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Differential response of corn (*Zea mays* L.) to postemergence application of CGA-136872 at different growth stages.

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Keywords: Sulfonylurea herbicide — Application timing — Phytotoxicity.

Summary

*CGA-136872 injured corn more when applied at the 5-leaf stage than when applied at the 7- and 9-leaf stage of corn. Symptoms of herbicide phytotoxicity were primarily stunting and chlorosis. Most injury occurred with high rates (400 g ai/ha) and appeared during the first two weeks following treatment. At five weeks after treatment, corn recovery from injury was complete and no yield reduction was recorded. Yield loss occurred in the weedy check, due to competition with johnsongrass (*Sorghum halepense *(L.) Pers.), giant foxtail (*Setaria faberi *Herrn.), common lambsquarters (*Chenopodium album *L.) and redroot pigweed (*Amaranthus retroflexus *L.).*

Résumé

*Les applications du CGA-136872 sur le maïs ont causé plus de dégâts au stade 5-feuilles qu'aux stades 7- et 9-feuilles. Les symptômes de phytotoxicité de l'herbicide ont été principalement le nanisme et la chlorose. Durant les deux premières semaines après traitement, les parcelles ayant reçu la plus forte dose de l'herbicide (400 g ai/ha) ont été les plus affectées. Cependant, ces dégâts ont complètement disparu à la cinquième semaine après traitement et aucune diminution de rendement n'a été observée. Dans les parcelles non traitées par contre une importante réduction de rendement a été enregistrée à cause de la compétition avec les mauvaises herbes telles que le sorgho d'Alep (*Sorghum halepense *(L.) Pers.), le *Setaria faberi *Herrn., le *Chenopodium album *L., et *Amaranthus retroflexus *L.*

Nomenclature: CGA-136872, 2-[[[[4,6-bis(difluoromethoxy)-2-pyrimidinyl]amino]carbonyl]amino]sulfonyl] benzoic acid methyl ester; corn, Zea mays *L.*

Introduction

Different growth stages of a particular crop or weed may cause differential responses of these plants to herbicides, and should be considered during the development of a new product. The best time to apply an herbicide should correspond to the period where the crop is less susceptible and the weed more vulnerable. However, in many instances, the two plants may show parallel responses in susceptibility.

CGA-136872 is an experimental herbicide for postemergence use in corn (1). Research results indicate a high level of corn tolerance to this herbicide (2,3,4,5,6,11,12,13). With corn varieties Golden harvest and Pionneer 3902, Miller et al. (4,5,6) observed no injury at 25 days after treatment with 40 g ai/ha, regardless of the growth stage. Similar results have been reported by Orr (11) with the variety Pionneer 3377, Bohwik and Germond (2) with the variety Agway 584S and Smart et al. (12) with the varieties Pionneer 3377, 3475, 3379 and 3183. Vidrine et al. (13) also reported no corn injury with CGA-136872 with application at six weeks after planting. Brown et al. (3) reported no significant injury to corn 3 weeks after treatment with rates as high as 400 g ai/ha.

Significant corn injury by CGA-136872 has been reported, however, (7,9,15). With 20 to 40 g ai/ha which is the normal recommended rate for field testing (1), Mueller et al. (9) observed 13 to 16% corn stunting and up to 8% chlorosis. Mitich and Smith (7) recorded 30% corn injury with 400 g ai/ha. Recovery, however, was rapid, with no yield reduction. Differential response of corn to CGA-136872 at different growth stages has been reported (6,14). Wilson (14) showed that corn was more susceptible at the early stages (2-leaf) than later stages. With 70 g ai/ha Miller et al. (6) observed no symptoms with treatments at 5- and 8-leaf stage, but more than 50% injury and 5200 kg/ha yield reduction with treatment at the 2-leaf stage. The objective of this study was to evaluate corn tolerance to CGA-136872, as influenced by herbicide rate and application timing.

Materials and methods

Field experiments were conducted in the summers of 1988 and 1989 in Blacksburg,Va to evaluate the response of corn to CGA-136872, using a factorial combination of application timings and herbicide rates.

