trials were initiated when broomsedge was 12" – 36" in height, in the boot stage. Additionally, the Brown Brush Monitor was evaluated only in 2002 as it was not available for subsequent years. Also, the Weedbug was not operational in 2005; therefore, data were collected only during 2002, 2003 and 2004.

Brown Brush Monitor and Burch Wet Blade treatments were mown to a height of 4" – 6" while Weedbug and conventional wick application were wiped at 6". The Brown Brush Monitor treatments were applied at 13 gallons per acre (GPA), Weedbug and Burch Wet Blade at 1 GPA and conventional wick treatments at 2.5, unless otherwise noted. Evaluated herbicides applied through application placement technologies included glyphosate (Roundup Pro 4L), MSMA (MSMA 6L), and hexazinone (Velpar 2L). Glyphosate was evaluated at 1 and 2 quarts product per acre (qt/a), MSMA at 2 pounds active ingredient per acre (lb ai/a), and hexazinone at 1.5 lb ai/a. These treatments were evaluated in five research trials over four years.

Broomsedge Control Along North Carolina Roadsides with Burch Wet Blade Evaluated at Four and Eight Inch Mowing Height (2004 - 2005). Additionally, in 2004 and 2005, the Burch Wet Blade was evaluated with Roundup Pro (2 qt/a) at four versus eight inch mowing height to determine if broomsedge control was effected by mowing height.

Broomsedge Control Along North Carolina Roadsides with Burch Wet Blade Evaluated at One Versus Two GPA Application Volume (2004 – 2005). Also evaluated in 2004 and 2005, the Burch Wet Blade was evaluated with Roundup Pro with application volumes of one versus two GPA to determine if broomsedge control differences could be discerned. The herbicide solution was mixed identically, hence, one and two GPA resulted in two or four qt/a, respectively.

Broomsedge control research trials were evaluated at one month and one year after treatment. Visual estimations of percent broomsedge control were collected and data were analyzed using SAS. Where appropriate, research trial data were pooled over years and locations.

Plant Growth Regulator Applications along Tall Fescue and Bahiagrass Roadsides in North Carolina with Application Placement Technologies. Experiments were conducted to evaluate plant growth regulators applied through application placement technologies for tall fescue and bahiagrass seedhead suppression along North Carolina roadsides. Tall fescue seedhead suppression field experiments were initiated on April 16 and April 29 2003 along I-77 in Elkin and US220 in Guilford County, respectively (Table 2). Additionally, research trials were initiated on April 13 and April 19 2004 along US25 in Madison County and US220 in Guilford County, respectively. Experiments were

arranged in a randomized complete block design and included three replicates with plot sizes ranging from 800 - 2800 ft^2.

Bahiagrass seedhead suppression field experiments were initiated on May 19 and June 01 2003 along US220 in Montgomery County (Table 3). Research trials were repeated in 2004 (initiated May 24 and June 01 2004) at Fort Bragg. Experiments were arranged in a randomized complete block design and included three replicates with plot sizes ranging from 1000 to 2300 ft^2.

Each of the seedhead suppression trials were initiated when the bahiagrass or tall fescue was in the boot stage prior to seedhead emergence. Tall fescue and bahiagrass ranged from six to eight inches in foliar height at trial initiation. Additionally, Brown Brush Monitor and Burch Wet Blade plots were mown at four inches while Weedbug only wiped foliage. Brown Brush Monitor treatments were applied at 13 GPA while Weedbug and Burch Wet Blade treatments were applied at 1 GPA. Conventional broadcast treatments were applied at 20 GPA.

Evaluated treatments along bahiagrass roadsides included: 0.5, 2, or 3 ounces product per acre (oz/a) imazapic (Plateau 2AS) and 0.5 oz/a sulfometuron (Oust 75WG). Imazapic (Plateau 2AS) was evaluated at 0.5, 2, or 3 oz/a as well as chlorsulfuron plus mefluidide (Telar 75DF plus Embark 2L) at 0.125 oz/a + 0.5 pint per acre (pt/a) along tall fescue roadsides.

