The EFFECT of SIMAZINE on *Tripsacum dactyloides* L.

A Thesis

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by

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INTRODUCTION

Ahring and Frank (1968) stated that Tripsacum dactyloides L. (eastern gamagrass) has been recognized for over a century as a nutritious, palatable hay and as a productive range plant by range specialists and stockmen. Eastern gamagrass is difficult to establish, either due to adverse environmental conditions or the low germination values of the seeds. A method that increases the percentage of germination could be beneficial in establishing gamagrass as a range plant.

Simazine, 2-chloro-4,6-bis(ethylamino)-s-triazine, is widely used as a selective herbicide and is usually applied prior to weed emergence (Allinson and Peters, 1970). Laboratory studies have shown simazine, at low concentrations, to increase growth and total protein content in seedlings of individual graminaceous plants (Ries and Gast, 1965; Pulver and Ries, 1973; Fink and Fletchall, 1967). Kozlowski and Torrie (1965) reported no significant difference of germination rates between control and soil incorporated simazine treated lots of pine seeds, although simazine was very toxic to 10 day old pine seedlings. It can be observed that simazine enhances growth of grasses and at the same time inhibits competition from weeds and seedling trees.

Laboratory experimentation data on the effects of simazine on the germination of grasses was not available and it is assumed few or no studies have been made. Personal communication with Leonard Jurgens indicated that the use of simazine, as a pre-emergent herbicide, stimulated germination and seedling growth of eastern gamagrass. The purpose of this research was: 1) to study the effects

of simazine on the germination of T. dactyloides and 2) to study the effect of simazine on initial (seedling) growth.

MATERIALS AND METHODS

Two different sources of T. dactyloides seeds were used. Both were obtained from the United States Department of Agriculture; Soil Conservation Service, Manhattan Plant Materials Center. Seed source I was noted to have an eight per cent germination rate. Seed source II was noted to have a 17 per cent germination rate and was malathion treated. Both sources were from the same lot (PMK-24). Source I was harvested in 1972 and source II in 1971.

Princep 80W, or simazine, a product of Geigy Chemical Company, was furnished by Teichgraeber Milling Company Incorporated. The simazine used in this research was a wettable powder.

Preparation of potting media and flats

Enough potting media was mixed to cover the bottoms of 7.5, 43 by 35 cm plastic flats, to a depth of approximately five cm. The media was prepared by mixing peat (trade name Vitahume), white silica sand and water-saturated sphagum in equal proportions. The media was saturated with water and placed in the pourous bottom flats immediately prior to planting the gamagrass seeds. Each flat was then divided into four equal parts using cardboard strips.

Preparation of simazine solutions and seed treatment

Eight different samples of simazine were weighed on a Mettler HR 10 balance. Two of the samples were 10 mg each, two were 25 mg each, two were 50 mg each and two were 100 mg. Each sample was mixed with 100 ml of distilled water.

Five different samples of five grams each were chosen at random from each seed source and weighed on the Mettler HR 10 bal-

ance. Four of the five seed samples, from both seed sources, were then placed separately in each of the above simazine solutions for one hour. This gave one treatment from each seed source the ratio 500:1 of mg seeds to mg of simazine, one from each source the ratio of 200:1, one from each source of the ratio 100:1, one from each source 50:1 and one five gram seed sample from each source not treated (control). Seventy-five seeds from each solution were planted in the flats. There were three plots of 25 seeds each of the 10 treatments.

Larger seed samples were planned but due to technical difficulties with a growth chamber, the size of the seed samples was reduced. The larger samples would have made more reliable data to test statistically.

Preparation of the growth chamber and watering procedure

The flats were placed in a growth chamber for a period of 91 days. The chamber controls were set to give 16 hours of light (day) and eight hours of darkness (night). The day temperature was set at 22.2 C and the night temperature was set at 16.6 C.

The flats were watered with tap water every two or three days. The amount of water varied from 1000 ml to 6000 ml for each watering, depending upon the dryness of the potting media.