The site of the experiment consisted of a Ross loam (fine-loamy, mixed, mesic cumulic Hapludolls) of 2% organic matter and pH 6.1. A natural infestation of johnsongrass, giant foxtail, common lambsquarters and redroot pigweed was present. 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. Corn was grown using conventional tillage and was planted May 23, 1988 and May

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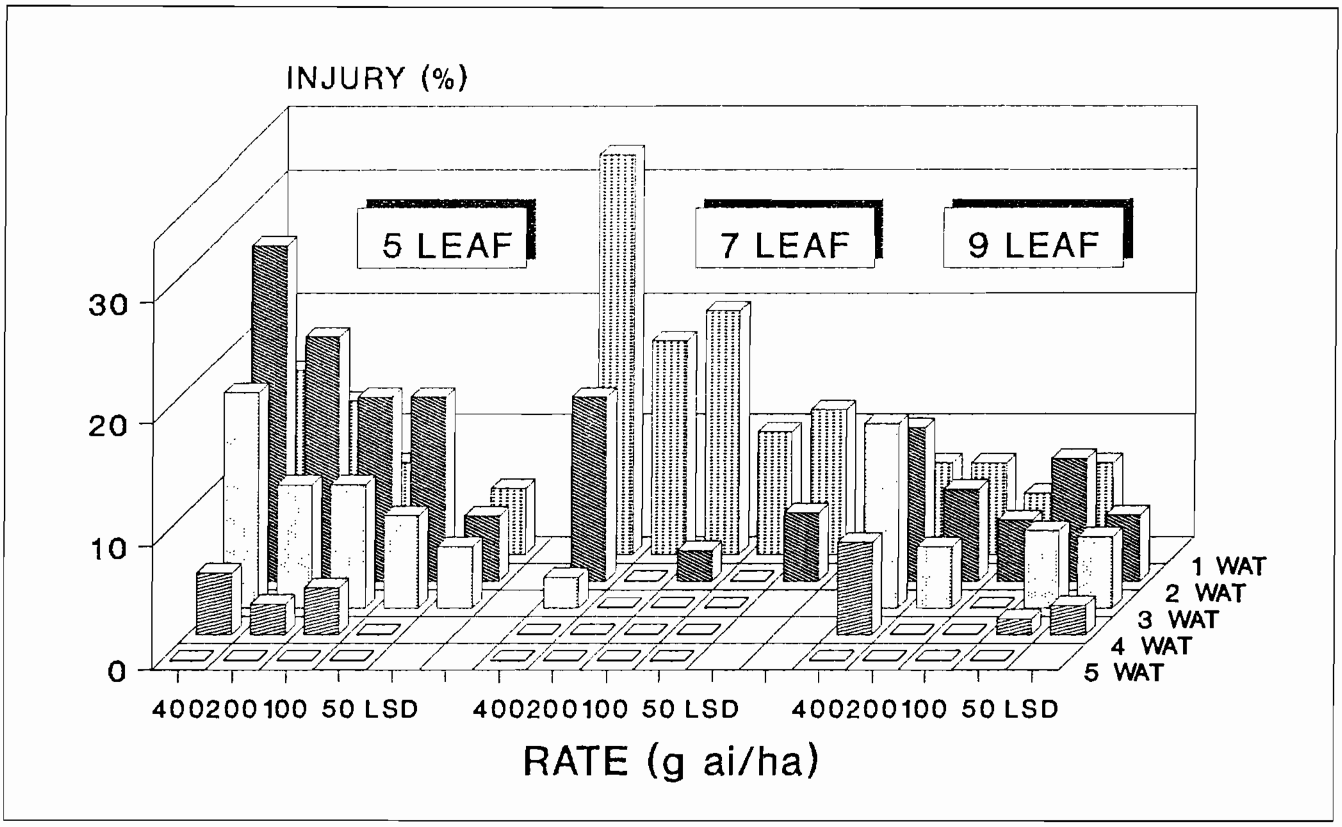

Figure 1 — Corn injury following postemergence application of CGA-136872 at different rates and timings (1988).
Notes: 1 No significant difference where LSD is not presented. 2 WAT: Weeks after treatment
3 Injury levels recorded on a 0 to 100% scale with 0% indicating no injury (chlorosis or stunting) and 100% indicating death of the crop.

