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Dormancy and Germination of Mucuna Urens

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Abstract

The seeds of *Mucuna urens* (L) have two sizes designated as small (SS) and large (LS) which occur in the ratio of 3:1. Both sizes of seeds are dormant. These dormant seeds were successfully germinated after various methods had been used to terminate the seed coat dormancy. The most successful method was scarification with concentrated H_2SO_4 for one hour, which gave 90% germination.

Heat treatment and seed coat removal also helped to break the dormancy of these seeds. It was observed that at 83°C days to germination in *M. urens* increased with time while percentage germination decreased with time.

Introduction

Mucuna urens, also known as Horse Eye Bean, occurs in Nigeria, Ghana and Sierra Leone. This plant is a climber and it fruits between July and August. The fruit is covered with stinging hairs. The seeds are flat, reddish brown in colour, and about 3-8 cm in diameter. The hilium is about $^4/_5$ of the circumference (Irvine, 1962).

The stem and leaves of the *Mucuna* plant, in combination with the fruit of *Alihornea cordifolia* yield a black or blue dye. The stem and flower stalk are used as rough fibre. *Mucuna urens* is also used as beverage and has medicinal value (Irvine, 1962). In Nigeria, the seed is very important to southerners because it is used in thickening soup and also used in games. Although this crop seems to be preserved by those that know its value, some factors have contributed to its low population density in the field. One of this is bush clearing and uncontrolled bush burning which are rampant in the dry season. Bush burning destroys the seedling and reduces the population density. One other factor is excessive grazing by livestock. These animals also destroy the seedling physically by their trampling through the field. Another factor is the formation of surface moulds when the seeds are planted. These moulds penetrate readily into the embryo and affect seed viability (Kozlowski, 1972). Perhaps a more important factor is the fact that only a few seeds germinate in the field after many months of planting. Most of the seeds are dormant.

There is no information on studies of germination and dormancy of *Mucuna urens.* Hence, this paper describes the different ways of breaking the dormancy and germination of *M. urens.*

Materials and Methods

Seeds used in this study was collected from 12 randomly selected trees in the field during fruiting period in Uyo, Akwa Ibom State. Collections were made and observation revealed that two types of seeds were present in the lot. The seeds were separated into two sizes designated large seeds (LS) and small seeds (SS). This ex-

periment was carried out in the Department of Botany, Obafemi Awolowo University, Ile-Ife.

Germination Studies

Two batches of 100 large seeds and 100 small seeds were selected and soaked overnight in sterile distilled water. The seeds were planted in plastic buckets (16 x 20 cm) containing sterilized soil and were placed in the screen house. The seeds were watered as need arose. The buckets were in ten replicates and were incubated at 27 ± 1°C for 40 days. The emergence of the seedlings from the soil was used as the basis of determining germination of seeds.

A second batch of large and small seeds was planted as earlier described and incubated at various temperatures ranges of 10°C, 15°C, 25°C, 30°C, 35°C and 40°C. Ten replicates were also used.

Dormancy Studies

Heat Treatment

These dormant seeds were subjected to heat treatment in order to break dormancy. Ten seeds were placed in a water bath at each of the specified temperatures 100°C, 90°C, 83°C, 70°C, 60°C and 50°C and the following time exposures: 1, 2, 5, 10, 15 and 20 minutes were used for each temperature tested. Heat treatment was carried out by immersing the seeds in water at the specified temperature. Seeds were planted as earlier described. Percentage and days to germination were recorded for different temperature and time combination treated (Tables 4 and 3).

Sacrification

Seed decoating

Partial testa removal of *M. urens* seeds was done by removing the seed coat from either the macropyle or nonmicrophyle end of the seeds. This was performed by using a sterile knife and forceps. Total decoating involved the removal of the seed coat. 100 seeds were used for each treatment. The decoated seeds were surfaced sterilized with 0.1% mercuric chloride solution for 30 seconds and washed with several changes of distilled water before planting in large sterile petri dishes. Each petri dish contained four sterile filter papers soaked with sterile distilled water. These dishes were incubated at 30°C for 40 days.

Acid scarification

These seeds were scarified by immersing in different types of concentrated acids for various periods. Concentrated acids used were HNO_3, H_2SO_4, HCl for 1, 2, 5, 10, 15, 30 and 60 min. respectively. Acid was placed in the beaker just enough to cover the seeds. Seeds were soaked in running tap water for 3 hours after the acid had been poured off. The treated seeds were planted in bucket with sterilized soil as above and unscarified seeds were planted as control.