Due to mechanical failure, no Burch Wet Blade data were collected from trial initiated on April 16 2003 (tall fescue). Additionally, trial initiated on April 29 2003 (tall fescue) was destroyed by contract mowing crews; therefore, no data were collected. Within each trial, seedhead counts were collected at monthly intervals throughout the growing season by counting seedheads present in a specified area. Data collected were analyzed using SAS and where appropriate, research trial data were pooled over years and locations.

FINDINGS AND CONCLUSIONS

Broomsedge Control along North Carolina Roadsides with Application Placement Technologies (2002). Statistical analysis prevented pooling data across all four years with broomsedge control data. However, only 2002 was an outlier and pooling among years 2003, 2004, and 2005 was permitted. Therefore, data are presented for 2002 separately and combined for 2003, 2004, and 2005. Efforts will be made to explain why 2002 was an outlier later in the discussion.

At one month after treatment in 2002 initiated trial, most treatments were providing fair to good broomsedge control (Table 4). Specifically, all treatments applied through the Brown Brush Monitor, Weedbug, or the wick applicator provided between 67 and 82% broomsedge control. Treatments applied through Burch Wet Blade were providing 27 - 75% broomsedge control while the mowed nontreated provided no broomsedge control at one month after treatment. Little will be discussed about one month after treatment data as long term (one year) broomsedge control is most important.

At one year after treatment in 2002 initiated trial, no application placement equipment was providing significant broomsedge control, regardless of herbicide used with many treatments provided 0% broomsedge control (Table 5). Further, glyphosate (2 qt/a) or hexazinone (1.5 lb ai/a) applied through Brown Brush Monitor provided 20 –

25% broomsedge control at one year after treatment. Again, at one year after treatment in 2002 initiated trial, no evaluated treatments provided significant broomsedge control.

Broomsedge Control along North Carolina Roadsides with Application Placement Technologies (2003 - 2005). Again, statistical analysis allowed pooling of data across years and locations for trials initiated in 2003, 2004, and 2005 (4 trials); therefore, data will be presented and discussed accordingly. Further, the interaction among application placement equipment and herbicide was significant and will be presented. At one month after treatment in 2003, 2004, and 2005 initiated trials, several treatments were providing fair to good broomsedge control (Table 6). Applied through Burch Wet Blade, glyphosate (2 qt/a) provided greater control (85%) than hexazinone (75%) or MSMA (70%) although glyphosate at 1 and 2 qt/a were statistically similar. Applied through Weedbug, glyphosate (2 qt/a) and hexazinone provided 87% control along with MSMA providing 90% control which was greater than glyphosate at 1 qt/a (75%).

Applied through wick applicator, only glyphosate (2 qt/a) provided greater than 75% broomsedge control although glyphosate at 1 and 2 qt/a were statistically similar. Additionally, the mowed nontreated provided 37% broomsedge control at one month after treatment.

Glyphosate applied at 1 or 2 qt/a as well as hexazinone provided greater control when applied through Burch Wet Blade or Weedbug as compared to wick applicator. Additionally, MSMA provided greater control when applied through Weedbug (90%) compared to Burch Wet Blade (70%) which was greater compared to wick applicator (52%).

At one year after treatment in 2003 – 2005 initiated trials, Burch Wet Blade application of glyphosate (2 qt/a) and hexazinone provided 90 and 80% broomsedge control, respectively, while glyphosate (1 qt/a) and MSMA only provided 56 – 66% control, respectively. Additionally, with glyphosate (2 qt/a) applied with Weedbug, 85% control was obtained while other herbicide treatments only provided 62 – 78% broomsedge control, although not significantly reduced. Similar to one month after treatment, no herbicide applied with wick applicator provided greater than 53% broomsedge control, one year after treatment.

Excluding glyphosate (1 qt/a), all herbicides provided greater broomsedge control when applied through Burch Wet Blade or Weedbug as opposed to wick applicator. Additionally, glyphosate (1 qt/a) applied through Weedbug provided greater broomsedge control compared to wick applicator.

