Postemergence Control of Johnsongrass, Dallis Grass, and Purpletop in Tall Fescue

S. W. BINGHAM, W. J. CHISM, AND P. L. HIPKINS

Selective control of Johnsongrass was evaluated in tall fescue roadsides. Initially, two application techniques were evaluated: spot handgun applications and broadcast boom application using 281 L/ha (30 gal/acre). The selective herbicides showing good promise were fenoxaprop, sethoxydim, and primisulfuron. The standard glyphosate gave 100 percent control of both Johnsongrass and tall fescue (nonselective). Fenoxaprop contains isomers, and a preparation for the more active isomer was evaluated during later experiments (HOE 46360 05H, Hoechst-Roussel Agri-Vet Co.). Fenoxaprop (active isomer), nicosulfuron, and fenoxaprop were effective for Johnsongrass control with acceptable tall fescue quality for roadside cover. Nicosulfuron caused more injury than the fenoxaprop formulations. During 1991, fluazifop was tank mixed with fenoxaprop for excellent Johnsongrass control and caused low tall fescue injury, which resulted in improved turfgrass quality on the roadside. Dallis grass and purpletop were effectively controlled out of tall fescue highway turf with fenoxaprop plus fluazifop and imazethapyr plus imazapyr. Fenoxaprop and imazethapyr alone provided less-than-desirable control of both species.

During the last 10 years, Johnsongrass and Dallis grass have become important weeds along Virginia highways and have continued to increase in severity in recent years. Currently, glyphosate is being widely used in tall fescue and bermudagrass roadsides for control of these weeds. Handgun foliar applications are primarily used, and severe damage on the actively growing turfgrasses has resulted in recurring Johnsongrass and Dallis grass. Thus, the aggressive Johnsongrass and Dallis grass are not completely controlled with current herbicides (*1*). With severe damage to the tall fescue and bermudagrass, regrowth of Johnsongrass and Dallis grass has occurred with little competition.

The timing for herbicide application to provide excellent control of Johnsongrass and Dallis grass has been during June and July in Virginia (*2*) and Texas (*3*). Complete tall fescue control and 90 percent control of bermudagrass is encountered at this time with glyphosate. Even though Johnsongrass is controlled well, new seedlings emerge as well as some new plants from rhizomes that escaped treatment or where rainfall occurred soon after application, reducing effectiveness (*4,5*).

Imazapyr alone and in tank mixtures with other herbicides has provided substantial Johnsongrass control (*5,6*); however, this herbicide has failed to be widely accepted by departments of transportation. Fenoxaprop and sethoxydim were apparently promising for Johnsongrass control and required only a short time (4 hr) between application and rainfall to be efficacious (*4*). The objectives of these studies were to evaluate selective herbicide treatments for Johnsongrass and Dallis grass control while allowing tall fescue to fill in the space to reduce regrowth of weeds from seed or underground structures.

Plant Pathology, Physiology and Weed Science, Virginia Polytechnic Institute and State University, 418 Price Hall, Blacksburg, Va. 24061-0331.

MATERIALS AND METHODS

Several tests were conducted on Virginia primary and Interstate highway roadsides in tall fescue infested with 25 to 50 percent Johnsongrass or Dallis grass. The herbicides selected for these studies have shown promise for control of Johnsongrass in crop situations and included fenoxaprop, an active isomer of fenoxaprop, nicosulfuron, sethoxydim, fluazifop, primisulfuron, quizalofop, imazethapyr, imazethapyr plus imazapyr, and fenoxaprop plus fluazifop. Glyphosate was used as a standard.