The effect of herbicide and fungicide on the seeds

Fiver herbicide and one fungicide (Table 5) were tested on the dormancy of *Mucuna urens* seeds. These seeds were exposed to the concentrated commercially formulated herbicides and fungicide as was described for acid scarification. The seeds were then planted in sterilized soil as earlier described.

The effect of growth regulators on the dormancy of M. urens

Different growth regulators were also tested on the dormancy of the *M. urens* seeds. Ten seeds were presoaked for 3 days in a solution of ethrel, thiourea, gibberellic acid (GA_3), indole acetic acid (IAA) and kinetin at the concentration of 0, 10, 100, 200 ppm respectively and then planted in buckets with sterilized soil. Control seeds were soaked only in sterile distilled water for 3 days. Ten replicates were also used. Records of germination were taken 40 days after planting.

Results

The ratio of the large seeds (LS) to the small seeds (SS) was found to be approximately 1:3 (Table 1) Germination studies indicate that both small and large seeds of *M. urens* did not germinate after 40 days, at various temperature treatments (Table 2). Both were dormant. 30% germination was obtained at 83°C for 10 min. and 20% at 83°C for 15 min. 20% germination was obtained at 70°C for 15 min (Table 4). At 83°C days to germination of *M. urens.* increased with time (Table 3). Untreated seeds did not germinate (the control).

Partial or total testa removal from dormant seeds showed increased germination over the heat treatment (Table 4). Partially decoated seeds at the micropyle end had 70% germination, seeds decoated at the non-micropyle end had 60% germination. totally decoated seeds had 80%, while scarification with concentrated sulphuric acid gave 90% germination in 60 min. Soaking of these dormant seeds in herbicide, fungicide, and growth regulators did not induce their germination (Table 6).

TABLE 1: The ratio of distribution of 12 samples of *M. urens* collected from the field.

Small seeds	*Large seeds*	*Total collected*	*Ratio of SS:LS*
90 (89.5) + +	30 (30.5)	120	3:1
60 (59.7)	20 (20.3)	80	3:1
80 (74.6)	20 (25.4)	100	4:1
54 (53.8)	18 (18.2)	72	3:1
30 (33.6)	15 (11.4)	45	2:1
150 (149.1)	50 (50.9)	200	3:1
140 (156.6)	70 (54.4)	210	2:1
165 (164.2)	55 (55.8)	220	3:1
192 (179.0)	48 (61.0)	240	4:1
220 (223.7)	100 (76.2)	312	2:1
234 (232.7)	78 (79.3)	312	3:1
320 (298.4)	80 (101.6)	400	4:1
1715	584	2299	3:1

+ + Large vs small sizes were significantly different at $P < 0.05$.

The figures in brackets are expected values.

TABLE 2: Percentage germination of *M. urens* under various temperature for 40 days. Data averages of 10 replicates

	Percentage germination					
Seed type	*10°C*	*15°C*	*25°C*	*30°*	*35°C*	*40°C*
Large seeds	0	0	0	0	0	0
Small seeds	0	0	0	0	0	0

TABLE 3: Days of germination of *M. urens* at various temperature + and time + +

Temperature in °C	*Time in minutes*						*Total*
	1	*2*	*5*	*10*	*15*	*20*	
Control (25°C)	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
70	0	0	0	0	24	0	24
83	0	0	0	19	18	21	58
90	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0
Total	0	0	0	19	42	21	82

+ + Not significant at P > 0.05 (two-way ANOVA)
+ Significant at P < 0.05 (two-way ANOVA)

TABLE 4: Effect of different treatments on the percentage germination of *M. urens*

	Different treatments + +			
	Partially decoated seeds at micropyle end	*Partially decoated seeds at non-micropyle end*	*Total decoated seeds*	*H_2SO_4 acid scarification for 60 min.*
	70	60	90	100
	65	50	70	90
	75	70	80	80
Total	210	180	240	270
Mean	70	60	80	90

+ +Significant at P < 0.01 (one way ANOVA)

TABLE 5: Percentage germination of *M. urens* at various temperature+ and time++

Temperature in °C	Time in minutes						Total
	1	2	5	10	15	20	
Control (25°C)	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0
70	0	0	0	0	20	0	20
83	0	0	0	30	20	10	60
90	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0
Total	0	0	0	30	40	10	80

TABLE 6: Percentage germination of *M. urens* after soaking with various chemicals. Data are averages of 10 replicates.