Assay of seed germination and initial growth

At one week intervals the total number of seeds germinated for each plot were counted and recorded. At the end of the growing period (13 weeks), the percentage of germination relative to control and Student's *t* statistical test was calculated for each

treatment of both seed sources. A histogram for each treatment of both seed sources was made to determine frequency distribution (germination rate). After the 13 week period, the height of each plant was measured and mean height for each treatment calculated and recorded. The plants were then removed from the flats and placed in a dryer (a Chicago Apparatus Company product) for 24 hours at 35 C. The roots were then separated from the stem of each plant and weighed separately on a Mettler HR 10 balance. The mean dry weights of the roots and stems were calculated and recorded separately for each treatment.

RESULTS AND DISCUSSION

Germination results of the simazine treated T. dactyloides seeds from seed source I indicated that all ratios of mg seeds to mg simazine stimulated germination, except the 200:1 and 50:1 ratios (Table I). The greatest per cent germination relative to control occurred with the 100:1 ratio (133 %) and the 500:1 ratio (122 %). These data showed that simazine in 100:1 and 500:1 ratios stimulated eastern gamagrass germination, the 200:1 ratio was inhibitory and the 50:1 showed no effect.

The results of simazine treated eastern gamagrass seeds from source II showed that all ratios stimulated germination (Table II). The greatest stimulation occurred with the 500:1 (333 %) and the 50:1 (250 %) ratios.

These data indicated that simazine, except for the 200:1 ratio of source I, was not detrimental to T. dactyloides germination and generally increased germination. Pillai and Davis (1973) also noted an increased germination percentage with simazine treated lettuce seeds (Lactuca sativa L.).

Although source I and II germination percentages were relatively consistent with the expected eight per cent and 17 per cent, comparatively the two seed sources showed different results. The effect of simazine on source II germination was greater than source I, the 500:1 ratio showed a greater germination percentage than the 100:1 ratio, the 200:1 ratio was not detrimental and the 50:1 ratio showed a marked increase in germination. The differences could have been due to the different ages of the seed sources or because source II was treated with malathion, thus causing a

TABLE I. The total number of T. dactyloides seeds from source I that germinated at the end of 13 weeks and percentage relative to control.

Ratio (mg seeds/mg simazine)	Total Number of Seeds Germinated	Per Cent Germination
Control	9	100 %
500:1	11	122 %
200:1	5	55 %
100:1	12	133 %
50:1	9	100 %

TABLE II. The total number of T. dactyloides seeds from source II that germinated at the end of 13 weeks and percentage relative to control.

Ratio (mg seeds/mg simazine)	Total Number of Seeds Germinated	Per Cent Germination
Control	6	100 %
500:1*	20	333 %
200:1	9	150 %
100:1	8	133 %
50:1*	15	250 %

* significantly different from control at the .05 level

synergism between malathion and simazine.

Analysis of germination rates for the treatments of source I indicated that the 500:1 ratio (relative to control) decreased the germination time within the first 56 days (Figure 1). The 200:1 ratio was not considered since the germination percentage was less than the control. All other ratios showed a decreased germination rate within the same period (Figure 2). These data indicated that the 500:1 ratio decreased germination time more than the control within the first 56 days. From 57 to 91 days the 100:1 ratio showed the greatest germination rate.

The results of source II germination rates showed all ratios of mg seeds to mg simazine decreased germination time relative to control (Figures 3 and 4). The greatest germination rate was the simazine treated seeds of the 500:1 ratio. This ratio was the most logical treatment to use for eastern gamagrass propagation since it increased germination percentage and decreased germination time.

It was worthless to use a chemical that enhanced germination and hindered seedling growth. Therefore, evaluation of initial (seedling) growth was necessary.

Source I showed a decreased height of T. dactyloides with an increased simazine concentration (Table III). Conversely, source II showed increased height with increased simazine concentrations to the 200:1 ratio, increased herbicide concentration reduced height.