Except for one study, the applications were made with a CO_2 backpack sprayer with a boom providing 281 L/ha (30 gal/acre). One study used a handgun technique to spray to wet the weed foliage. Three to four replications were used in a randomized complete block design with plots 183 by 366 cm (6 by 12 ft) or larger. The data collected included control ratings on a 0 to 10 scale where 0 = no control, 1 to 3 = slight symptoms, 4 to 6 = definite control but generally not acceptable, 7 to 9 = acceptable control to excellent, and 10 = complete control; injury ratings with similar scale; rhizome counts in 30.5 by 30.5 by 15.2 cm (1 ft by 1 ft by 6 in.) deep in soil; percent control; and quality ratings with a 1 to 9 scale where 5 = acceptable, 9 = best, and below 5 = less than acceptable turfgrass quality for roadsides.

RESULTS AND DISCUSSION

Selective Johnsongrass Control

Using the handgun technique to wet the foliage of Johnsongrass was the standard procedure for herbicide application at the department of transportation in Virginia. This technique would be most effective when the weed occurs in clumps and the clumps are scattered widely. Glyphosate was very effective for control of rhizome Johnsongrass; however, the tall fescue

TABLE 1 Johnsongrass Control in Tall Fescue Using Handgun Application

Treatments 7/6/88	Rate[b] g ai/379 L	Control Ratings[a] Johnsongrass Shoots 7/30	9/30	Rhizomes 9/30
Fenoxaprop	181	1.3 c	8.7 b	6.7 b
Sethoxydim + Crop oil con.	340 0.50% v/v	9.3 a	7.3 a	6.3 b
Primisulfuron + X-77	36 0.25% v/v	6.7 b	7.0 c	4.7 c
Glyphosate	2722	9.3 a	10.0 a	10.0 a
Check		1.0 c	0.0 d	0.0 d

[a] Control rating scale: 0 = no control, 1-3 = slight symptoms, 4-6 = definite control but generally not acceptable, 7-9 = acceptable control to excellent, 10 = complete control.

[b] To obtain lb ai/100 gal, multiply g ai by 0.002205, then L by 0.2642.

was completely controlled using 2722 g ai/379 L (6.0 lb ai/100 gal) (Table 1). Fenoxaprop was slightly more effective than sethoxydim and primisulfuron. These herbicides were not completely efficacious; regrowth was apparent even during the same year except for glyphosate, which allowed seedlings to reestablish during the next season.

In the second study, the rate of glyphosate was reduced to 561 g ai/ha (0.5 lb ai/A), which is tolerated by the tall fescue (Table 2). The best rhizome control was by fenoxaprop and sethoxydim, and poor results were obtained with primisulfuron. Sethoxydim caused severe injury to the tall fescue. Fenoxaprop contains isomers, and a more active isomer was evaluated in 1990 and 1991 (Table 3). The active isomer appeared to require only about one-half to three-fourths as much active ingredient where 95 percent control of Johnsongrass was obtained at 2 months after treatment. The second study during 1990 was initiated after the second mowing (August 3), and the results were very poor compared with those of the June application. Nicosulfuron was very effective for Johnsongrass control; however, a definite injury level occurred on tall fescue. This injury may still be acceptable to many managers of highway tall fescue.

During 1991, fluazifop was used to boost the effectiveness of fenoxaprop for Johnsongrass control and provided a high-

TABLE 2 Selective Johnsongrass Control in Highway Tall Fescue Using an Over-the-Top Application

Treatment 7/26/89	Rate[b] g ai/ha	Control Ratings[a] Johnsongrass Shoots 8/24	9/29	Rhizomes[b] Number per 14,158 cm³	Turf Injury[a]
Fenoxaprop + X-77	140 0.25% v/v	7 a	7 a	4	0
Sethoxydim + Crop oil con.	213 0.50% v/v	9 a	7 a	5	10
Primisulfuron + X-77	22 0.25% v/v	5 ab	7 a	17	5
Glyphosate + X-77	561 0.25% v/v	9 a	7 a	8	3
Check		0 b	0 b	21	0

[a] Control rating or injury scale: 0 = no control or injury, 1-3 = slight discoloration, 4-6 = definite control or injury but generally not acceptable control, 7-9 = acceptable control or unacceptable injury, 10 = complete control or dead turfgrass.