Chemicals	*Exposure time (minutes)*							
	1	*2*	*5*	*10*	*15*	*30*	*40*	*60*
Control	0	0	0	0	0	0	0	0
HCl	0	0	0	0	0	0	0	0
H_2SO_4	0	0	0	0	0	0	0	90
HNO_3	0	0	0	0	0	0	0	50
Atrazine	0	0	0	0	0	0	0	0
2,4 D	0	0	0	0	0	0	0	0
EPTC	0	0	0	0	0	0	0	0
Molinate	0	0	0	0	0	0	0	0
Monuron	0	0	0	0	0	0	0	0
Gammalin 20	0	0	0	0	0	0	0	0

+ Not significant at $P > 0.05$ (Two-way ANOVA)

++ Significant at $P < 0.05$ (Two-way ANOVA)

Discussion

The ratio of occurrence of small size to large size seeds was approximately 1:3 and were significantly different at ($P < 0.05$). The occurrence of these sizes of seeds could be attributed to genetic influence (Etejere *et al.*, 1982). In this study seed decoating gave increased germination over heat treatment. This result is in line with the study of Etejere *et al.* (1982) who found that partial or total decoating of dark brown *Parkia chapertoniana* seeds showed improved germination over the heat treatment.

M. urens is a leguminous plant that is characterized by hard seed coat and long lived seeds which are mechanically resistant and impermeable to water (Fordham, 1965). It is likely that the dormancy of *M. urens* is due to seed coat impermeability. Similar seed coat impermeability has been reported in *Parkia auriculata* by Coutinho and Struffaldi (1971).

Usually, dry seeds have a low moisture content and will not absorb water until the seed coat is penetrated by abrasion, preheating or microbial action (Gerumond, 1978). The hard seed coat and low moisture content permit a long period of dormancy and viability (Flores and Mora, 1984). In dry seeds, it is often the case that the higher the temperature, the shorter the dormancy period, as in most cereals and grasses. Because of this relationship, it is often possible to treat any seed with relatively high temperature for a few days to remove dormancy (Roberts, 1965). Similar observations were shown in the *M. urens* germination.

In this study, it was observed that the germination days of *M. urens* increased with increased period of heating while high heat increased the percentage germination of *M. urens.* The high heat treatment breaks the dormancy of *Mucuna urens.* by making the seed permeable to water Kozlowski (1972). It might also have lowered the concentration of certain growth inhibitors accumulating in the seeds during their development. Etejere et al (1982) obtained the highest germination of *Parkia clapertoniana* with acid scarification but germination was inhibited by fungicide and herbicide. In the germination of *M. urens* scarification with concentrated sulphuric acid for 60 min. gave 90% germination while herbicide and fungicide did not break the dormancy of these seeds.

Auxin and gibberellic acid seed treatment have been shown to remove dormancy and accelerated germination (Kozlowski, 1972). In contrast, growth regulators did not break the dormancy of these seeds. The percentage germination of *M. urens* is low in the field as compared with other plants. This is further evidenced by the number of dormant seeds and their poor response to different treatments. In the field, the condition is worse when the hard seed coats are softened only by alternating temperature and biological activity of the soil flora and fauna. It may take several weeks or even months for the seed coats to be degraded by biological activity for germination to proceed smoothly.

With increased percentage germination of dormant *M. urens* with heating and scarification treatment, there seems to be a ray of hope of increasing the population of this economic crop in the field.

References

Aramide, S.A. 1976. Seed dormancy and germination in some moraceous plants. M.Sc. Thesis, University of Ibadan.

Coutinho, L.M.L. and Struffaldi, Y. 1971. Observations on seed germination and seedling of leguminous plants of Amazon forest gaps. *Parkia auriculata Phyton Dev. Int. Bot. Expt.* 28:

Etejere, E.O. Fawole, M.O. Sani, A. 1982. Studies on the germination of *Parkia clapertoniana Turrialba* 32: 181-185.

Flores, E.M. Mora, B. 1984. Germination and seedling growth of *Pithocellobium arboreum Urban. Turrialba* 34: 485-488.

Fordham, A.J. 1965. Germination of woody legume seeds with impermeable seed coat. *Arnoldia* 25: 1—8.

Gerumond, H. 1978. Physiological aspect of seed germination. *Seed Science and Technology* 6: 625-639.

Irvine, F.R. 1962. The woody plants of Ghana. 2 edn. Oxford University Press, 397.

Kozlowski, T.T. ed. 1972. Seed Biology. *Academic Press* Inc. New York.

Roberts, E.H. 1965. Dormancy in Rice seed. IV Varietal responses to storage and germination temperature. *J. Expt. Botany.* 16: 341-394.