Analysis of top and bottom dry weights of T. dactyloides from source I indicated with decreased mg seeds to mg simazine ratio

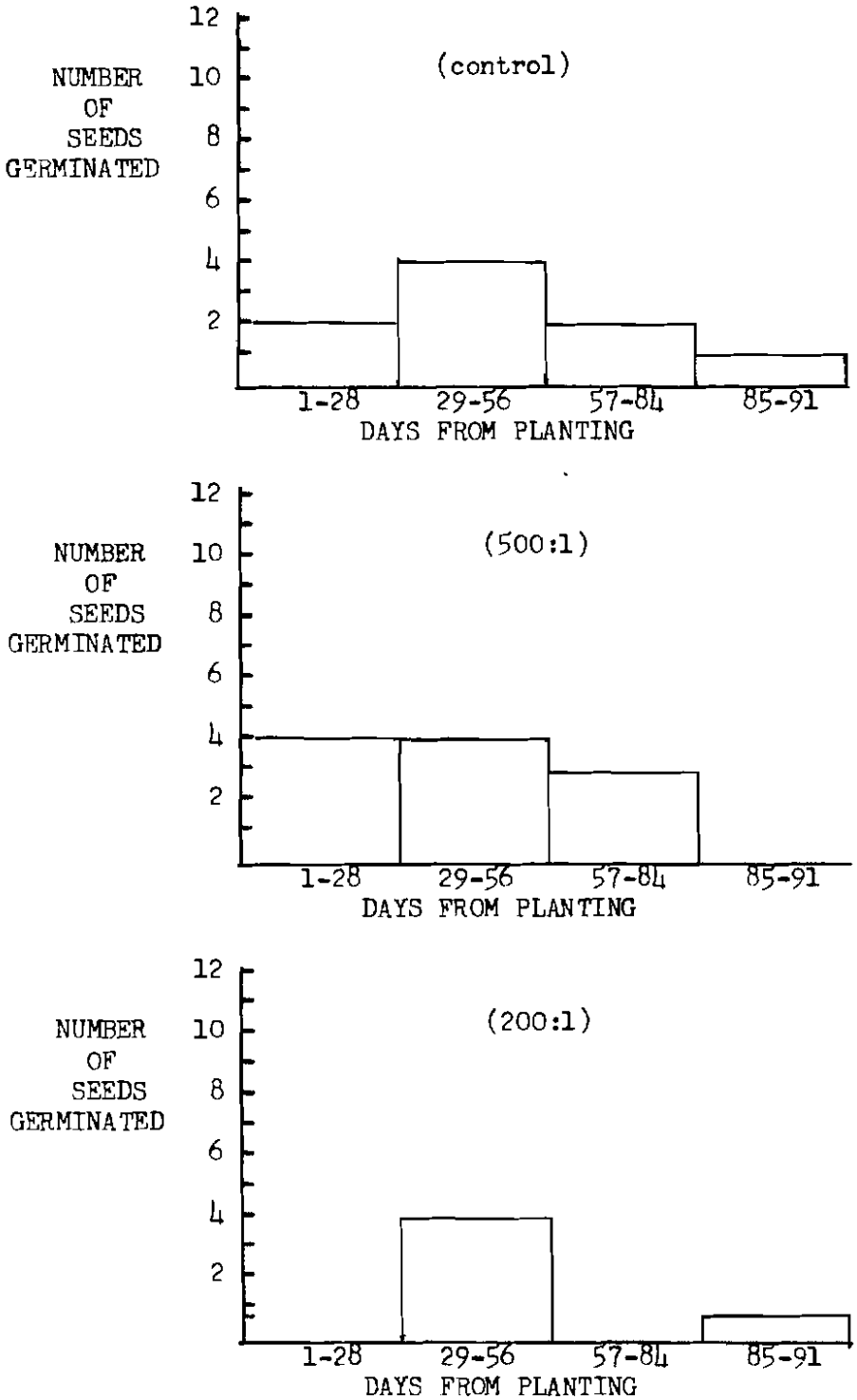


Figure 1. Histograms for determination of germination rates of control, 500:1 and 200:1 ratios from source I.