[b] To obtain lb ai/A, multiply g ai/ha by 0.000892. To obtain ft³, multiply cm³ by 0.0000353.

TABLE 3 Selective Johnsongrass Control in Highway Tall Fescue Using 281 L/ha (30 gal/acre) Broadcast Sprayer

Treatment Time/Herb.	Rate[a] g ai/ha	Johnsongrass shoot Percent control		Tall fescue ratings Injury[b]	Quality[c]
6/14/90[d]		7/19	8/9	6/27	7/19
Fenoxaprop	294	88 ab	78 abc	2.0 cd	6.7 ab
	392	98 a	60 abc	2.0 cd	7.7 a
Fenoxaprop	140	62 bc	57 abc	1.0 de	5.7 bc
(act. isomer)	280	97 a	95 a	2.0 cd	7.0 ab
Nicosulfuron +	41	93 a	95 ab	3.0 abc	2.3 e
X-77(0.25% v/v)	81	97 a	100 a	4.0 a	2.0 e
Primisulfuron +	35	7 d	3 d	2.7 bc	4.0 cd
X-77(0.25% v/v)	70	50 c	45 cd	3.0 abc	4.3 cd
Check		0 d	7 d	0.0 e	4.3 cd
8/3/90[d]			9/3	9/3	
Fenoxaprop	294		30 e	0.0 f	
	392		43 b-e	0.3 ef	
Fenoxaprop	140		35 de	0.0 f	
(act. isomer)	280		55 abc	0.3 ef	
Nicosulfuron +	41		53 a-d	2.7 bc	
X-77(0.25% v/v)	81		67 a	4.7 a	
Primisulfuron +	35		32 e	0.7 ef	
X-77(0.25% v/v)	70		40 cde	20 cd	
Check			0 f	0.0 f	

[a] To obtain lb ai/A, multiply g ai/ha by 0.000892.

[b] Injury rating scale: 0 = no injury, 1-3 = slight discoloration, 4-6 = definite injury, 7-9 = unacceptable injury, 10 = dead turf.

[c] Quality rating scale was 1-9, where 5 = acceptable, 9 = best, and below 5 = unacceptable quality.

[d] No mowing was done prior to 6/14 and johnsongrass was 30.5 to 61 cm (12 to 24 inches) tall. Test site treated 8/3 was mowed twice before treatment, the second just one week before treatment.

TABLE 4 Selective Johnsongrass Control in Highway Tall Fescue Using Broadcast Sprayer

Treatment Time/Herb.	Rate[a] g ai/ha	Turf ratings Injury[b]	Quality[c]	Johnsongrass shoot Percent control	
6/4/91[d]		6/18	8/2	8/2	9/20
Fenoxaprop	294	0.3 ab	5.3 ab	83 ab	83 abc
	392	1.0 ab	4.3 abc	75 abc	75 abc
Fenoxaprop	140	0.0 b	4.7 abc	90 ab	90 ab
(act. isomer)	280	1.3 ab	5.3 ab	90 ab	90 ab
Fenoxaprop(act.)+	35	0.7 ab	5.7 ab	68 abc	83 abc
Fluazifop	140				
Fenoxaprop(act.)+	70	1.7 a	6.0 a	93 ab	95 ab
Fluazifop	280				
Fluazifop	211	1.7 a	4.3 abc	42 a-d	38 cde
Check		0.0 b	3.7 bc	20 cd	7 de
6/4/91 + 7/5/91[d]		6/18	8/2	8/2	9/20
Fenoxaprop	197+197	0.7 a	6.0 ab	90 a	87 ab
	294+294	0.3 a	7.0 a	100 a	77 ab
Fenoxaprop	140+140	1.0 a	6.3 ab	98 a	97 ab
(act. isomer)	280+280	0.3 a	6.3 ab	98 a	88 ab
Fenoxaprop(act.)+	17+70	1.0 a	6.3 ab	97 a	90 ab
Fluazifop	17+70				
Fenoxaprop(act.)+	35+140	0.7 a	5.3 abc	98 a	93 ab
Fluazifop	35+140				
Fenoxaprop(act.)+	70+280	0.7 a	5.0 bc	100 a	97 ab
Fluazifop	70+280				
Check		0.0 a	4.0 c	3 c	0 c

[a] To obtain lb ai/A, multiply g ai/ha by 0.000892.