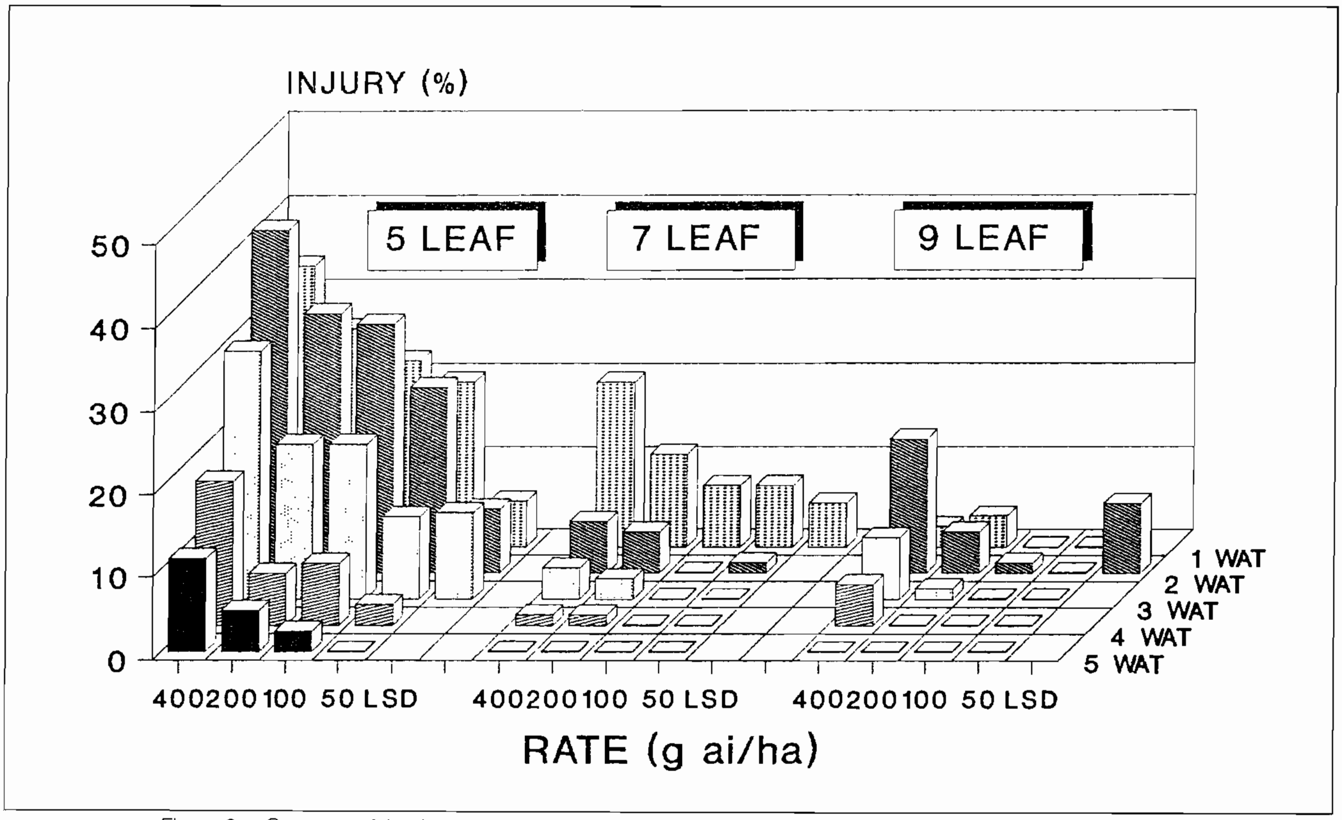

Figure 2 — Corn injury following postemergence application of CGA-136872 at different rates and timings (1989).
Notes: 1 No significant difference where LSD is not presented. 2 WAT Weeks after treatment.
3 Injury levels recorded on a 0 to 100% scale with 0% indicating no injury (chlorosis or stunting) and 100% indicating death of the crop.

18, 1989. The experiment contained a two-way herbicide rate by application timing (5 by 3) factorial in a randomized complete block design of four replications. Herbicide rates were 0, 50, 100, 200 and 400 g ai/ha, corresponding to 0, 1.2, 2.5, 5 and 10 times the recommended rates, respectively. For the timing factor, CGA-136872 was applied at the 5-, 7- and 9-leaf stages of corn, corresponding to 15-20, 35-40 and 90-110 cm tall plants, respectively. The number of fully expanded leaves was used to determine leaf stages, and the final number of leaves was about 14 to 15. A weedy check was used in 1988 and a weed free check in 1989.

