Research Note on Viability of Herbicide and Hormone - Treated Seeds of Four Tropical Weed Species

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Abstract

*The responses and viability of acid scarified seeds of four tropical weeds to gibberellic acid and seven herbicides including Galex, Gramoxone, 2 - 4 D, Atrazine, Simazine, Roundup and Primextra in the Laboratory were investigated. The weeds used are Cassia occidentalis, **Cassia obtusifolia Cassia hirtusa** and **Calapogonium mucunoides**. A concentration of 100 ppm solutions of the herbicides inhibited germination of seeds in the 4 weed species. Only 50 ppm 2-4D, Atraxine and Primextra inhibited seed germination in C. occidentalis. Solutions of 100 ppm Galex and Atrazine reduced the viability of seeds of C. hirtusa to 0%. The Germination rate was increased by 100 ppm gibberellic acid. Total percentage seed germination in herbicide-free seeds ranged between 75 - 90%.*

Key words: Weeds, seed germination, herbicides gibberellic acid

Introduction

Cassia obtusifolia Cassia occidentalis (Linn.) *Cassia hirtusa* and *Calapogonium mucuneides* are weeds of field crop, cultivated fields, bush regrowths, road sides waste places. They are wide spread in West Africa most especially in areas where the annual rainfall exceeds 1000 - 2500 mm with optimum temperatures of 25 - 35^{0}C (Olaoye, 1974). The *cassia* weeds are shrubs while *C. mucunodes* is a creeping and rarely climbing plant.

Cassia hirtusa (stinking cassia) is an erect, hairy perennial plant up to 2.5m high while *C. occidentalis* (Coffee senna) is an erect hairless under-shurb, annual or biennial, growing to about 100 cm high. *C. mucunoides* is creeping hairy annual plant that spreads fast covering the land during the rain season in Nigeria (March - October), (Akobundu and Agyakwa, 1987). These weeds propagate by means of seeds and in the dry season they shed many seeds from their pods some of which may germinate sporadically in the field (Etejere and Ajibola 1990). Most of the seeds remain dormant within the soil for many years. This condition thus makes the eradication or control of these plants difficult.

Weed control in the field can be achieved by the stimulating or inhibitory effect of herbicides on the germination of seeds. The increased field emergence of seedlings, obtained by stimulating germination, make it possible to reduce the content of soil-borne viable weed seeds (Kolk, 1979). The emerged seedlings can subsequently be destroyed by mechanical or chemical weed control measures. Soil-borne viable seeds can also be destroyed directly by using herbicides of a suitable concentration and dosage. The stimulating effect of Carbamate herbicides on germination and field emergence of different weed seeds was shown by Fawcett and Stife (1975). The inhibitory or eliminating effect of herbicides such as 2, 4 - D (2, 4 - dichloro phenoxy acetic acid) and 2, 4, 5 - T (2, 4, 5 - trichloro phenoxy acetic acid) on the viability of soil-borne weed seeds especially of *Psoralis caryfolia* has been demonstrated by Shukia (1972) DNOC (- 4, 6, dinitrocresol), MCPA (4 - chloro - 2- Methyl phenoxy acetic acid) and Calcium cyanamide have been used to control weeds such as *Veronica Persica, Sinapsis arvensis, Rumes crispus and Stellaria*

media through destruction of the soil-borne seeds (Hurle, 194).

The present investigation examines the viability and responses of scarified seeds to gibbedrellic acid and some herbicide formulation. This is with a view to knowing more about the measures needed to control the spread of these weeds.

Materials and Methods

Seeds were collected in November and December, 1998 during the early period of the dry season. Seeds were processed from their pods manually with hand. Seeds were sundried for 2 weeks. Seeds were then scarified with concentrated H_2SO_4 for 15min, washed several times in distilled water and sundried for 3 days according to the method of Agboola (1995). The dried scarified seeds were stored in glass bottles with a pack of silica. Seeds for the experiment were taken when needed.