[b] Control and injury rating scale: 0 = no control or injury, 1-3 = slight discoloration, 4-6 = definite control or injury but generally not acceptable control, 7-9 = acceptable control or unacceptable injury, 10 = complete control or dead turfgrass.

[c] Quality rating scale was 1-9, where 5 = acceptable, 9 = best, and below 5 = unacceptable quality.

[d] No mowing of either test prior to treatment.

TABLE 5 Selective Dallis Grass and Purpletop Control in Highway Tall Fescue Using Broadcast Sprayer

Treatment Time/Herb.	Rate[a] g ai/ha	Tall fescue Quality[d]		Dallisgrass % Control		Purpletop % Control
6/6/91[b]		7/18	8/22	7/18	8/22	8/22
Fenoxaprop	294	4.0 c	5.0 bc	22 d	7 de	83 a-d
	392	4.7 abc	5.0 bc	33 cd	37 b-e	60 a-e
Fenoxaprop	140	5.0 abc	5.0 bc	67 ab	53 a-e	42 d-e
(act. isomer)	280	4.7 bc	5.0 bc	57 bc	27 b-e	87 a-d
Fenoxaprop(act.)+	35+140	6.0 a	5.0 bc	88 ab	78 ab	65 a-e
Fluazifop	70+280	6.0 a	5.0 bc	97 a	63 a-d	93 ab
Fenoxaprop(act.)+	41+140		5.7 a		95 a	93 ab
Fluazifop	81+280		5.7 a		98 a	100 a
Nicosulfuron	62	5.3 ab	5.0 bc	85 ab	30 b-e	75 a-d
(X-77 0.25% v/v)	81	5.3 ab	5.0 bc	82 ab	35 b-e	48 b-e
Imazethapyr	70	4.0 c	5.0 bc	32 cd	28 b-e	58 a-e
(X-77 0.25% v/v)	140	4.3 bc	5.0 bc	22 d	45 a-e	88 a-c
Imazethapyr +						
Imazapyr	70+9		5.0 bc		83 ab	97 a
(X-77 0.25% v/v)	140+9		5.3 ab		83 ab	100 a
Primisulfuron	62	4.3 bc	5.0 bc	13 d	32 b-e	50 b-e
(X-77 0.25% v/v)	70	4.0 c	5.0 bc	17 d	67 abc	27 e
Quizalofop	35	4.0 c	5.0 bc	8 d	32 b-e	62 a-e
	70	4.0 c	5.0 bc	20 d	20 cde	70 a-e
Check		4.0 c	4.7 c	5 d	58 b-e	42 de
6/25/91[b]		7/24 Injury[c]	8/7 Quality[d]	8/7 %Control		
Fenoxaprop	294	0.3 de	3.7 abc	23 e-h		
	392	0.0 e	3.3 abc	25 e-h		
Fenoxaprop	140	1.0 cde	3.7 abc	27 d-h		
(act. isomer)	280	0.7 cde	4.3 ab	68 abc		
Fenoxaprop(act.)+	41+140	0.3 de	4.3 ab	70 abc		
Fluazifop	81+280	0.3 de	4.0 ab	95 a		
Nicosulfuron	62	5.0 a	3.0 bc	88 ab		
(X-77 0.25% v/v)	81	23 bc	3.0 bc	62 abc		
Imazethapyr	70	1.0 cde	3.7 abc	43 c-f		
(X-77 0.25% v/v)	140	2.0 bcd	3.3 abc	65 abc		
Primisulfuron	56	0.0 e	3.7 abc	12 fgh		
(X-77 0.25% v/v)	70	0.7 cde	3.3 abc	17 fgh		
Quizalofop	35	2.0 bcd	4.7 a	57 b-e		
(X-77 0.25% v/v)	70	3.7 ab	3.3 abc	53 cde		
Check		0.0 e	3.3 abc	0 h		