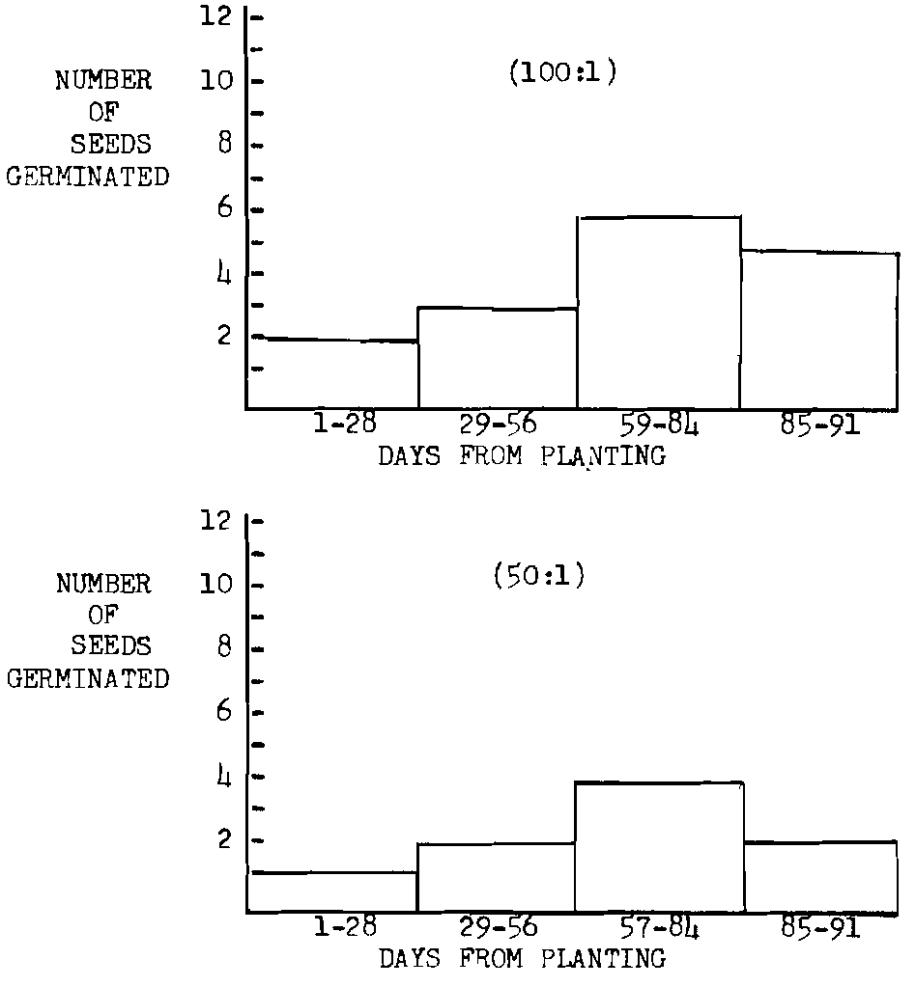


Figure 2. Histograms for determination of germination rates of 100:1 and 50:1 ratios from source I.