Seeds were divided into 150 lots per specie Four concentrations 0 (water), 10, 50 and 100ppm were prepared from 7 commercial formulations of herbicides including Galex, Gramoxone, 2-4D, Atrazine, Simazine Roundup and Primextra. Twenty millitres of the concentrations of the herbicide solution was added to each of the seed lots, and mixed thoroughly and left for 4-5h according to the method of Etejere (1980). The herbicide-treated seeds were then sundried for 2-3h and stored for use in a dry place. The experimental design was a complete randomized block one with 28 treatments (4 concentrations X 7 herbicides)

In a separate experiment 100ppm solution of gebberellic acid was used as bath solutions when the seeds were prepared for germination. Water served as the control. Seeds were sampled from the specimen bottles where they were stored for germination tests.

For the germination tests, 50 seeds in each case were sterilized with 5% sodium hypochlorite solution for five minutes and rinsed in several changes of distilled water. The herbicide treated seeds were planted in 9cm pertridishes containing filter paper and moistened with 10 mls distilled water. Water treated seeds served as control. In the case of the set up on GA3 treatment, 10mls of the 100ppm solution of the hormone was used to moisten the seeds instead of distilled water. The experiments were maintained at 30 ± 1^0C under a light intensity of 2000 lux. Five replicates of the set-up were made while germination counts were recorded daily for 8 days. Mean germination percent values from 5 replicates were calculated and used for graphical presentation. Data were also for subjected to an analysis of variance (ANOVA). The treatment means were also compared by the least significance different test- LSD.

Results

Results on the response of scarified seeds to herbicide treatment after 7 days of germination in the Laboratory showed that 100ppm of the seven herbicides used were effective in inhibiting germination in seeds of the 4 weed species. For example 0% germination was obtained for all the species after 8 days of germination (Tables 1-4). 50ppm Roundup and Primextra were most effective in checking germination in *C. occidentals* as this gave 0% germination. These are followed by Atrazine and Galex, which gave 25 -35% germination after 7 days (Table1). It was observed that only 100ppm solutions of the 7 herbicides completely inhibited germination of seeds in *C. obtusifolia*. Galex, Atrazine and Primextra reduced the viability by 55- 65% in this same weed species- (Table 2). Seeds of *C. mucunoides* treated with 50ppm 2, 4-D, Atrazine and Primextra showed 0% germination while 100ppm of the 7 herbicides also gave 0% germination. 10ppm solution of 2, 4-D, Atrazine and Primextra reduced viability of the seeds by 50-65% (Table 3). Only 100ppm Galex and Atrazine reduced the viability of seeds to 0% in *C. hirtusa* (Table 4). However, it was observed that reduction of viability by 60-80% was brought about by 50-100ppm solution of Galex, Gramoxone, Simazine and Primextra in *C. hirtusa* (Table 4). Germination of herbicide- free scarified seeds of the 4 species ranged from 75-90% (Tables 1-4).

Data with same letter are not significantly different at 95% probability level. LSD = 0.1970

Table 1: Percentage germination of untreated and herbicide treated seeds of *Cassia occidentalis* after 7 days

		Percentage germination		
		Concentration (ppm)		
Treatment	0 (water)	10	50	100
2-4d	75±3 a	70±7a	45±3c	0±0c
Galex	75±3a	65±5*b	35±5*c	0±0c
Gramaxone	75±3a	75±3*b	60±4*b	0±0c
Atriazine	75±3a	65±14b	25±5*c	0±0c
Simazine	75±3a	60±6b	45±3c	0±0c
Round up	75±3a	55±3*b	0±0*c	0±0c
Primextra	75±3a	45±2*c	0±0*c	0±0c

* Significantly different from control at 95% probability level. Data with same letter are not significantly different at 95% probability level. LSD= 0.3277

Table 2: Percentage germination of untreated and herbicide treated seeds of *Cassia obtusfolia*

		Percentage germination		
		Concentration (ppm)		
Treatment	0(water)	10	50	100
2-4d	90±4a	75±3a	75±2b	0±0c
Galex	90±3a	65±5*b	35±5*C	0±0c
Gramaxone	90±14a	70±3*b	55±5*b	0±0c
Atrazine	90±14a	65±7*b	45±6*b	0±0c
Simazine	90±14a	80±10a	60±2*b	0±0c
Round up	90±14a	70±5b	65±3b	0±0c
Primextra	90±14a	80±3a	45±7*c	0±0c