[a] To obtain lb ai/A, multiply g ai/ha by 0.000892.
[b] No mowing of either test prior to treatment.
[c] Injury rating scale: 0 = no injury, 1-3 = slight discoloration, 4-6 = definite injury, 7-9 = unacceptable injury, 10 = dead turfgrass.
[d] Quality rating scale was 1-9, where 5 = acceptable, 9 = best, and below 5 = unacceptable quality.

quality tall fescue (Table 4). Very little injury was encountered with the tank mixture of fenoxaprop and fluazifop. Repeat applications of the tank mixture were very effective and allowed reduced rates of fenoxaprop and more effective control than fluazifop alone.

Selective Dallis Grass and Purpletop Control

Dallis grass control in tall fescue was obtained with fenoxaprop plus fluazifop and imazethapyr plus imazapyr (Table 5). Fenoxaprop and imazethapyr alone were not effective on Dallis grass. A more active isomer of fenoxaprop provided some control early; however, this isomer appeared to control shoots for a short time, and regrowth from crowns was apparent. The mixture of the active isomer of fenoxaprop at one-fourth the rate with fluazifop appeared to provide a synergistic response to reach up to 98 percent control of Dallis grass.

Nicosulfuron gave initial shoot control of Dallis grass; however, regrowth was apparent after 75 days. Nicosulfuron, the high rate of imazethapyr, and quizalofop cause significant injury to the tall fescue. However, this injury was temporary and may be acceptable in management of tall fescue. Thus, the Dallis grass control was acceptable with fenoxaprop (active isomer) plus fluazifop and imazethapyr plus imazapyr, while some improvement was obtained in tall fescue highway turf quality.

Purpletop was controlled in tall fescue with fenoxaprop plus fluazifop and imazethapyr plus imazapyr. The results were variable with a trend toward good control with fenoxaprop or imazethapyr alone.

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Ohio Native Wildflower Seed Nursery

ROBERT E. TATMAN

The Ohio Department of Transportation (ODOT) started a roadside wildflower program in 1984. Seed sources for Ohio native wildflowers did not exist. After attempts to interest the private sector in developing a native wildflower nursery failed, ODOT entered into agreement with the Park District of Dayton and Montgomery County to develop such a nursery. Both agencies developed criteria to proceed with the nursery as a research effort. Much emphasis was placed on record keeping and testing every phase of development. Currently the Ohio Native Seed Nursery is producing approximately 250 lb of seed each year consisting of eight different species. Field test of seed has resulted in satisfactory germination and establishment in test plots. ODOT plans to continue the development of the Native Seed Nursery, at the same time encouraging private seed growers to develop nurseries of their own.

During fall 1984, the Ohio Department of Transportation (ODOT) initiated a roadside wildflower program. ODOT received much public support for the efforts; however, one area of concern was expressed. There was no source of Ohio native wildflower seed available in sufficient quantity.

ODOT requested in 1987 that the Ohio Department of Natural Resources (ODNR) explore the possibility of a joint program to produce Ohio native wildflower seed for use by both agencies. ODNR did not have the resources for a program at that time and suggested that contact be made with the various organizations interested in establishment of native wildflower areas.

In June 1988 ODOT entered into an agreement with the Dayton–Montgomery County Park District to establish a production nursery for wildflower seed. This was a first for Ohio, and much new ground had to be broken. Wildflower seed production is a competitive industry, so nurseries already in business were reluctant to share technical information. However, the Department of Natural Resources in Wisconsin had a native seed nursery and was very helpful in the early planning days.

