Rate and timing effect of CGA-136872 for postemergence Johnsongrass *Sorghum halepense* L. control in corn *Zea mays* L..

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Summary

Field experiments were conducted in Virginia in 1988-89 to evaluate CGA-136872 activity for postemergence control of johnsongrass Sorghum halepense *(L.) Pers in field corn* Zea mays *L. grown under conventional tillage system. CGA-136872 activity on johnsongrass was dependent on the application timing. Applications at three weeks after planting (WAP) were more effective than early or late applications. Five weeks after treatment, these applications provided 90 % control of the weed with 30 and 40 g ai (active ingredient)/ha of the herbicide. Early applications resulted in less than 70 % control at with all rates due to regrowth from rhizomes. Sequential applications with low rates resulted in more activity than a single high rate applied early or late in the season. Corn yield was improved with applications at three weeks after planting and sequential applications, compared to early or late applications. Johnsongrass competition with corn in untreated plots resulted in very low yield (174 kg/ha).*

Résumé

Des essais en champ ont été conduits en Virginie en 1988-89 pour évaluer l'activité du CGA-136872 en vue du contrôle du sorgho d'Alep Sorghum halepense *(L.) Pers dans le maïs* Zea mays *L. L'activité du CGA-136872 sur le sorgho d'Alep était dépendante de la période d'application de l'herbicide. Les traitements herbicides effectués trois semaines après semis se sont montrés plus efficaces que les traitements précoces ou tardifs. Cinq semaines après traitement, les applications faites trois semaines après semis ont donné 90 % de contrôle de la mauvaise herbe à des doses 30 et 40 g de matière active/ha. La faible efficacité des applications précoces (moins de 70 % de contrôle) était due à la regermination du sorgho d'Alep. Les traitements séquentiels (deux traitements sur les mêmes parcelles) avec de faibles doses ont montré plus d'activité que les applications uniques précoces ou tardives avec de fortes doses d'herbicide. Les traitements effectués trois semaines après semis ainsi que les traitements séquentiels ont donné les meilleurs rendements en maïs. Le plus faible rendement (174 kg/ha) observé sur les parcelles non traitées montre l'importance de la compétition entre le maïs et le sorgho d'Alep.*

Nomenclature:
CGA-136872 (primisulfuron): 2-[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl]amino]sulfonyl] benzoic acid methyl ester.

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Introduction

Johnsongrass *Sorghum halepense* (L.) Pers. ranks sixth among the world's worst weeds (5) and is one of the three most serious weeds in corn in the United States (2). Bendixen (2) showed that in situations of heavy infestations, corn yield was eliminated by this weed. In some crops such as soybeans, johnsongrass control with postemergence broadcast over the top applications can be obtained with cyclohexanedione and aryloxyphenoxypropionate herbicides. However, lack of selectivity of these herbicides prevent their use postemergence in corn (11).

CGA-136872, an experimental sulfonylurea herbicide known under the trade name «Beacon» and the proposed common name «primisulfuron», has shown very good potential for selective postemergence johnsongrass control in corn (1,9). At very low rates, 20 to 40 g active ingredient/ha (ai/ha) it provides adequate control of more than 30 weed species (1). During the 1987 and 1988 growing seasons, this herbicide was tested extensively in the United States. Vidrine et al. (10) obtained 86 % control of seedling johnsongrass with 50 g ai/ha. Control ratings of more than 90 % with the same rates have been reported by Mueller et al. (8). High level of corn tolerance to CGA-136872, has been observed by Ngouajio and Hagood (9). They found no yield reduction when corn was treated with ten times the recommanded use rate.

CGA-136872 activity has been found to be dependent on johnsongrass growth stages. Reduced activity has been reported on johnsongrass with early applications (4,6,7). With these applications, Kaufman and Ritter (6) found more regrowth from rhizomes than when applications were made at later stages. Due to this regrowth problem, Kaufman and Ritter (6) as well as Brown et al. (3) showed that johnsongrass control was improved with sequential applications rather than a single early or late postemergence treatment.

The objectives of this research were to evaluate the activity of CGA-136872 and to determine the optimum rates and timings of application for control of this weed species.

