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EFFECT OF SCARIFICATION AND DIPPING DURATION ON THE SEEDLING EMERGENCE AND GROWTH OF GOLDEN SHOWER TREE (*Cassia fistula* LINN)

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ABSTRACT

A field experiment was carried out at the Horticultural Nursery of Crop Production department, Federal University of Technology, Minna, between April and August 2017. The aim of the research was to compare the effect of scarification and dipping duration on the seedling emergence and growth of *Cassia fistula* (Golden shower). Golden shower is a multipurpose plant widely used for its ornamental and environmental beautification but it has problem of hard seed coat dormancy which affect the rate, speed and percentage of germination, thus limit seedling production. Scarification method by using mechanical means and acid hold promise in breaking the dormancy of the seeds of golden shower. Field trials were conducted to determine the best method of scarification and dipping duration for optimum germination and seedling growth using gibberellic acid and mechanical method at different dipping duration of 10 Minutes, 20 Minutes, and 30 Minutes. In the experiment, a 2 × 4 factorial arrangement in a Complete Randomized design with five replicates, two factors (i) made up of scarification method by the use of gibberellic acid and by mechanical means (ii) dipping duration of 10 Minutes, 20 Minutes, and 30 Minutes and the use of one line, two lines, and three lines, and the untreated (control). Data collected on germination and seedling growth parameters, were subjected to Analysis of Variance (ANOVA) using DMRT and means were separated using Least Significant Difference (LSD) at 5% level of probability. In the experiment, highest germination percentage (77 %) was recorded in the seeds treated mechanically, followed by the seeds treated with GA₃ (60 %) and the untreated seeds had the least germination percentage (53 %). Also seeds dipped in GA₃ for 30 Minutes had the highest percentage germination followed by 20 Minutes dipped and seeds dipped for 10 Minutes had the least while seeds with three lines had the highest (83 %) followed by the seeds with one line and the seeds with two lines had the least germination percentage. Data were also collected on plant height, number of leaves, leaf area, number of branches and stem girth. It is therefore, concluded that the highest germination and growth yield were recorded on seeds treated mechanically and the interaction effect showed that mechanical scarification using three lines improves the breaking of seed dormancy in *Cassia fistula* (golden shower) and it enhance mass propagation of the ornamental tree.

Keywords: *Cassia fistula*, Gibberellic acid, Mechanical Scarification, Dipping duration.

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INTRODUCTION

Cassia fistula (golden shower tree) is an ornamental tree commonly grown for its beauty and medicinal properties, it is a deciduous ornamental tree planted in homesteads and along roadside for beautification and relaxation purposes. It is one of the 400 different species that comprise the genus *Cassia* and it belongs to the subfamily Caesalpinaceae and family Fabaceae (Sartorelli et al. 2009).

Many biologically important compounds were isolated and identified from different parts of *Cassia fistula*, it reversibly suppresses fertility in male rats and Oral administration of aqueous extract from seeds of *Cassia fistula* to mated female rats from day 1-5 of pregnancy at the doses of 100 and 200 mg/kg body weight resulted in 57.1% and 71.4% prevention of pregnancy, whereas 100% pregnancy inhibition was noted at 500 mg/kg body weight (Verma et al. 2009). Presence of hard seed coat hinders the easy propagation of *Cassia fistula*, so thus exhibit seed dormancy. This is a limiting factor for germination seed germination is a sequence of complex processes which leads to the initiation of quiescent embryo in the seed (Hartmann, 2002). Hence this study seeks to provide information on the best scarification method and dipping duration to break hard seed coat in seed of *Cassia fistula* for optimum seedling emergence and growth for large seedling propagation.

METHODOLOGY

Experimental location

The experiment was carried out at the experimental nursery of Crop Production department, School of Agriculture and Agricultural Technology, Federal University of Technology, Minna which lies on latitude and longitude $9^{\circ} 40' N$ and $6^{\circ} 30' E$ on the equator in the Southern Guinea Savannah of Nigeria.

Sources of planting material

The seeds of golden shower tree (*Cassia fistula*) for the study was sourced from Federal University of Agriculture Abeokuta, (FUNAAB) Ogun State, top soil, and pots for planting

Treatment and experimental design

The experiment consist of two factors, firstly is breaking of seed dormancy by mechanical (scarification) means, and with the use of hormone (GA_3). Secondly is the duration of dipping of the seeds in the hormone and the number of mechanical lines made on the seed. A total number of 400 seeds were used in the experiment, 200 seeds were used for the mechanical scarification, and 200 seeds were also used for the (GA_3), thus giving a 2×4 factorial experiment resulting in eight treatment combination arranged in a Complete Randomized Design (CRD) with five replicates.

