SOIL PERSISTENCE OF CYANAZINE UNDER FIELD CONDITIONS IN HUMID TROPIC[1]

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ABSTRACT - The persistence of cyanazine {2-[[4-chloro-6(etylamino)-s-triazin-2-yl] amino]-2 metylpropionitrile} applied in pre-emergence at 1.25, 1.75 and 2.25 kg/ha was studied under field conditions during three years. A phytotron bioassay using oat (*Avena sativa* L.) showed that cyanazine was not present at phytotoxic levels in the top soil samples (0-10 cm depth) taken from treated plots four weeks after treatment in areas cultivated with soybeans.

Index terms: herbicides, bioactivity, bioassay.

PERSISTÊNCIA DA CYANAZINE NO SOLO EM CONDIÇÕES DE CAMPO EM CLIMA TROPICAL ÚMIDO

RESUMO - A persistência, no solo, da cyanazine {2-[[4-cloro-6-(etilamino)-s-triazina-2-il] amino]-2-metilpropionitrila} aplicada em pré-emergência a 1,25, 1,75 e 2,25 kg/ha, foi estudada em condições de campo durante três anos. Bioensaios conduzidos em fitotron, utilizando-se aveia (*Avena sativa* L.) como planta indicadora da bioatividade do herbicida, mostraram que cyanazine não se encontra presente em níveis fitotóxicos a plantas sensíveis na camada superficial do solo de 0-10 cm, amostrado das parcelas tratadas, quatro semanas após o tratamento em áreas cultivadas com soja.

Termos para indexação: herbicidas, bioatividade, bioensaios.

INTRODUCTION

Cyanazine is a s-triazine first introduced in 1972 as a soil-applied herbicide for selective weed control of annual grasses and broadleaf weeds in soybeans and other crops. It is applied to soil as a preemergence treatment.

The persistence of soil-applied herbicides is of concern during the period in which weed control is required and also in regard to potential damage to succeeding susceptible crops.

In all world crop growers and weed scientists have been f-life of 6 days, under climate conditions of two corn fields in Quebec, Canada.

The triazine-soil and triazine-climate interactions and their role influencing triazines persistence have been studied extensively in moderate climate (Dubach, 1970; Sheets, 1970; Libik & Romanowski, 1976). However, very little information is available on this subject in the humid and subhumid tropics, mainly under Brazilian conditions where there are no reports on cyanazine-soil interactions.

MATERIALS AND METHODS

Field studies

The investigations were conducted at Ribeirão Preto (1986), Sales de Oliveira (1987) and Aguaí (1989) in São Paulo State, Brazil. Data on the physical and chemical properties of soils from the experimental sites, together with rainfall and air temperature during the study period are given in Tables 1-3.

The experimental procedure the choose of a soybean grower and to apply pre-emergence treatment of cyanazine after the area was seeded in November. The experimental design was a randomized complete block with split-plot for timing of soil samples with four

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TABLE 1. Physical and chemical characteristics of the soils used in the persistence studies.

Year and location	Texture			pH ------- $CaCl_2$	O.M.[a]	Sand	Silt	Clay	CEC[b] (T)
					----------	%	----------		(meq/100g)
1986, Ribeirão Preto	Sandy	Clay	Loam	5,8	3,0	65,0	9,0	26,0	3,7
1987, Sales de Oliveira		Clay		5,1	4,8	48,0	10,0	42,0	9,8
1989, Aguaí	Sandy		Loam	4,9	2,2	78,8	4,9	16,3	4,9

[a] O.M. = Organic matter content as determined by colorimetric method
[b] CEC = Cation exchange capacity as determined by extraction of ions by ion-exchange resin

TABLE 2. Amount of rainfall (mm) during the period of study.