These data indicate herbicide selection is important and should be based on which application placement equipment is being utilized as differences exist. Further, it confirmed wick applicators only provide fair control, at best, of tough to control perennial weeds as we consistently observed reduced broomsedge control with herbicides applied through wick applicator as opposed to other application methods. Reduced control with wick applicators may be due in part to non-uniform herbicide application as it is extremely difficult to obtain when there is a high weed infestation. In general, we observed similar results with herbicides applied through Burch Wet Blade and Weedbug. As far as differences among 2002 initiated trial versus trials initiated 2003 - 2005, in 2002, the trial was initiated in September while subsequent trials were initiated in mid-August, possibly indicating that timing is extremely crucial to results obtained with these

equipment for broomsedge control. Although timing may be important, it would be difficult for applications to begin prior to mid-August as the height differential is not likely to be present earlier in the growing season. In conclusion, these data indicate glyphosate (2 qt/a) applied through Burch Wet Blade or Weedbug would offer acceptable broomsedge control through one year after treatment. It is likely that subsequent applications, or a multi-year approach, would be necessary to gain long-term broomsedge control along North Carolina roadsides.

Broomsedge Control Along North Carolina Roadsides with Burch Wet Blade Evaluated at Four and Eight Inch Mowing Height (2004 - 2005). At one year after treatment, four and eight inch mowing height provided 92 and 83% broomsedge control, respectively, which were statistically similar (Table 8). These data indicate increasing the mowing height from four inches to eight did not enhance broomsedge control.

Broomsedge Control Along North Carolina Roadsides with Burch Wet Blade Evaluated at One Versus Two GPA Application Volume (2004 - 2005). At one year after treatment, with glyphosate applied through Burch Wet Blade at one versus two GPA, no differences in broomsedge control were present indicating it is likely feasible to utilize either application volume (Table 9).

Application Placement Technologies for Plant Growth Regulator Applications along Tall Fescue Roadsides in North Carolina. At one month after treatment, excluding imazapic (0.5 oz/a) or mefluidide + chlorsulfuron applied through Burch Wet Blade, all plant growth regulators and application placement equipment provided 98 – 100% tall fescue seedhead suppression compared to the nontreated (Table 10). Mefluidide + chlorsulfuron applied through Burch Wet Blade was reduced numerically (87%) compared to other application placement equipment. However, imazapic (0.5 oz/a) applied through Burch Wet Blade was reduced (76%) compared to other application placement equipment. Again, the 0.5 oz/a of imazapic rate was included to determine if reduced rates of plant growth regulators would provide acceptable results as 2 – 3 oz/a of imazapic is the standard broadcast application rate. Additionally, mechanical mowing provided 23% tall fescue seedhead suppression at one month after treatment. At two months after trial initiation, all plant growth regulators and application placement equipment provided excellent (91 – 100%) tall fescue seedhead suppression while mechanical mowing provided 36% (Table 11). Additionally, at three months after treatment, all plant growth regulators and application placement equipment provided complete tall fescue seedhead suppression while mechanical mowing provided 12% (Table 12).

These data indicate application placement equipment along with standard plant growth regulators may provide tall fescue seedhead suppression similar to that obtained with conventional broadcast applications.

Application Placement Technologies for Plant Growth Regulator Applications along Bahiagrass Roadsides in North Carolina. At two months after treatment, broadcast spray applications of imazapic (2 or 3 oz/a) as well as sulfometuron were providing 100% bahiagrass seedhead suppression (Table 13). Further, imazapic (2 oz/a) applied through

Burch Wet Blade and Weedbug provided 90 and 82% bahiagrass seedhead suppression, respectively, while 3 oz/a imazapic provided 100 and 90% applied through Burch Wet Blade and Weedbug, respectively, each of which were statistically similar to broadcast applications. Sulfometuron provided approximately 90% bahiagrass seedhead suppression applied through Burch Wet Blade or Weedbug. Imazapic (0.5 oz/a) applied through Burch Wet Blade provided only 40% bahiagrass seedhead suppression which was reduced compared to broadcast and Weedbug applications while mechanical mowing provided 0% bahiagrass seedhead suppression at two months after treatment.