Treatment procedure

Mature pods of *C. fistula* were collected, the pods were gently crushed and the seeds removed. The seeds were thoroughly washed with distilled water to remove adhering pericarp parts, these seeds were air-dried and tested for viability by floatation method in distilled water. This involves separating the seeds into "floaters" and "sinkers". Viable seeds were considered to be those that sank. Three sets of 50 seeds were put in different Petri dishes and were soaked in equal volume of 20 ml of gibberellic acid (GA_3) at dipping duration of 10, 20, and 30 minutes respectively, making the total of 150 seeds used. As the timing elapsed, the acid solution was poured and the seeds were thoroughly rinsed with distilled water to ensure proper cleaning from the remains of acid (GA_3). For the scarified seeds, 50 seeds were subjected to lining once, another set of 50 seeds were lined twice, and the third set of 50 seeds were lined trice making the sum total of 150 seeds that was mechanically scarified. And 100 seeds were left untreated. Thereafter, the treated and the untreated seeds were sown.

Filling of the planting pots and sowing of the seeds

Top soil was collected from Horticultural Nursery and air dried, 14 kg of the air dried soil was weighed into the planting pots, the polythene pots were perforated to prevent water logging. The seeds (treated and the untreated) were sown at 3 cm depth into the soil and the spacing was (5 × 5) cm on the planting pot containing 14 kg of soil with a total of ten seeds per pot.

Data collection

Data were collected on the following parameters number of days to 50% germination, number of leaves, number of branches, Plant height (cm), Stem girth (mm), and Leaf area (cm²)

Statistical analysis

Data collected were subjected to Analysis of Variance (ANOVA) using DMRT and means were separated using Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Effect of GA_3 /Mechanical and dipping duration on germination of Golden shower

The result of effect of GA₃/Mechanical and dipping duration on germination of golden shower at 5-30 Days After Sowing (DAS) was shown in the Table 1. GA₃/Mechanical had significant ($P \geq 0.05$) effect on germination of golden shower, at 30 DAS seeds treated using mechanical method resulted to the highest germination rate of 7.8 compared to seeds treated with GA₃ and Control produced the lowest germination. Dipping duration had significant effect on germination of golden shower at 0, 10, 20 and 30 with 30 minutes dipping duration resulting to highest germination. The interaction between GA₃ and Mechanical and dipping duration were not significant.

Effect of GA₃/ Mechanical and dipping duration on number of leaves of *Cassia fistula*

The result of the effect of GA₃/Mechanical and dipping duration on number of leaves of golden shower at 5-13WAS was shown in Table 2. GA₃/Mechanical had a significant ($P \geq 0.05$) effect on number of leaves at 5-13WAS. Seed treated mechanically resulted to the highest number of leaves of 103.3 compared to other seed treated with GA₃ and control produced the lowest number of leaves 80. Dipping duration had a significant effect on numbers of leaves on golden shower at 0, 10, 20 and 30 Minutes with dipping duration at 30 Minutes resulted to the highest germination at 13 WAS (92.6) compared to other dipping duration and control produced the lowest number of leaves 80 also seeds with 3 lines produced the highest number of leaves of 107 at 13WAS compared to seeds with 1 line and 2 lines. The interaction between GA₃/Mechanical and dipping duration were not significant on golden shower.

Effect of GA₃/ Mechanical and dipping duration on number of branches of *Cassia fistula*

The effect of the GA₃/Mechanical and dipping duration on number of branches of golden shower was shown in Table 3. GA₃/Mechanical had significant ($P \geq 0.05$) effect on number of branches at 5-13 WAS. Seeds treated using mechanical method resulted to the highest number of branches at 13 WAS (20.4) compared to other seeds treated with GA₃. Control produced the lowest number of branches 14.6. Dipping duration had significant effect on the seeds of *Cassia fistula* at 0, 10, 20, and 30 Minutes. 30 Minutes dipping duration resulted to the highest number of branches compared to other dipping duration and also seeds with 3 lines produced the highest number of branches (121.3) compared to line 1 and 2. The interaction between GA₃/Mechanical and dipping duration were not significant.