Location	Year	Weeks after treatment						Total rainfall
		0[a]	3	6	9	12	15	
Ribeirão Preto	1986	57,0	246,3	596,2	138,6	325,0	121,0	1484,1
		0[a]	2	4	6	8	10	
Sales de Oliveira	1987	76,0	38,0	24,0	87,0	77,0	33,0	335,0
		0[a]	1	2	3	4	5	
Aguaí	1989	29,0	27,4	0,0	91,2	7,6	16,8	172,0

[a] Recorded 1 week before cyanazine application

TABLE 3. Average air temperature (°C) during the period of study.

Location	0-lst Sample	lst-2nd Sample	2nd-3rd Sample	3rd-4st Sample	4-5st Sample
Ribeirão Preto, 1986	25.1	23.8	26.5	25.0	24.7
Sales de Oliveira, 1987	25.1	24.8	24.2	23.4	27.1
Aguaí, 1989	24.1	25.9	24.4	23.7	23.0

replications in the 1986, and six replications in the 1987 and 1989 experiments. Plot size was 5m by 4m with 9 soybean rows spaced 0.50m. Cyanazine was applied at rates of 1.25, 1.75 and 2.25 kg/ha. Soil samples were taken at random from treated plots between soybean rows with a soil probe immediately after treatment and following intervals of three weeks after treatment (WAT) in 1986, and intervals of 2 WAT (1987) and 1 WAT (1989). Samples from all soils consisted of a mixture of two cores per plot to a depth of 0-10cm.

The lowest dose of cyanazine in this study reflects the normally recommended rate in Brazil; the highest rate is higher than 1.75 kg/ha recommended in soils with more than 4% organic matter.

Phytotron bioassay

Soil samples were stored in freezer (-15°C) and thoroughly mixed and sieved (sieve 0.2cm mesh) before bioassay. Two plastic pots were filled with 250g soil from each sample and 10 oat seeds sowed/pot. The seedlings were thinned down to six, two days after emergence. Plants were grown under a 12-h photoperiod with day-night temperature of approximately 24 and 20°C, respectively, under 16 Klux supplied by normal and fluorescent lights and 70 ± 10% of relative air humidity. The soil pots were watered daily to keep soil field capacity. After 21 days the fresh weight of six whole-plants per pot were recorded.

Statistical analyses

Bioassay experiments were conducted for three years, each year at a different location. A split-plot randomized complete block for time after treatment like subplots with 16 or 24 soil samples from each time (four treatments with four or six replications) was used for each bioassayed experiment. Cyanazine residues were assayed by measuring the fresh weight of oat shoots and analysed by ANOVA. Treatment means were compared using least significant differences (LSD) at the 5% level of significance by Tukey test. Bioassay data are expressed as percent of the shoot weight of plants grown in untreated soil.

RESULTS AND DISCUSSION

Despite its great initial toxicity, cyanazine was rapidly dissipated from all soils (Fig. 1, 2 and 3).

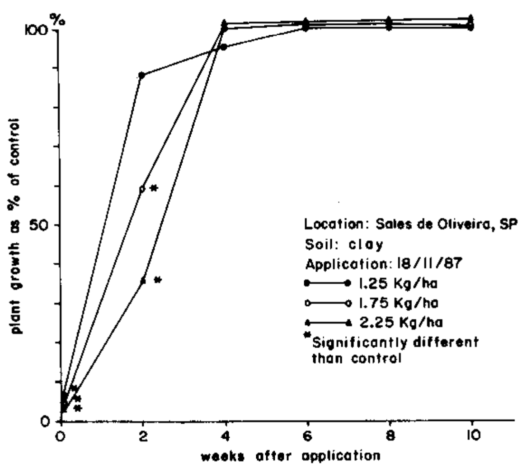

FIG. 1. Persistence of cyanazine in sandy clay loam soil as measured by seedling oat bioassays. Vertical bar indicate LSD P < 0.05.