All treatments were applied to 1.5 m wide by 8 m long plots containing 2 rows of corn, with a CO_2-pressurized backpack sprayer delivering 214 l/ha at a pressure of 210 kPa through flat fan spray tips. Non ionic surfactant (X-77) was added to all treatments at 0.25% volume/volume. Herbicide applications were made early in the morning when the wind was calm, and nozzle tips held at about 35 cm on top of the crop to avoid spray drift from neighboring plots. Estimates of percent corn injury were made at 1, 2, 3, 4 and 5 weeks after treatment, using a 0 to 100% scale, with 0% indicating no injury (chlorosis or stunting) and 100% indicating death of the corn plant. Yield data were obtained at harvest and grain moisture was adjusted to 15.5%.

All data were subjected to analysis of variance and means were separated using Duncan's multiple range test at the 0.05 significance level. Homogeneity of variance procedures did not allow combination of data from separate years. In individual tables, means have been separated within individual levels of factors when a significant ($\alpha \leqq 0.05$) interaction occurred.

Results and discussion

Symptoms of CGA-136872 injury were primarily stunting and chlorosis. Most injury was observed 1 or 2 weeks after treatment (WAT). However, at 5 WAT, corn recovered completely from injury and showed no observable symptoms (figures 1 and 2). Applications at the 5-leaf stage generally resulted in the highest level of injury (table 1, figures 1 and 2). In 1989, treatments applied at the 7- and 9-leaf stage did not cause significantly different crop injury (table 1). In 1988, 400 g ai/ha caused the highest level of injury, irrespective of the application timing (table 1). Injury levels of 16.3, 12.5 and 10.7% were observed for applications at the 5-, 7- and 9-leaf stage, respectively. With 400 g ai/ha applied at the 5-leaf stage, the greatest injury was recorded during both years with 16.3 and 30.7% injury for 1988 and 1989, respectively (table 1). At 5 WAT, all herbicide rates provided over 85% control of the four weed species (johnsongrass, giant foxtail, common lambsquarters and redroot pigweed).

In general, more injury was observed in 1989 compared to 1988. During the period from one week before the first treatment to one week after the last treatment, rainfall was 110 mm in 1988 and 250 mm in 1989. This difference in rainfall may account for the difference in injury levels observed during the two years. Roggenbuck and Penner (10) have demonstrated increased injury to corn from postemergence applications of trifluralin (2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine), when the crop is growing under conditions of high soil moisture.

Generally, corn yield was improved by CGA-136872 applications. In 1988, treated corn produced yield higher than the weedy check (table 2). In this treatment, corn was allowed to compete with weeds while herbicides application completely suppressed these weeds in other treatments. This result indicates that the effect of herbicide phytotoxicity even with the highest rate (400 g ai/ha) reduced yield less than weed competition. In 1989, the control treatment was kept weed free, and no significant difference in yield was observed between treatments. This result shows that, with CGA-136872 rates as high as ten times the suggested use rate, corn reco-

TABLE 1

Corn injury following postemergence applications of different rates of CGA-136872 applied at three different growth stages (1).

Year	Rates	Growth stage		
	(g ai/ha)	5-leaf	7-leaf	9-leaf
1988		% injury (2)		
	0	0 Da	0 Ca	0 Da
	50	6 Ca	2 BCa	6 Ba
	100	9 Ba	6 Bb	2 CDc
	200	11 Ba	4 Bb	5 BCb
	400	16 Aa	12 Aa	11 Aa
989				
	0	0 Ca	0 Ca	0 Aa
	50	14 Ba	2 Cb	0 Ab
	100	20 Ba	2 Cb	0 Ab
	200	21 Ba	5 ABb	2 Ab
	400	31 Aa	8 Ab	8 Ab

l) Individual means for herbicide rates within a year and within a column ›llowed by the same upper case letter and timing means within a row fol- ›wed by the same lower case letter do not differ significantly at the 0.05 ›vel as determined by Duncan's multiple range test. Mean separation pro- ›edures performed for levels within a factor due to significant interaction. ach mean represents the average injury over the first four weeks following eatment.

') Injury recorded using a 0 to 100% scale with 0% indicating no injury hlorosis of stunting) and 100% indicating death of the crop.

TABLE 2

Corn yield as affected by postemergence applications of CGA-136872 applied at three different growth stages (1).