At three months after trial initiation, broadcast applications of imazapic (2 or 3 oz/a) and sulfometuron provided 98 – 100% bahiagrass seedhead suppression (Table 14). Imazapic (2 oz/a) applied through Burch Wet Blade (83%) and Weedbug (79%) did not provide complete seedhead suppression. Further, imazapic (3 oz/a) applied through Burch Wet Blade and Weedbug provided 96 and 89% bahiagrass seedhead suppression, respectively, but were similar to broadcast applications. Similarly, sulfometuron only provided about 80% bahiagrass seedhead suppression applied through Burch Wet Blade and Weedbug although they were not significantly reduced, compared to broadcast applications. The reduced rate of imazapic (0.5 oz/a) applied through Weedbug provided 95% bahiagrass seedhead suppression similar to 83% with broadcast applications. However, applied through Burch Wet Blade bahiagrass seedhead suppression was reduced.

Similar to tall fescue seedhead suppression, these data indicate application placement equipment do not enhance bahiagrass seedhead suppression along North Carolina roadsides and, in certain instances, reduce bahiagrass seedhead suppression when compared to conventional broadcast applications. Therefore, it is not advised to integrate application placement equipment into the tall fescue or bahiagrass seedhead suppression portion of the integrated vegetation management plan.

RECOMMENDATIONS AND TECHNOLOGY IMPLEMENTATION

It is imperative to incorporate these data into the North Carolina Department of Transportation integrated vegetation management plan for roadsides. These data indicate that application placement technologies offer a viable solution for broomsedge control along centipedegrass roadsides which has been an area of concern for several years as selective control options do not exist. It appears Burch Wet Blade (also known as Diamond Wet Blade) would be the best fit for broomsedge control along North Carolina roadsides. With glyphosate (2 qt/a) applied through Burch Wet Blade at 1 GPA mown at 4 inches, we were able to obtain 90% broomsedge control through one year after treatment. It is imperative to develop these programs into a multi-year approach as these data extend to one year after treatment and do not take into account broomsedge plants which are propagated the following years as glyphosate does not provide residual activity. It is also imperative to encourage the health of the desired turf species as the best defense against any weed infestation is to maintain a healthy, vigorous, competitive turf; therefore, any cultural practices which can be completed to encourage the centipedegrass health would be advantageous. The Weedbug also provided good control with glyphosate; however, this unit is no longer commercially available in the United States.

As for plant growth regulator applications along tall fescue or bahiagrass roadsides with application placement technologies, in no instance were application placement technologies advantageous to a conventional broadcast spray application. Additionally, with the success of the broadcast applied plant growth regulator program, it is not suggested to integrate application placement technologies as tall fescue or bahiagrass seedhead suppression was not enhanced nor were plant growth regulator application rates able to be reduced. Although efficacy was not enhanced, a possible advantage to application placement technologies for plant growth regulator applications and general weed control may be that Burch Wet Blade combines mowing and plant growth regulator application into a single pass. Additionally, with each of the application placement equipment, it is somewhat of a hidden application as the general population traveling along North Carolina roadsides would most likely not associate these application placement equipment with a pesticide application as they routinely do with broadcast application equipment.

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APPENDICES

Table 1. Application Placement Technologies for Broomsedge Control along North Carolina Roadsides Research Trials Sites and Initiation Date.

Year	Initiation date	Plot size	Location
2002	September 04 2002	2000ft^2	US264/Nash County
2003	August 13 2003	1000ft^2	Fallow field/Alamance County
2004	August 04 2004	1200ft^2	US264/Nash County
2005	August 23 2005	1000ft^2	Fallow field/Alamance County
2005	August 24 2005	1000ft^2	Fallow field/Guilford County

Table 2. Application Placement Technologies for Seedhead Suppression along Tall Fescue Roadsides in North Carolina Research Trial Sites and Initiation Date.