Whenever a new venture such as this is begun, certain resources must be available (i.e., labor, equipment, and material). Skilled labor, specialized equipment, and ideal growing conditions are required. ODOT and the Park District addressed these issues early in the program to ensure eventual success.

The year the nursery was started followed the driest year on record for Ohio. Seedling wildflower plants must have water, and if the natural rainfall was lacking, the efforts would fail. To ensure adequate moisture, ODOT constructed an irrigation pond on the site, and the Park District set up an irrigation system before the first seed was planted.

Ohio Department of Transportation, 25 South Front Street, P.O. Box 899, Columbus, Ohio 43216-0899.

The pond construction was carried out concurrently with the site preparation for the nursery itself. The nursery was to be located in an old abandoned field, which had become overgrown with small brush and weeds. Mowing and the selective use of herbicides soon had the site ready for further preparation.

It was decided that, for maintenance reasons, the nursery would be laid out in strips 4 ft wide. The strips were rototilled, and grass, which could be mowed, was left between the planting beds. The nursery was now ready for seed planting. However, before native wildflower seed can be produced, a native seed source must be found. Fortunately the Park District had volunteer persons knowledgeable in the collection of wildflower seed. The selection of wildflowers for roadside and Park District use was based on several criteria. Visibility, color, growing habit, and availability were the primary reasons for selecting a plant type for harvesting. The volunteers collected the initial seed stock from locations all over Ohio and kept detailed records on this process. Enough seed was collected, by hand, to start the nursery.

Plants that could be useful on certain special areas, such as the shale cuts in southeastern Ohio, were collected. During fall 1989, an annual wildflower growing on the shale cuts had been observed. It belonged to the Asteraceae family (*Bidens polylepis*), and if it could be grown successfully, it would not only be an attractive flower but also would probably survive after planting on shale cuts. One lb of the Bidens seed was harvested for use in the nursery.

The next technical question to be addressed was how to break dormancy of the collected seed. Reports indicated a wide range in wildflower seed dormancy, which initially led us to believe that some problems in germination would exist.

Several techniques for breaking dormancy were tested: cold-dry, cold-wet in vermiculite, and cold-wet in flats with planting soil. The seed was subjected to the various treatments and observations were recorded. It was found that cold storage over winter in flats provided adequate germination.

The first problem encountered after initial seed planting was weed intrusion into the planting beds. Once the old vegetation cover was removed, the weed seed already present in the soil on the site quickly germinated, and weeds proliferated. Because of this, many of the seedbeds were failures that first spring.

Because of the weed problem, it was decided to use plants instead of seed to establish the planting beds. The herbicides Round-up and Surflan provided a virtually weed-free site. A small greenhouse was built, which provided all the plant material needed to fill the nursery. At planting time, volunteers were used once again to transplant the seedlings.

The production of seedlings for transplanting also underwent a series of experimental procedures, much the same as that occurring with the seed dormancy problem. Wildflowers have, in many cases, a well-developed root system. Perennials, in particular, develop the root system before much top growth takes place. We found that because of this growth habit, some plants became root bound in the planting trays before they could be transplanted.

It was fairly easy to solve this problem. Seed was sown in the planting trays and after germination was transplanted to growing tubes. This allowed plenty of room for root growth and also made transplanting easy. The success rate for the transplants in the nursery improved dramatically as a result.

Table 1 gives the seed harvest totals from the nursery for 1990. Nearly 200 lb of seed was harvested on less than ⅓ acre of the cultivated area. We were pleased with the total seed harvest, especially since this was the first year of seed production from the perennials.