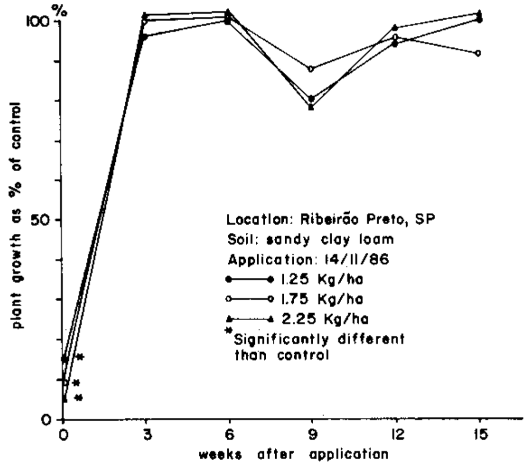

FIG. 2. Persistence of cyanazine in clay soil as measured by seedling oat bioassays. Vertical bar indicate LSD P < 0.05.

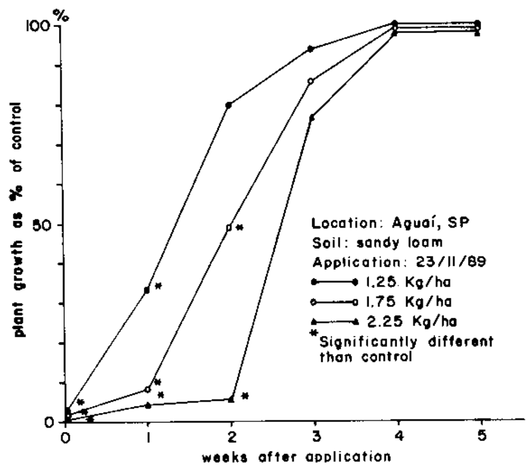

FIG. 3. Persistence of cyanazine in sandy loam soil as measured by seedling oat bioassays. Vertical bar indicate LSD P < 0.05.

The results were similar in all experiments. The apparent differences are explained by the different sampling intervals used each year.

These results showed no phytotoxic effects of cyanazine on sensitive plants three weeks after treatment (WAT) even in the higher recommended rates (1.75 and 2.25 kg/ha); 1.75 was also the highest rate for the experiments 1986 and 1989 as the organic matter content in these soils was below 4%.

Yoo et al. (1981) also showed that cyanazine has a relatively short persistence in soil with its half-life of six days in Quebec, Canada.

It is possible that the high temperatures recorded (Table 3) are the main factor to explain the dynamic of cyanazine degradation in these trials. Majka & Lavy (1977) reported that cyanazine was degraded more rapidly at higher temperature than at 5°C. Cyanazine was usually decomposed at 10th week at 5°C and at 5th week at higher temperatures. The aerobic half-lives for cyanazine were 1.40 months and 4.35 months at 30 and 15°C respectively (Ginzerich & Zindahl, 1976).

Cyanazine is water-soluble (171 ppm at 25°C) but it does not appear to leach appreciably to lower soil depths (Muir & Baker 1978). Yoo et al. (1981) found out that the major portion (greater than 95%) of cyanazine residues was detected in 0 to 20cm depth. Based on this, it is presumed that the rapid disappearance of cyanazine in upper 10cm soil depth was not by downward movement, despite the high indices of rainfall during the study period (Table 2).

The assertion of Best & Weber (1974) that triazines break down more rapidly at low soil pH could have influenced the action of cyanazine in these trials.

The results in this study show that cyanazine dissipated rapidly under hot and humid field conditions and has a short persistence in soils in the São Paulo State. In these conditions corryover into the next growing season or leaching below the plow layer would not be expected. This study shows that cyanazine can be used in a given growing season and followed safely in the next season with crops that are sensitive to it.

CONCLUSION

1. A phytotron bioassay carried out during three years in three differents soils cultivated with soybeans crop indicated relatively short cyanazine persistence under hot and humid field conditions in São Paulo State, Brazil.

2. These soils showed no phytotoxic effects of cyanazine on sensitive plants three weeks after treatment even in the higher recommended rates (1.75 and 2.25 kg/ha).

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