Year	Initiation date	Plot size	Location
2003	April 16 2003	2800ft^2	I-77/Elkin
2003	April 29 2003	1600ft^2	US220/Guilford County
2004	April 13 2004	800ft^2	US25/Madison County
2004	April 19 2004	800ft^2	US220/Guilford County

Table 3. Application Placement Technologies for Seedhead Suppression along Bahiagrass Roadsides in North Carolina Research Trial Sites and Initiation Date.

Year	Initiation date	Plot size	Location
2003	May 19 2003	2300ft^2	US220/Montgomery County
2003	June 01 2003	2000ft^2	US220/Montgomery County
2004	May 24 2004	1000ft^2	Fort Bragg Air Strip
2004	June 01 2004	1000ft^2	Fort Bragg Air Strip

Table 4. Broomsedge control along North Carolina roadsides at one month after treatment (2002).

	Application Placement Equipment					
Herbicide	**Brown Brush Monitor**	**Burch Wet Blade**	**Weedbug**	**Wick Applicator**	**Mowed Nontreated**	**Nontreated**
	---------- % Broomsedge Control ----------					
glyphosate 1 qt	**73 abc**	**35 d**	**78 ab**	**80 a**	-	-
glyphosate 2 qt	**78 ab**	**75 abc**	**70 abc**	**82 a**	-	-
hexazinone 1.5 lb ai	**80 a**	**65 c**	**75 abc**	**67 bc**	-	-
MSMA 2 lb ai	**78 ab**	**27 de**	**82 a**	**80 a**	-	-
	-	-	-	-	**0 e**	**0 e**

Means within a column followed by the same letters are not significantly different according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre.

Table 5. Broomsedge control along North Carolina roadsides at one year after treatment (2002).

	Application Placement Equipment					
Herbicide	**Brown Brush Monitor**	**Burch Wet Blade**	**Weedbug**	**Wick Applicator**	**Mowed Nontreated**	**Nontreated**
	---------- % Broomsedge Control ----------					
glyphosate 1 qt	**13 a**	**0 a**	**0 a**	**0 a**	-	-
glyphosate 2 qt	**22 a**	**7 a**	**0 a**	**7 a**	-	-
hexazinone 1.5 lb ai	**23 a**	**10 a**	**0 a**	**0 a**	-	-
MSMA 2 lb ai	**0 a**	**0 a**	**0 a**	**0 a**	-	-
	-	-	-	-	**0 e**	**0 e**

Means within a column followed by the same letters are not significantly different according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre.

Table 6. Broomsedge control along North Carolina roadsides at one month after treatment (Averaged over years 2003 - 2005).

	Application Placement Equipment					
Herbicide	**Burch Wet Blade**	**Weedbug**	**Wick Applicator**	**Mowed Nontreated**	**Nontreated**	**LSD (P=0.05)**
	---------- % Broomsedge Control ----------					
glyphosate 1 qt	**76**	**75**	**58**	**-**	**-**	**10.5**
glyphosate 2 qt	**85**	**87**	**76**	**-**	**-**	**7.7**
hexazinone 1.5 lb ai	**75**	**87**	**54**	**-**	**-**	**17.1**
MSMA 2 lb ai	**70**	**90**	**52**	**-**	**-**	**9.7**
	-	-	-	**37**	**0**	-
LSD (P=0.05)	**9.8**	**11.5**	**18.1**	**13.1**	-	-

LSDs within a column correspond with means within application placement equipment while LSDs within a row correspond with herbicide selection. Means followed by the same letters are not significantly different according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre. Weedbug data included 2002, 2003 and 2004 only as it was not operational in 2005. Additionally, Brown Brush Monitor was not available after 2002; therefore, no further data were collected.

Table 7. Broomsedge control along North Carolina roadsides at one year after treatment (Averaged over years 2003 - 2005).