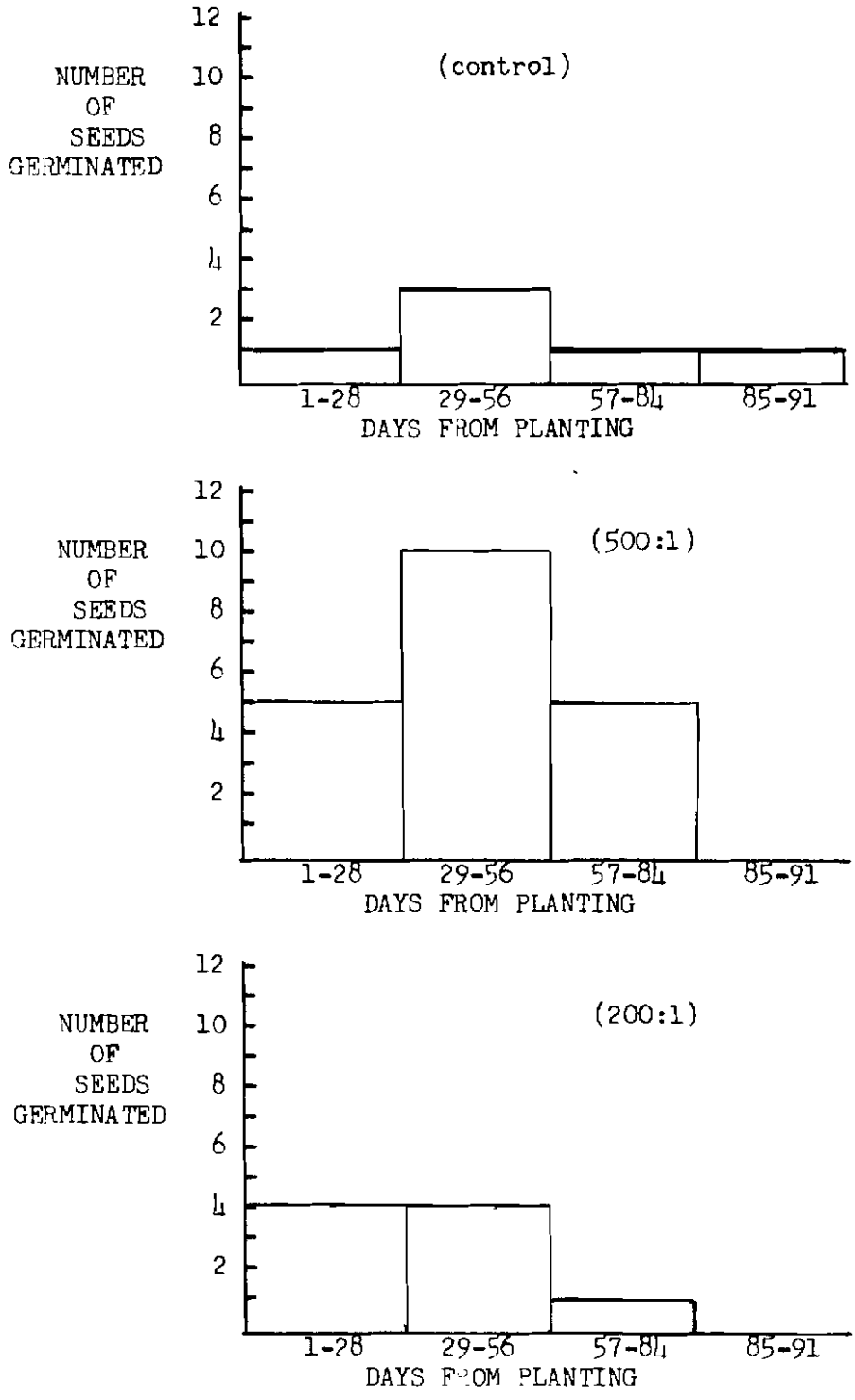


Figure 3. Histograms for determination of germination rates of control, 500:1 and 200:1 ratios from source II.