* Significantly different from control at 95% probability level, Data with same letter are not significantly different at 95% probability level. LSD= 0.12209

Table 3: Percentage germination of untreated and herbicide treated seeds of *Calapogonium mucunoides* hirtusa

		Percentage germination		
		Concentration (ppm)		
Treatment	0(Water)	10	50	100
2-4d	80±6a	0±3*c	0±0c	0±0c
Galex	80±6a	5±7b	45±4*b	0±0c
Gramaxone	80±6a	0±3a	55±3b	0±0c
Atrazine	80±6a	5±2*c	0±0c	0±0c
Simazine	80±6a	5±3b	40±7c	0±0c
Round up	80±6a	0±12*b	4±5*c	0±0c
Primextra	80±6a	5±3*c	0±0*c	0±0c

*Significantly different from control at 95% probability level. Data with same letter are not significantly different at 95% probability level. LSD= 0.2832

Gibberellic acid treatment showed 40-50% germination within 2-3 days in the untreated seeds compared to 70-100% 0bserved for the GA_3 - treated scarified seeds for the same period in *C. occidentalis* (Fig. 1). Germination in *C. obtusifolia* seeds showed 50 - 80% within 4 - 7 days in the untreated compared to 50 - 100% shown in the treated within 2 - 3 days (Fig. 2). Germination percentage of 80 - 100% was shown by hormone - treated seeds of *C.*

Table 4: Percentage germination of untreated and herbicide treated seeds of *Cassia*

		Percentage germination		
		Concentration (ppm)		
Treatment	0(Water)	10	50	100
2-4d	86±4a	72±6*a	43±2c	31±3c
Galex	86±4a	64±7b	22±3*c	0±0c
Gramaxone	86±4a	56±2*b	25±3*c	25±2*c
Atrazine	86±4a	60±5b	42±4c	0±0c
Simazine	86±4a	74±5a	35±1c	24±7*c
Round up	86±4a	66±1b	45±2c	15±6*c
Primextra	86±4a	70±1a	36±*c	16±4*c

* Significantly different from control at 95% probability level. Data with same letter are not significantly different at 95% probability level. LSD= 0.2832

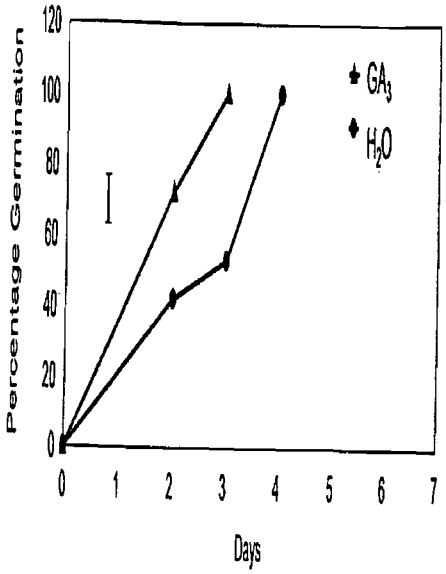

Figure 1: Effect of gibberellic acid on the germination of seeds of *C obtusifolia*

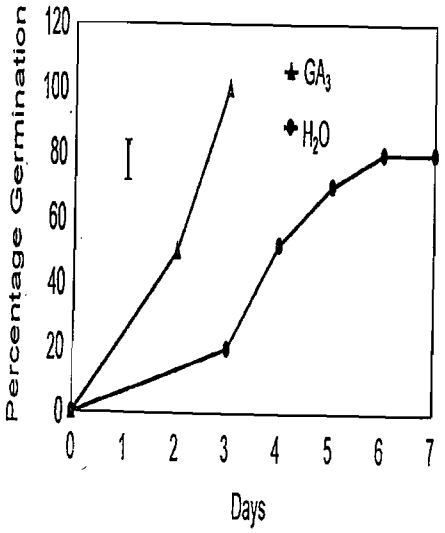

Figure 2: Effect of gibberellic acid on the germination of seeds of *C. obtusifolia*