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Materials and methods

This research was conducted in Blacksburg, Virginia, during the summers of 1988 and 1989 (temperature 20-25°C, rainfall 110-250 mm). The site consisted of a Ross loam (fine loamy, mixed, mesic cumulic Hapludolls) with 2% organic matter and pH 6.1. The experimental plot had a natural infestation of rhizome johnsongrass. Corn variety Southern States 565 was planted in 75 cm rows using a commercial planter adjusted to a population of one seed per 18 cm of row.

The crop was grown using conventional tillage and was planted May 23 and May 20 for 1988 and 1989 respectively. The experiment contained a two-way herbicide by timing factorial in a randomized complete block design with three replications. Herbicide rates were 20, 30 and 40 g ai/ha and the application timings were early postemergence (EP) applied two weeks after planting (WAP), mid-postemergence (MP) applied 3 WAP and late postemergence applied 5 WAP. Sequential treatments were also made at the EP, MP and LP, using 40 g ai/ha splited in two applications (in 3 weeks interval) of 20 g ai/ha each. The growth stage of corn and johnsongrass at the time of herbicide applications is indicated in Table 1. Individual plots were 1.6 m wide and 8 m long and consisted of two rows of corn.

TABLE1

Height and number of fully expanded leaves of corn and johnsongrass at the time of herbicide applications*.

Plants	EP	MP	LP	EPsq**	MPsq	LPsq
corn						
number of leaves:	4-5	6-7	9-11	4-5	6-7	9-11
height (cm):	13-20	35-50	>60	13-20	35-50	>60
Johnsongrass						
number of leaves:	1-2	4-5	5-7	1-2	4-5	5-7
height (cm):	3-7	13-20	30-45	2-7	13-20	30-45

* EP = Early postemergence, MP = Mid-postemergence, LP = Late postemergence, EPsq = Early postemergence sequential. MPsq = Mid-postemergence sequential, LPsq = Late postemergence sequential.
** The second application in sequential treatments was performed when johnsongrass regrowth was 10-15 cm tall.

All treatments were applied with a CO_2-pressurized backpack sprayer delivering 214 l/ha at a pressure of 210 kilopascals through flat fan spray tips. Non ionic surfactant[1] was added to all treatments at 0.25% volume/volume.
Estimates of johnsongrass control were made at 2, 3, 4 and 5 weeks after treatment (WAT) on a scale of 0% (no control) to 100% (complete death of the plant) based on population density and plant vigor. Corn grain moisture was adjusted to 15.5% after harvest. All data for johnsongrass control and grain yield were subjected to analysis of variance and means separated using Duncan's multiple range test at the 0.05 significance level.

Results and discussions

Johnsongrass control was dependent on the application timing. The MP applications resulted in more activity than the EP or the LP applications. Five weeks after treatment (1988), 67, 90 and 90% control were observed with 20, 30 and 40 g ai/ha respectively, applied at the MP timing (Table 2). During the same time, 27-67 and 50-80% control were recorded with the EP and the LP treatments respectively. With LP treatments johnsongrass growth was stopped and the weed was not completely killed. The low activity of EP applications was primarily due to the regrowth from rhizomes. Comparable results have been reported by other investigators (4,6,7,). With two applications of 20 g ai/ha, sequential treatments provided 90, 90 and 47% control of johnsongrass in 1988 with the EP, MP and LP treatments, respectively. In 1989, control ratings of 90, 72 and 70% were observed with the same treatments. Similar results have been found by Kaufman and Ritter (6) as well as Brown et al. (3). Although sequential applications required additional labor, they however provided full season control of johnsongrass. The incidence of maize dwarf mosaic virus (MDMV) and maize

TABLE 2

Johnsongrass control with varying rates of CGA-136872 applied at different timings*.