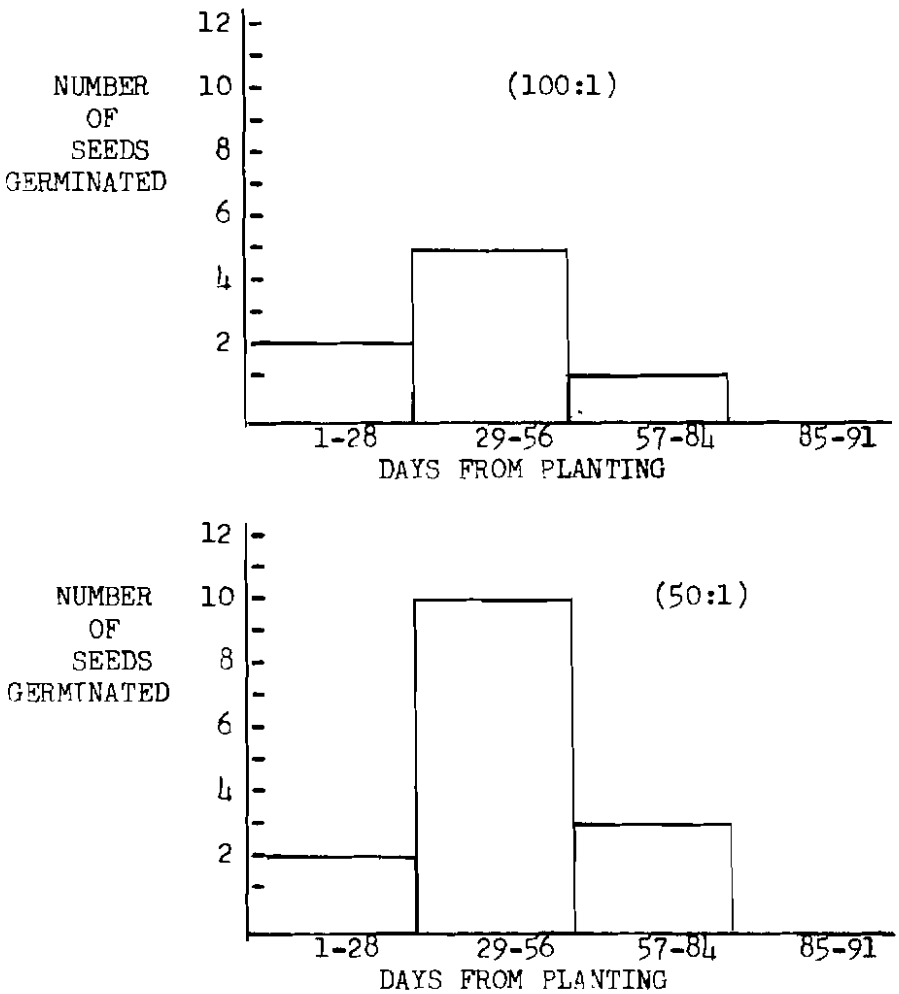


Figure 4. Histograms for determination of germination rates of 100:1 and 50:1 ratios from source II.

TABLE III. Mean height of simazine treated *T. dactyloides* from source I.

Ratio (mg seeds/mg simazine)	Mean Height (cm)
Control	31.27 cm
500:1	30.72 cm
200:1	29.25 cm
100:1	25.38 cm
50:1	17.38 cm

TABLE IV. Mean height of simazine treated T. dactyloides from source II.

Ratio (mg seeds/mg simazine)	Mean Height (cm)
Control	33.83 cm
500:1	37.43 cm
200:1	39.28 cm
100:1	38.00 cm
50:1	34.73 cm

there was a corresponding decreased mean dry weight (Table V). Source II mean dry weights of tops and bottoms suggested that simazine stimulated shoot and root development with a decreased ratio to 200:1 (Table VI). Decreased ratios beyond 200:1 decreased mean dry weights.

It was concluded that simazine treatment of source I seeds retarded initial growth and treatment of source II stimulated eastern gamagrass growth. This difference in effect could have been due to the different ages of the seed sources, the older seeds (source II) showed the stimulatory effect on initial growth. The older seed source could have shown this stimulatory effect on initial growth due to a synergistic phenomenon of malathion plus simazine or a combination of older seeds with malathion. No conclusion on the causative factor was made.