Year	Rates	Growth stage			Mean
	(g ai/ha)	5-leaf	7-leaf	9-leaf	
1988		kg/ha			
	0 (2)	7870	7870	7870	7870 B
	50	9640	9370	8410	9140 AB
	100	9560	9450	9910	9640 A
	200	10030	12340	8450	10270 A
	400	10680	9720	7850	9410 A
	Mean	9550 a	9750 a	8490 a	-
1989 (3)					
	0	8420	8420	8420	8420 A
	50	8550	7780	9070	8460 A
	100	8270	8180	8600	8350 A
	200	8660	8630	8870	8720 A
	400	7820	9200	7150	8050 A
	Mean	8340 a	8440 a	8420 a	-

(1) In individual years, herbicide rate means within a column followed by the same upper case letter and timing means within a row followed by the same lower case letter do not differ significantly at the 0.05 level as determined by Duncan's multiple range test.
(2) A single control treatment was used.
(3) No significant effect of treatments was observed.

vered completely from injury by 5 WAT, with no yield loss. Also, no delay in the maturity date of corn was observed. Similar results have been found by other researchers (8,9,15). This suggests a high level of safety of CGA-136872 for postemergence use in corn.

Conclusion

CGA-136872 is an experimental sulfonylurea herbicide that has shown very good potentials for selective postemergence control of many grass and broadleaf weed species in corn. Our study indicates that slight crop injury may occur when high rates are applied at the earlier stages of corn growth.

However, yield is not generally affected. Within the suggested use rate range (20 to 40 g ai/ha), corn showed excellent level of tolerance to this herbicide and adequate weed control was observed. This used rate seems well adapted for both crop tolerance and weed control.

These results indicate that CGA-136872 could represent an important supplement to existing selective postemergence corn herbicides.

Literature

1. Anonymous, 1988. Beacon herbicide. Technical release. Agricultural division, CIBA-Geigy Corporation, Greensboro, NC. 8 p.
2. Bhowmik P.C. & Germond B.J., 1989. Postemergence quackgrass control in field corn. Proc. Northeast. Weed Sci. Soc. **43**: 17
3. Brow W.B., Defelice M.S. & Perkins C.S., 1988. Postemergence grass control in corn. Proc. North Cent. Weed Cont. Conf. **43**: 31-32.
4. Miller S.D., Ball D.A. & Dalrymple A.W., 1989. Wild proso millet control in corn with postemergence herbicide treatments. Research progress report, West. Soc. Weed Sci. p. 288-289.
5. Miller S.D., Dalrymple A.W. & Krall S.M., 1989. Evaluation of postemergence herbicide treatments in corn. Research progress report, West. Soc. Weed Sci. p. 292-293.
6. Miller S.D., Dalrymple A.W. & Krall S.M., 1989. Corn tolerance to postemergence application of DPX-V9360 and CGA-136872. Research progress report, West. Soc. Weed Sci. p. 294-295.
7. Mitich L.W. & Smith N.L., 1989. Evaluation of preplant incorporated, postemergence and sequential herbicide treatments in field corn. Research progress report, West. Soc. Weed Sci. p. 296-297
8. Moshier L.J., Delvin D.L., Morishita D.W. & Camacho R.F., 1988. Johnsongrass control in corn with CGA-136872, DPX-V9360 and KIH-2665. Proc. North Cent. Weed Cont. Conf. **43**: 25.
9. Mueller T.C., Bridges D.C. and Banks P.A., 1989. Postemergence johnsongrass control in corn. Proc. South. Weed Sci. Soc. **42**: 44.
10. Roggenbuck F.C. & Penner D., 1987. Factors influencing corn (*Zea mays*) tolerance to trifluralin. Weed Sci. **35**: 89-94.
11. Orr J.P., 1989. Johnsongrass control in field corn. Research progress report, West. Soc. Weed Sci. p. 298-299.
12. Smart J.R., Mortensen D.A. & Roeth F.W., 1988. Methods of evaluating corn tolerance to postemergence grass herbicides. Proc. North Cent. Weed Cont. Conf. **43**: 24.
13. Vidrine P.R., Reynolds D.B. & Griffin J.L., 1989. Comparison of postemergence grass herbicides in corn. Proc. South. Weed Sci. Soc. **42**: 50.
14. Wilson R.G., 1988. Comparison of DPX-V9360, CGA-136872 and tridiphane for weed control in corn. Proc. North Cent. Weed Cont. Conf. **43**: 19.
15. Worsham A.D. & Saunders E., 1989. Johnsongrass control postemergence in corn with DPX-V9360 (Accent), CGA-136872 (Beacon) and SD-63596. Proc. South. Weed Sci. Soc. **42**: 51

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