	Application Placement Equipment					
Herbicide	**Burch Wet Blade**	**Weedbug**	**Wick Applicator**	**Mowed Nontreated**	**Nontreated**	**LSD (P=0.05)**
	---------- % Broomsedge Control ----------					
glyphosate 1 qt	**56**	**66**	**39**	**-**	**-**	**15.8**
glyphosate 2 qt	**90**	**85**	**53**	**-**	**-**	**10.3**
hexazinone 1.5 lb ai	**80**	**78**	**50**	**-**	**-**	**11.8**
MSMA 2 lb ai	**66**	**62**	**36**	**-**	**-**	**15.2**
	-	-	-	**30**	**0**	-
LSD (P=0.05)	**17.8**	**26.7**	**21.5**	**9.5**	-	-

LSDs within a column correspond with means within application placement equipment while LSDs within a row correspond with herbicide selection. Means followed by the same letters are not significantly different according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre. Weedbug data included 2002, 2003 and 2004 only as it was not operational in 2005. Additionally, Brown Brush Monitor was not available after 2002; therefore, no further data were collected.

Table 8. Effect of Burch Wet Blade mowing height on broomsedge control along North Carolina roadsides at one year after treatment (Averaged over years 2004 - 2005).

	Application Placement Equipment
Mowing Height (inches)	Burch Wet Blade (Roundup Pro 2 qt)
	---------- % Broomsedge Control ----------
4	92
8	83
LSD (P=0.05)	NS

LSDs were calculated according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre. These data are based on three research trials initiated in 2004 and 2005. NS indicates nonsignificance.

Table 9. Effect of Burch Wet Blade application volume on broomsedge control along North Carolina roadsides at one year after treatment (Averaged over years 2004 - 2005).

	Application Placement Equipment
Application Volume (gallons per acre)	Burch Wet Blade (Roundup Pro 2 or 4 qt)
	---------- % Broomsedge Control ----------
1	89
2	92
LSD (P=0.05)	NS

LSDs were calculated according to Fisher's Protected LSD test at P =0.05. Percent broomsedge control was based on visual estimates and utilized a 0% (no control) to 100% (complete death) scale. Herbicide rates are expressed per acre. These data are based on three research trials initiated in 2004 and 2005. Treatments were mixed identically; however, application volume varied, hence 1 gallon per acre (application volume) resulted in the equivalent broadcast rate of Roundup Pro at 2 qt while 2 gallons per acre resulted in Roundup Pro 4 qt. NS indicates nonsignificance.

Table 10. Tall fescue seedhead suppression with plant growth regulators applied through application placement technologies compared to broadcast applications along North Carolina roadsides at one month after treatment (Averaged over years 2003 - 2004).

	Plant Growth Regulator			
application placement equipment	imazapic (0.5 oz)	imazapic (2 oz)	imazapic (3 oz)	mefluidide + chlorsulfuron (.5 pt + .125 oz)
	---------- % Tall Fescue Seedhead Suppression ----------			
Burch Wet Blade	76 b	99 a	100 a	87 a
Weedbug	100 a	100 a	100 a	100 a
broadcast spray	99 a	100 a	100 a	98 a
mowed nontreated	23 c	23 b	23 b	23 b

Means within a column followed by the same letters are not statistically different according to Fisher's Protected LSD (P=0.05). Percent tall fescue seedhead suppression was calculated by comparing number of seedheads present in treated versus nontreated areas. Plant growth regulator rates are expressed per acre. These data are based on three research trials initiated in 2003 and 2004. Additionally, Burch Wet Blade data are based only on two trials in 2004 as equipment was not functional in 2003. Each treatment included a non-ionic surfactant (0.25 % vol/vol).

Table 11. Tall fescue seedhead suppression with plant growth regulators applied through application placement technologies compared to broadcast applications along North Carolina roadsides at two months after treatment (Averaged over years 2003 - 2004).