Since germination of simazine treated T. dactyloides seeds in some instances was increased, simazine may have a characteristic that stimulated germination. This suggested that simazine was able to cause tissues to differentiate and to form buds. Pillai and Davis (1973) observed that simazine parralleled the effects of kinetin in their lettuce seed germination tests. Kinetin is a cytokinin and the ability of tissues to differentiate in culture and to form buds was found to depend on the presence of a high enough ratio of cytokinin to auxin (Levitt, 1969). Possibly simazine stimulated kinetin production or resembled kinetin activity in eastern gamagrass seeds. This latter statement was hypothetical and was not supported by this research or literature reviewed.

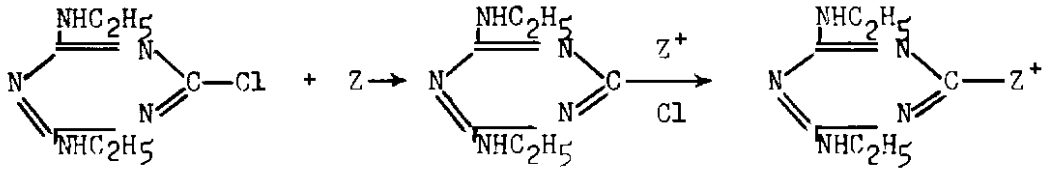
TABLE V. Mean dry weights of tops and bottoms of simazine treated T. dactyloides from source I.

Ratio (mg seeds/mg simazine)	Mean Oven Dry Weights	
	tops (vegetative)	bottoms (roots)
Control	0.13 gram	0.15 gram
500:1	0.10 gram	0.15 gram
200:1	0.08 gram	0.09 gram
100:1	0.07 gram	0.10 gram
50:1	0.05 gram	0.09 gram

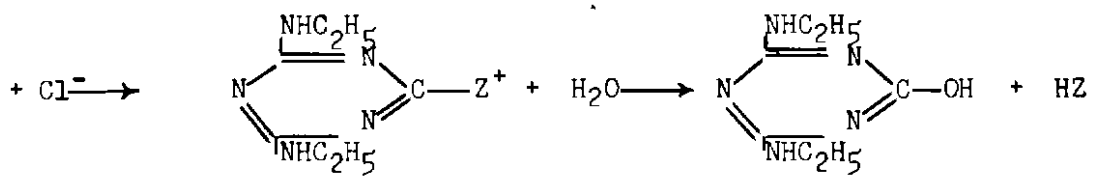
TABLE VI. Mean dry weights of tops and bottoms of simazine treated T. dactyloides from source II.

Ratio (mg seeds/mg simazine)	Mean Oven Dry Weights	
	tops (vegetative)	bottoms (roots)
Control	0.12 gram	0.15 gram
500:1	0.16 gram	0.18 gram
200:1	0.19 gram	0.20 gram
100:1	0.14 gram	0.19 gram
50:1	0.13 gram	0.13 gram

Since subsequent growth occurred after germination of simazine treated eastern gamagrass seeds, it was assumed that T. dactyloides was tolerant to simazine. Tolerant species are able to metabolize and render simazine to a non-toxic form via conversion of the triazine to the hydroxy derivative (White-Stevens, 1971). Audus (1964) illustrated the reaction in tolerant plants as follows:



simazine + cyclic hydroxamate (Z) = Intermediate "sweet substance"



Intermediate + H_2O ⟶ Hydroxysimazine + reduced hydroxamate

It was assumed that this reaction took place in the eastern gamagrass seedlings. This could have explained why eastern gamagrass was tolerant to simazine but did not explain the increased mean dry weight and increased mean plant height with source II treatments.

Allinson and Peters (1970) reported significant increases in percent crude protein and, generally, decreases in both dry matter yield and percent cellulose occurred when may forage grasses were treated with simazine. This possibly corresponds with the decreased mean dry weight of simazine treated eastern gamagrass from source I.

The malfunction of one of the growth chambers was responsible for the reduced seed sample sizes used in this research. To compensate for the low germination percentages larger seed samples

should have been used as originally designed. These larger samples would have made the data more reliable.

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