Application timing	Rate (g/ha)	Control in % 2 WAT 1988	3 WAT 1988	4 WAT 1988	4 WAT 1989	5 WAT 1988	5 WAT 1989
EP	20	44 d	37 f	27 f	-**	27 d	—
EP	30	50 cd	50 de	54 de	60 b	54 cd	43 d
EP	40	64 abc	57 cd	67 b-e	—	67 bc	—
MP	20	74 ab	74 ab	70 a-d	70 b	67 bc	60 cd
MP	30	60 bc	74 ab	77 abc	83 a	90 a	73 abc
MP	40	70 ab	77 ab	80 ab	93 a	90 a	88 a
LP	20	14 ef	40 ef	50 de	35 c	50 cd	60 cd
LP	30	20 e	34 f	47 e	40 c	60 c	70 abc
LP	40	20 e	50 de	60 b-e	45 c	80 ab	75 abc
EPsq	20 + 20	77 a	84 a	90 a	88 a	90 a	90 a
MPsq	20 + 20	60 bc	67 bc	57 cde	68 b	90 a	72 abc
LPsq	20 + 20	4 fg	30 f	30 f	38 c	47 d	70 abc
Control	0	0 g	0 g	0 g	0 d	0 e	0 e
LSD (0.05)		**12.6**	**11.1**	**18.7**	**11.0**	**16.6**	**19.0**

* Individual means for control ratings within a column followed by the same letter do not differ significantly at 0.05 level as determined by Duncan's multiple range test.
WAT = Weeks after treatment, EP = Early postemergence, MP = Mid-postemergence, LP = Late postemergence, EPsq = Early postemergence sequential, MPsq = Mid-postemergence sequential, LPsq = Late postemergence sequential.
** Missing data.

TABLE 3

Corn yield in 1988 as affected by different rates of CGA-136872 applied at different timings*.

Application timing	Rate (g ai/ha)	Yield** (kg/ha)
EP	20	2945 c-f
EP	30	4057 b-e
EP	40	4283 b-e
MP	20	5681 abc
MP	30	6000 abc
MP	40	7969 a
LP	20	2944 c-f
LP	30	1713 ef
LP	40	1300 ef
EPsq	20 + 20	6551 ab
MPsq	20 + 20	5466 a-d
LPsq	20 + 20	2287 ef
Control	0	174 f
	LSD (0.05)	**2940**

* Data not recorded in 1989 due to severe virus infections.
**Individual means for control ratings within a column followed by the same letter do not differ significantly at 0.05 level as determined by Duncan's multiple range test.
WAT = Weeks after treatment, EP = Early postemergence, MP = Mid-postemergence, LP = Late postemergence, EPsq = Early postemergence sequential, MPsq = Mid-postemergence sequential, LPsq = Late postemergence sequential.

[1] X-77, a mixture of alkylarylpolyxyethylene glycols, free fatty acids, and isopropanol, marketed by Chevron Chemical Co., 575 Market Street, San Francisco, CA 94120

chlorotic dwarf virus (MCDV) was found to be higher in treated plots compared to the control. This was for sure not due to a direct effect of herbicide treatment. Apart from competition, it is well known that one of the most destructive effect of johnsongrass is its role as the host and reservoir of maize viruses and their insect vectors. Therefore, limiting the interference of johnsongrass in treated plots may increase the attack of corn by insect vectors of MDMV and MCDV. An adequate insecticide treatment associated with herbicide application may be an alternative to solve this problem.

Yield data were not recorded in 1989 due to severe virus infections. In 1988 however, corn yield was higher with the MP treatments than the EP or LP treatments. Also, the EP and MP sequential treatments yielded more than the EP and the LP treatments (Table 3). These results relate very well with johnsongrass control ratings (Table 2 and 3). The highest yield (7960 kg/ha) was observed with 40 g ai/ha applied at the MP timing. This was followed by 6551 kg/ha with 20 g ai/ha applied at the EP sequential and 6000 kg/ha with 30 g ai/ha applied at MP timing. The lowest yield (174 kg/ha) was observed with the control treatments. This was due to competition with johnsongrass, and relates very well its level of infestation in the test plot.

Conclusion

The results of this research indicate high level of activity of CGA-136872 on johnsongrass. However, the application timing is very important for optimum control of the weed. The best results for weed control and corn yield are obtained either with high rates of the herbicide (40 g ai/ha) applied about 3 to 4 weeks after planting, or with two applications using low rates (20 g ai/ha). With these results, there is no doubt that CGA-136872 will constitute an important breakthrough in corn production for postemergence grasses control in general and johnsongrass in particular.

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