Effect of GA₃/ Mechanical and dipping duration on plant height of *Cassia fistula*

The result of the effect of GA₃/Mechanical and dipping duration on plants height of golden shower is shown in Table 4. GA₃/Mechanical had a significant ($P \geq 0.05$) effect on plant height of golden shower 5-13 WAS. Seeds treated using mechanical method have the highest plant height at 13 WAS 32.0 compared to GA₃ and control. Control produced the lowest plant height 25.6. The dipping duration had a significant effect on golden shower at 0, 10, 20 and 30 minutes. 30 Minutes dipping duration resulted to the highest plant height 31.3 compared to other dipping duration and also line 3 produced the highest plant height at 13 WAS compared to line 1 and 3. The interaction between GA₃/Mechanical and dipping duration were not significant.

Effect of GA₃/ Mechanical and dipping duration on stem girth of *Cassia*

The result of the effect of GA₃/Mechanical and dipping duration of stem growth of cassia fistula was shown in table 5. GA₃/Mechanical had a significant ($P \geq 0.05$) effect stem girth at 5-13 WAS. Seeds treated using mechanical method resulted to the thickest stem girth at 13 WAS (0.8) compared to seeds treated with GA₃ and control produced the lowest value for stem girth (0.7). The dipping duration had a significant effect on the plant of golden shower at 0, to 20 and 30 minutes with 30 minutes dipping having the highest stem girth value (0.8) compared to other dipping duration and also line 2 and 3 produced the highest stem (0.9) and seeds with 1 line scarification having the least. The interaction between GA₃/Mechanical and dipping duration were not significant.

Effect of GA₃/ Mechanical and dipping duration on leave area of *Cassia fistula*

The result of the effect of GA₃/Mechanical and dipping duration on leaves area of the plant of cassia fistula is shown in Table 6. V/Mechanical had a significant ($P \geq 0.05$) effect on leave area at 5-13 WAS seed treated using mechanical resulted to the highest leaves area at 13WAS (88.7) compared to other seed treated with GA₃, control produced the lowest leaves area (61 cm²). The dipping duration had a significant effect on the plant of cassia fistula at 0, 10, and 20 and 30 minutes with 30 minutes dipping resulted to the highest leave area(83.9 cm²) compared to other dipping duration and also line 3 produced the highest leave area at 13 WAS(97.1 cm²) compared to line 1 and 2. The interaction between GA₃/Mechanical and dipping duration were not significant.

DISCUSSION

The result of this study on scarification method and dipping duration on germination of *Cassia fistula* revealed that *Cassia fistula* treated using mechanical method produce the highest germination rate, seeds with three (3) line produced the highest germination, the finding from this study was in agreement with (David & Midcap, 2007) who said Mechanical scarification is a technique for overcoming the effect of an impermeable seed coat. Mechanical scarification can be done by rubbing seeds between two pieces of sandpaper or using a file, a pin, or a knife to rupture the seed coat, cracking with hammer or a vice. Also scarification method and dipping duration on number of leaves of *Cassia fistula* revealed that *Cassia fistula* treated using mechanical method produce the highest number of leaves and line three (3) produced the highest number of leaves, this was in agreement with Todaria and Negim (1992) which were of the opinion that mechanical scarification helps in physically weakening of the impermeable layer in the seed coat allowing water and air to enter the seeds thereby permitting the embryo to overcome the mechanical restriction of surrounding tissues. *Cassia fistula* seeds treated mechanical produced the highest number of branches, highest plant height, highest stem girth, highest and leaves area respectively, these finding was in agreement with the work of Pant & Chauhan (2013) that reported that soaking of *Cassia* seeds in water for 24 hours after mechanical scarification (by rubbing the seeds with sand paper) showed a significant level of improved germination (76.88%) when compared to sulfuric acid scarification, hot water and alcohol treatments. This result is also consistent with the results of other authors such as Al- Menaie et al. (2010) for *C. fistula* in Kuwait, Babely and Kandya (1998) for *C. fistula* in Egypt, Karaboon et al. (2005) for *C. fistula* in Thailand and Nalawadi et al. (1977) for *C. fistula* in India. Consequently, mechanical scarification is an excellent, cheap and practical treatment to be used to break seed coat dormancy in tropical plant species.

CONCLUSION AND RECOMMENDATION

Based on the result from the experiment it could be therefore concluded that, the highest germination, was recorded in seeds treated using mechanical scarification method with line 3 showing an effective germination of the seeds of *Cassia fistula* hence, for proper growth, broader leave area, taller plant height, a reasonable number of leaves, number of branches, and a thicker stem girth, the use of mechanical scarification method with line 3 dipping duration and the use of GA₃ as scarification at 30 minutes duration is very effective for the growth of *Cassia fistula*. From the result obtained, it is recommended that *Cassia fistula* seed treated using mechanical scarification method was effective and viable for the breaking the seed dormancy in *Cassia fistula* seeds for it enhance the growth and germination of (*Cassia fistula*). The dipping duration should be 30 minutes dip for GA₃, while the line should be line 3 for optimum performance, and to obtain flower with good vigor.