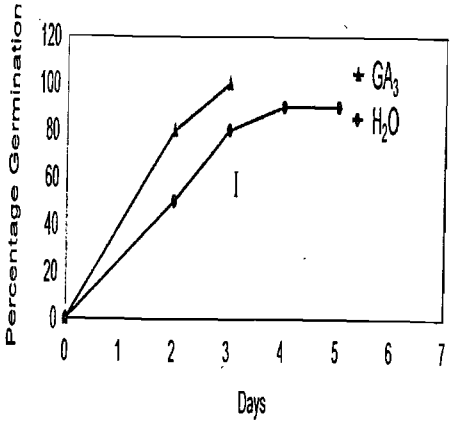

Figure 3: Effect of gibberellic acid on the germination of seeds of *C. mucunoides*

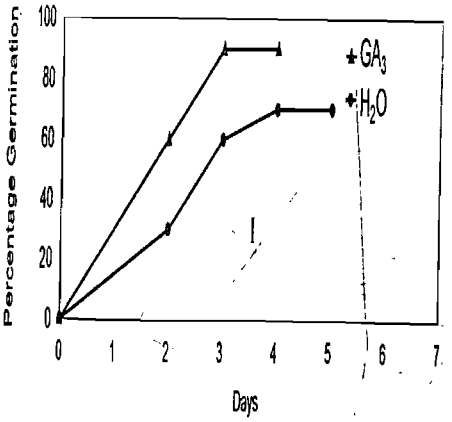

Figure 4: Effect of gibberellic acid on the germination of seeds of *C. hirtusa*

mucunoides within 2 - 3 days while 50 - 80% was given by the untreated (Fig. 3). Result in *C. hirtusa* showed 30 - 70% germination at the 2nd and 4th day respectively in the untreated seeds compared to 60 - 90% in the hormone - treated for the period (Fig. 4).

Discussion

The seeds of the four weed species lost their viability in 100 ppm solution of the seven herbicides tested. Germination of the seeds whose dormancy was broken by scarification with conc. H_2SO_4 was also variously inhibited by the herbicides. This is in line with the results of some other works on herbicides and weeds. For example, reduction in the viability of seeds of siam weed, *Eupatorium odoratum (Chromoleana odoratum)* up to 0% by 2, 4-D, Diuron, Daconate and simazine has been reported by Etejere (1980). The inhibitory or eliminating effect of herbicides on viability of weed seeds has been indicated in some work on *Psoralis caryfolia* (Shukla, 1970) and *Parthenium hysteroplus* (Dagar, 1977).

Some stages of germination prior to seedling emergence include mobilization of food materials in the endosperm or cotyledons after inhibition of water, resumption of growth by the embryo and consequent development and emergence of the radicle. Each of these stages require metabolic energy produced during the metabolic processes involved in the oxidation of carbohydrates, proteins and fats. Since many pre-emergence herbicides are known to affect these processes, the absorption of any of these herbicides by germinating seeds of plants sensitive to them is bound to disrupt one or more of the stages in germination (Akobundu and Agyakwa 1987). For example, Chloramben and the carbamate herbicides inhibit early germination. The mechanism of this action is the inhibition of amylase enzyme activity in the endosperm of those germinating seeds that depend on carbohydrate mobilization in their endosperm (Devlin and Cunningham, 1970; Penner, 1968).

The germination rate of scarified seeds of the four weed species was increased by 100 ppm gibberelic acid. Similar effect of GA_3 on the rate of germination in seeds of *Crotolaria juncea* has been established by Prasad *et al.* (1976) Low levels of GA_3 has also been found to promote and accelerate germination in seeds of *Barbarea vulgaris* (Taylorson, 1976a).

Gibberellic acid is one of the major plant hormones involved in the control processes for mobilization of food reserved from the endosperm or cotyledons, most especially enzyme production (Black, 1972). Hence acceleration of the rate of germination by 100 ppm GA_3 in scarified seeds is due to the fact that there is an unhindered entry of GA_3. The seed coat barrier having been reduced and softened by acid scarification. The entering hormone concentration also compliments that of the internal.

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