With harvest time came the next set of problems: how to pick, clean, and store the seed. The problem in connection with harvesting the seed of wildflowers was compounded by the fact that seed developed in different stages and varied in height, density, and ability of the plant to hold the seed without shattering. In some plants, like the *Bidens*, seed ripened almost overnight and fell from the plant. Other species such as purple coneflower ripened gradually and then held the mature seed for an indefinite time before it fell from the plant. This required that the nursery manager keep a close watch on the plants by monitoring progress to avoid loss of seed by shattering.

Several methods of picking the seed were tried, including handpicking and use of a vacuum and hand-held gas-powered harvester. The preferred method has not been determined. It is hoped that less labor-intensive methods can be found.

The method used for cleaning the harvested seed was fairly successful. After the seed heads had dried, they were processed through a shredder. The product of the shredder was then sent through a fan mill. The finished product, although not commercially clean, was clean enough to pass through the planting equipment much of the time.

Seed will not be stored after the harvest if it is at all feasible to carry out planting. Thus we will not be required to provide cold, vermin-proof storage over winter. This should work well, since the natural planting period for many plants in Ohio is late fall or early winter.

Since the Ohio Native Wildflower Nursery is research oriented, it was decided to find out as much as possible about the quality of the seed produced. Several of the species harvested were selected to test for percent of viable seed. Samples were collected and sent to a commercial seed-testing laboratory, where they were tested for viable seed using the Tetrazolium method of determination. Table 2 gives the results of these tests. They indicated that much of the seed lots were of a good quality.

Other research data have been compiled concerning plant height, color, soil preference, bloom period, and planting requirements. This information has been placed on charts and will be made available for use by our field crews (Table 3).

Another report showing groups of wildflowers to be planted together in specific soil types has also been developed (see Table 4). This should also greatly assist the field crews at planting time.

Comprehensive data about each wildflower variety are compiled as information becomes available from the nursery. This information will be maintained at a central data base and updated as observations are made.

The 1990–1991 seed harvest has been planted along Ohio's roadsides and throughout the Dayton–Montgomery County Park District. ODOT and Park District staff conducted field reviews of the wildflower plots during the first half of 1992. All plots showed a very acceptable germination rate.

In this paper two plots will be described. Plot A is located in northern Ohio in Lorain County. The soil in this area is largely shale and has a low pH. Past efforts by ODOT to establish vegetation on this site have not been successful.

The soil was lightly raked and hand seeded to the *Bidens polylepis* at a rate of approximately 10 lb/acre. No further site treatment was performed. Observations of this site determined that there was an extremely high germination rate, and a solid mass of yellow flowers was reported at bloom time.

TABLE 1 Seed Harvest, 1990

FORBES	HARVESTABLE SQ. FT.	WEIGHT OF SEED
Bergamot	100 sqft	2 lbs
Bur-Marigold	1800 sqft	60 lbs
Blackeyed Susan	400 sqft	1.25lbs
Greyheaded coneflower	300 sqft	16 lbs
Liatris	1100 sqft	12.25 lbs
New England Aster	300 sqft	18.75 lbs
Nodding Wild Onion	200 sqft	6.5 oz
Prairie Drop Seed	100 sqft	2.6 lbs
Purple Coneflower	1300 sqft	25.75 lbs
Orange Coneflower	400 sqft	2.37 lbs
Oxeye	700 sqft	9.3 lbs
Stiff Goldenrod	1600 sqft	28.75 lbs
Whorled rosinweed	200 sqft	10.4 oz.

TABLE 2 Seed Test Results (Test Performed by Seed Technology, Inc.)

Kind	Percent germination
Bur-Marigold	80
Oxeye	90
Orange Coneflower	87
Purple Coneflower	70
Liatris	88
Bergamot	55
Grey-Headed Coneflower	91

Note: Testing with Tetrazolium (Tz) is based on the principle that respiration processes within living tissues release hydrogen, which combines with the colorless Tetrazolium solution and produces a red pigment. Strong, healthy tissues develop a normal red strain. The Tz Test is especially useful in evaluating dormant seed at harvest. It was for this reason that this test was chosen over conventional germination tests for our wildflower seed.