	Plant Growth Regulator			
application placement equipment	imazapic (0.5 oz)	imazapic (2 oz)	imazapic (3 oz)	mefluidide + chlorsulfuron (.5 pt + .125 oz)
	---------- % Tall Fescue Seedhead Suppression ----------			
Burch Wet Blade	93 a	98 a	100 a	91 a
Weedbug	100 a	100 a	100 a	100 a
broadcast spray	100 a	100 a	100 a	99 a
mowed nontreated	36 b	36 b	36 b	36 b

Means within a column followed by the same letters are not statistically different according to Fisher's Protected LSD (P=0.05). Percent tall fescue seedhead suppression was calculated by comparing number of seedheads present in treated versus nontreated areas. Plant growth regulator rates are expressed per acre. These data are based on three research trials initiated in 2003 and 2004. Additionally, Burch Wet Blade data are based only on two trials in 2004 as equipment was not functional in 2003. Each treatment included a non-ionic surfactant (0.25 % vol/vol).

Table 12. Tall fescue seedhead suppression with plant growth regulators applied through application placement technologies compared to broadcast applications along North Carolina roadsides at three months after treatment (Averaged over years 2003 - 2004).

	Plant Growth Regulator			
application placement equipment	imazapic (0.5 oz)	imazapic (2 oz)	imazapic (3 oz)	mefluidide + chlorsulfuron (.5 pt + .125 oz)
	---------- % Tall Fescue Seedhead Suppression ----------			
Burch Wet Blade	100 a	100 a	100 a	100 a
Weedbug	100 a	100 a	100 a	100 a
broadcast spray	100 a	100 a	100 a	100 a
mowed nontreated	12 b	12 b	12 b	12 b

Means within a column followed by the same letters are not statistically different according to Fisher's Protected LSD (P=0.05). Percent tall fescue seedhead suppression was calculated by comparing number of seedheads present in treated versus nontreated areas. Plant growth regulator rates are expressed per acre. These data are based on three research trials initiated in 2003 and 2004. Additionally, Burch Wet Blade data are based only on two trials in 2004 as equipment was not functional in 2003. Each treatment included a non-ionic surfactant (0.25 % vol/vol).

Table 13. Bahiagrass seedhead suppression with plant growth regulators applied through application placement technologies compared to broadcast applications along North Carolina roadsides at two months after treatment (Averaged over years 2003 - 2004).

	Plant Growth Regulator			
application placement equipment	imazapic (0.5 oz)	imazapic (2 oz)	imazapic (3 oz)	sulfometuron (0.5 oz)
	---------- % Bahiagrass Seedhead Suppression ----------			
Burch Wet Blade	40 b	90 a	100 a	87 a
Weedbug	87 a	82 a	90 a	93 a
broadcast spray	93 a	100 a	100 a	100 a
mowed nontreated	0 b	0 b	0 b	0 b

Means within a column followed by the same letters are not statistically different according to Fisher's Protected LSD (P=0.05). Percent tall fescue seedhead suppression was calculated by comparing number of seedheads present in treated versus nontreated areas. Plant growth regulator rates are expressed per acre. These data are based on four research trials initiated in 2003 and 2004. Each treatment included a non-ionic surfactant (0.25 % vol/vol).

Table 14. Bahiagrass seedhead suppression with plant growth regulators applied through application placement technologies compared to broadcast applications along North Carolina roadsides at three months after treatment (Averaged over years 2003 - 2004).

	Plant Growth Regulator			
application placement equipment	imazapic (0.5 oz)	imazapic (2 oz)	imazapic (3 oz)	sulfometuron (0.5 oz)
	---------- % Bahiagrass Seedhead Suppression ----------			
Burch Wet Blade	60 b	83 b	96 a	82 a
Weedbug	95 a	79 b	89 a	81 a
broadcast spray	83 a	100 a	98 a	98 a
mowed nontreated	6 c	6 c	6 b	6 b

Means within a column followed by the same letters are not statistically different according to Fisher's Protected LSD (P=0.05). Percent tall fescue seedhead suppression was calculated by comparing number of seedheads present in treated versus nontreated areas. Plant growth regulator rates are expressed per acre. These data are based on four research trials initiated in 2003 and 2004. Each treatment included a non-ionic surfactant (0.25 % vol/vol).