Table 5. Correlation coefficients for evapotranspiration ET at 25° and 35°C, vertical elongation rate (VER), shoot density (SD), verdure (V), and root density of 5 Kentucky bluegrass cultivars representing high, medium, and low water-use categories.

Parameter	Correlation coefficients					
	ET (25°)	ET (35°)	VER	SD	V	RD
ET 25°	---	0.48	0.66	−0.85*	0.40	−0.31
ET 35°	0.48	---	0.96*	−0.87*	−0.83*	−0.73
VER	0.66	0.96*	---	−0.95*	−0.69	−0.65
SD	−0.85*	−0.87*	−0.95*	---	0.48	0.45
V	0.40	−0.83*	−0.69	0.48	---	0.92*
RD	−0.31	−0.73	−0.65	0.46	0.92*	---

*Indicates significance at the 5% probability level.

resistance (5). Their study was conducted under well-watered conditions, as was this study. 'Park' and 'S. Dakota' had rapid vertical elongation rates, vertical leaf orientation, and open canopies, resulting in lower ET resistance. These characteristics contributed significantly to high ET rates observed under high ET demand conditions.

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Fenoxaprop-ethyl for Postemergence Crabgrass Control in Kentucky Bluegrass Turf

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Abstract. **Fenoxaprop-ethyl at rates of 0.09 to 0.28 kg·ha^{-1} provided effective smooth crabgrass [*Digitaria ischaemum* (Schreb.) Muhl.] control with minor injury to 'Baron' Kentucky bluegrass (*Poa pratensis* L.). Optimum timing for application was the 4-leaf to 5-tiller stage of crabgrass growth. At this stage of growth, fenoxaprop-ethyl applied at 0.20, 0.28, or 0.38 kg·ha^{-1} provided excellent (90% or better) season-long crabgrass control. Fenoxaprop-ethyl at 0.09 kg·ha^{-1} was an effective crabgrass control treatment at 2 to 4 leaf stage when combined with DCPA at 11.76 kg·ha^{-1}. Split applications of fenoxaprop-ethyl in June and July at both 0.14 + 0.14 and 0.28 + 0.28 kg·ha^{-1} also provided season-long crabgrass control. Chemical names used: (±)-ethyl 2-[4-[(6-chloro-2-benzoxazolyl)oxy]phenoxy]propanoate (fenoxaprop-ethyl); and dimethyl tetrachloroterephthalate (DCPA).**

Crabgrass (*Digitaria* spp.) is a serious weed in home lawns, golf courses, and other turfgrass areas. Research has shown that selective crabgrass control can be achieved with preemergence herbicides (1, 3, 4, 7). Effectiveness of these herbicides varies considerably year to year and region to region.

Postemergence control of crabgrass has been obtained with arsenicals, such as monosodium methanearsonate (MSMA) (4, 6). Control failures that had related turfgrass discoloration involved application number and environmental conditions conducive to herbicide phytotoxicity. In addition, timing of herbicide application with respect to crabgrass development is key to its effective control.

Fenoxaprop-ethyl, a new herbicide, reportedly provides excellent postemergence control of several annual grasses (2, 5). The objectives of this study were to: a) evaluate effectiveness of this herbicide for crabgrass control; b) determine optimum stage of crabgrass growth for postemergence control; and c) assess any possible chemical turfgrass injury.

Two experiments were conducted at the Univ. of Massachusetts Turf Research Center, South Deerfield, on a Winooski silt loam (Aquic Udifluvents) with a pH of 6.2 and an organic matter content of 2.2%. The test area was heavily infested with smooth crabgrass. The turf was fertilized twice annually with a 20N–5.2P–6.6K fertilizer at 24.4 kg N·ha^{-1}.

The first experiment was conducted on 'Baron' Kentucky bluegrass turf moved twice weekly at 3.4 cm. Treatments were applied on 28 May 1983, when crabgrass was at the 3-leaf stage. Split applications were made on 11 July 1983. Mean daily air temperatures ranged from 10° to 28°C during the experiment.

The 2nd experiment was initiated in 1984 on 'Baron' Kentucky bluegrass on the same farm. Postemergence treatments were applied on 19 June, 5 July, and 19 July, when crabgrass was at the 2- to 4-leaf stage, 4-leaf to 3-tiller stage, and 3- to 5-tiller stage, respectively. Mean daily air temperatures ranged from 14° to 33°C during the course of this experiment.

Herbicide plots were 1.0 × 3.0 m, replicated 3 times in a randomized complete block design. All treatments were applied with a CO_2 backpack sprayer, delivering 675 liter·ha^{-1} at 152 kPa. Data were subjected to arcsin transformation and then to analysis of variance. The original data are reported.

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Table 1. Turfgrass injury and crabgrass control from postemergent herbicide treatments in Kentucky bluegrass turf in 1983.

Treatments			Turf injury (%)[z]			Crabgrass control (%)		
Herbicide	Rate (kg·ha^{-1})	Applied	14 June	8 July	10 Aug.	14 June	8 July	10 Aug.
Fenoxaprop-ethyl	0.14	Post[y]	0	0	0	92	82	45
Fenoxaprop-ethyl	0.28	Post	8	7	0	92	83	50
Fenoxaprop-ethyl	0.14 + 0.14	Post split	8	5	0	92	82	93
Fenoxaprop-ethyl	0.28 + 0.28	Post split	8	8	0	92	83	100
Untreated check	---	---	---	---	---	0 (67)[x]	0 (97)	0 (97)
LSD, 5% level			11	6	0	15	26	7

[z]Rating scale for turf injury: 0 = no injury; 100 = dead turf. For crabgrass control: 0 = no control; 100 = complete control.
[y]Treatments were applied on 28 May; split application was made on 11 July 1983.
[x]Values in parenthesis indicate the percentage of ground covered by smooth crabgrass.