TABLE 3 Earliest Bloom to Latest Bloom (Harvested Fall 1990)

Botanical Name	Common Name	Height (ft)	Flower Color	Soil Type	Bloom Period
Rudbeckia hirta	Blackeyed susan	1–3	Yellow	Mesic-dry	June–October
Ratibida pinata	Greyheaded cone	3–5	Yellow	Mesic-dry	June–September
Monarda fistulosa	Bergamot	2–4	Lavender	Mesic-dry	June–September
Echinacea purpurea	Purple coneflower	2–3	Reddish-purple	Mesic-dry	June–October
Heliopsis heliauthoides	Oxeye	2–5	Yellow	Mesic-dry	July–August
Allium cernuum	Nodding wild onion	1–2	White	Mesic-dry	July–August
Liatris spicata	Blazing star	2–5	Rose-purple	Wet-mesic	July–September
Rudbeckia fulgida	Orange coneflower	1–3	Orange-yellow	Mesic	August–October
Aster novae-angliae	New England aster	3–7	Violet-rose	Wet, mesic-dry	August–October
Bidens polylepis	Bur-marigold	1–3	Yellow	Wet-mesic	August–October
Solidago rigida	Stiff goldenrod	2–5	Yellow	Wet-dry	August–October
Sporobolis heterolepis	Prairie dropseed	1½–3½	Tan	Mesic-dry	August–October

TABLE 4 Seed Distributed to ODOT, 1991 (Site Selection Based on Soils of Southwestern Ohio)

Soil Type	Seed
Wet	Bur-Marigold
	Liatris
	New England Aster
	Stiff Goldenrod
Mesic	Bergamot
	Blackeyed Susan
	Bur-Marigold
	Greyheaded Coneflower
	Liatris-Blazing Star
	New England Aster
	Orange Coneflower
	Oxeye
	Prairie Dropseed
	Purple Coneflower
	Stiff Goldenrod
	Whorled Rosinweed
	Nodding Wild Onion
Dry	Bergamot Prairie Dropseed
	Blackeyed Susan
	Grey-headed coneflower
	New England Aster
	Oxeye
	Purple coneflower

Plot B is located in southeastern Ohio in Athens County. The site was vegetated with Kentucky 31 fescue and various other plant types. ODOT crews sprayed the site with Round-up and then, approximately 10 days later, mowed the treated grass as close as possible. A disc was lightly pulled over the planting area, and the following native wildflower seed was planted: purple coneflower, grey-headed coneflower, oxeye, liatris, nodding onion, and stiff goldenrod.

All species planted have shown satisfactory germination. Since the site was laid out in strips, it will be easy to continue the review process into the next growing season, at which time the plants should be in bloom.

We believe that the Ohio Native Wildflower Seed Nursery has been successful. Since the nursery can only produce a small amount of the seed needed for the Park District and ODOT needs, we plan to carefully select future planting sites. Areas close to nature preserves, rest areas, and, in the case of the *Bidens*, critical erosion sites will be chosen as first priority. It is hoped that our success will encourage private growers to become interested in growing native wildflowers for commercial use.

Our agreement with the Dayton–Montgomery County Park District expires in June 1993. What will be the future of the Ohio Native Wildflower Nursery? At this time, we have every reason to believe that an extension of the program will be approved. Certainly ODOT, the Park District, and the people of Ohio have much to gain by the continued success of this program.

LITERATURE SEARCH

An extensive literature search was conducted through ODOT library services. TRIS and DIALOG computer searches did not locate published data on growing wildflowers commercially in Ohio.

The purpose of this study was to investigate the possibilities of growing wildflowers in Ohio in commercial quantities. We realize that similar work may have been done in other states. However, their data were not used as a reference because of Ohio's differences in geology, climate, and so forth, which could affect growing procedures in Ohio.

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