Table 2. Turfgrass injury and crabgrass control at various growth stages of crabgrass using a postemergent herbicide in Kentucky bluegrass turf in 1984.

		Crabgrass		Turf injury (%)[z]			Crabgrass control (%)		
Treatment	Rate (kg·ha^{-1})	growth stage	Timing of application	11 July	26 July	24 Aug.	11 July	26 July	24 Aug.
Fenoxaprop-ethyl	0.09	2–4 leaf	19 June	2	5	0	100	96	47
Fenoxaprop-ethyl	0.13	2–4 leaf	19 June	3	7	0	99	94	53
Fenoxaprop-ethyl	0.20	2–4 leaf	19 June	22	0	0	100	93	38
Fenoxaprop-ethyl	0.13	4 leaf– 3 tiller	5 July	5	0	0	100	98	86
Fenoxaprop-ethyl	0.20	4 leaf–3 tiller	5 July	13	5	0	100	99	92
Fenoxaprop-ethyl	0.28	4 leaf–3 tiller	5 July	20	0	0	100	96	94
Fenoxaprop-ethyl	0.20	3–5 tiller	19 July	---	0	8	---	100	99
Fenoxaprop-ethyl	0.28	3–5 tiller	19 July	---	2	13	---	100	99
Fenoxaprop-ethyl	0.39	3–5 tiller	19 July	---	0	20	---	77	99
MSMA	3.36	4 leaf–3 tiller	5 July	0	0	0	87	40	10
Fenoxaprop-ethyl + DCPA	0.09 + 11.76	2–4 leaf	19 June	2	0	0	99	98	91
DCPA	11.76	2–4 leaf	19 June	0	5	0	68	65	32
Untreated check	---	---	---	0	0	0	0 (63)[y]	0 (82)	0 (93)
LSD, 5% level				8	7	7	10	10	23

[z]Rating scale for turf injury; 0 = no injury; 100 = dead turf. For crabgrass control: 0 = no control; 100 = complete control.
[y]Values in parenthesis indicate the percentage of ground covered by smooth crabgrass.

Injury to turfgrass was rated visually on a scale of 0% to 100%, where 0% represents no turf injury and 100% represents complete dead turf. Crabgrass control also was rated on a scale of 0% to 100%, where 0% represents no control and 100% represents complete crabgrass control. These observations were made on 14 June, 8 July, and 10 Aug. 1983 and on 11 July, 26 July, and 24 Aug. 1984. Excellent crabgrass control was considered to be ≥90%.

Fenoxaprop-ethyl at 0.14–0.28 kg·ha^{-1} resulted in light initial injury to Kentucky bluegrass (Table 1). The injury was temporary as the turf recovered fully by August. The split application on 11 July did not cause any injury to the turf. Crabgrass control during the June period was excellent with a single application of fenoxaprop-ethyl. By August, single applications did not provide adequate smooth crabgrass control. Split applications at 0.14 + 0.14 and 0.28 + 0.28 kg·ha^{-1} provided season-long smooth crabgrass control.

In the 2nd experiment, the applications of fenoxaprop-ethyl on 19 June and 5 July resulted in minor injury to turfgrass. The injury was temporary as the turf was fully recovered by August. Turfgrass injury also was noted on 28 Aug. from the 19 July application. This injury may have been related to cultivar response or to interaction with warm, humid weather that occurred at this time in 1984. Maximum daily air temperatures ranged from 23° to 33°C, with a mean maximum temperature of 29.3° during August.

Fenoxaprop-ethyl at 0.09, 0.18, and 0.20 kg·ha^{-1}, applied during the 2- to 4-leaf stage of crabgrass growth (19 June), provided excellent crabgrass control through 26 July, but the control was reduced to an unacceptable level by 24 Aug. (38% to 53%). Fenoxaprop-ethyl at 0.13, 0.20, and 0.28 kg·ha^{-1} applied postemergence, when crabgrass was in the 4-leaf to 3-tiller stage (5 July), and at 0.20, 0.28, and 0.39 kg·ha^{-1} applied postemergence, when crabgrass was in the 3- to 5-tiller stage (19 July), provided excellent season-long crabgrass control.

Treatment with MSMA at 3.36 kg·ha^{-1} exhibited only 87% crabgrass control by 11 July and control declined later in the season. The combination of DCPA at 11.8 kg·ha^{-1} with fenoxaprop-ethyl at 0.09 kg·ha^{-1} gave improved smooth crabgrass control when compared to either herbicide at those rates applied alone.

These data indicate that fenoxaprop-ethyl is very effective for smooth crabgrass control. Results from preliminary studies in Massachusetts (2) and from Maryland (5) also agree with the results from the present study. The excellent postemergence activity of fenoxaprop-ethyl in controlling smooth crabgrass coupled with little injury to Kentucky bluegrass indicates its potential for use on commercial and home lawns. Fenoxaprop-ethyl offers an alternative, postemergent herbicide control for crabgrass in addition to preemergent crabgrass control herbicides.

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