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Table 1: Effect of GA₃/Mechanical and dipping duration on germination of *Cassia fistula*

Treatment Method	5DAS	10DAS	15DAS	20DAS	25DAS	30 DAS
Mechanical	1.2a	3.8a	6.2a	6.8a	7.5a	7.7a
GA ₃	0.5ab	2.6ab	4.3b	4.1b	5.1b	6.0b
Control	0.0b	2.3b	3.6b	4.3b	5.0b	5.3b
SE±	0.1	0.2	0.3	0.3	0.3	0.7
Dipping Duration (Minutes)						
GA ₃						
10	0.3a	1.6a	3.0a	5.3a	4.3a	5.3b
20	0.3a	2.0a	3.3a	5.3a	4.3ab	5.6ab
30	1.0a	3.3a	4.6a	5.3a	6.3b	7.0a
Mechanical						
Line 1	2.0a	4.6a	6.0b	7.0ab	7.6a	8.0a
Line 2	0.6b	3.6ab	5.3bc	5.7b	7.0a	7.0ab
Line 3	1.0b	3.3ab	7.3a	8.0a	10a	8.3a
SE±	0.2	0.3	0.3	0.4	0.3	0.3
Interaction	NS	NS	NS	NS	NS	NS
G x M						

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS= Not Significant

Table 2: Effect of GA₃/ Mechanical and dipping duration on number of leaves of *Cassia fistula*

Treatment Method	5WAS	7WAS	9WAS	11WAS	13WAS	Numb
Mechanical	25.3a	41.7a	62.8	82.6a	103.3a	
GA ₃	19.1b	34.0b	52.8b	68.5b	89.5b	
Control	13.3c	25.3c	44.3c	62.3c	80.0b	
SE±	1.1	1.4	1.85	2.59	2.4	
Dipping Duration						
GA ₃						
10	18.0a	30.3b	45.0b	56.0b	82.3ab	
20	18.3a	35.6a	56.3a	75.6a	92.6a	
30	21.0a	36.0a	57.3a	74.0a	93.6a	
Mechanical						
Line 1	23.6a	39.3a	61.3a	78.3a	99.6a	
Line 2	26.0a	42.3a	62.0a	83.6a	103.3a	
Line 3	26.3a	43.6a	65.3a	85.6a	107.0a	
SE±	1.7	3.3	2.6	3.1	3.6	
Interaction	NS	NS	NS	NS	NS	
G x M						

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS= Not Significant

Table 3: Effect of GA₃/ Mechanical and dipping duration on number of branches of *Cassia fistula*

Number of Branches

Treatment Method	5WAS	7WAS	9WAS	11WAS	13WAS
Mechanical	5.6a	8.8a	12.5a	16.0a	20.4a
GA ₃	4.0b	8.2a	11.8a	15.5a	20.1a
Control	3.3b	5.6b	8.6b	11.0b	14.6b
SE±	0.2	0.3	0.3	0.4	0.4
Dipping Duration (Minutes)					
GA ₃					
10	13.3a	7.3b	11.3a	14.6b	19.6a
20	4.3a	8.3a	11.6a	15.7a	20.0a
30	4.3a	9.0a	12.6a	15.3a	20.6a
Mechanical					
Line 1	5.3a	8.3a	12.0b	16.6ab	20.0a
Line 2	5.6a	9.0a	12.3b	15.3b	20.0a
Line 3	6.0a	9.3a	13.3a	16.6a	21.3a
SE±	0.3	0.4	0.5	0.6	0.7
Interaction	NS	NS	NS	NS	NS

G x M

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS = Not Significant

Table 4: Effect of GA₃/ Mechanical and dipping duration on plant height of *Cassia fistula*

Plant height (cm)					
Treatment Method	5WAS	7WAS	9WAS	11WAS	13WAS
Mechanical	7.3a	16.3a	19.5a	25.6a	32.0a
GA ₃	7.6a	14.4b	17.7b	23.6b	30.5b
Control	5.3b	8.6c	14.3c	20.0c	25.6c
SE±	0.2	0.6	0.4	0.4	0.5
Dipping Duration					
GA ₃					
10	6.6b	13.0b	17.3a	23.6a	30.0a
20	8.0a	14.6a	18.0a	23.6a	20.3a
30	8.3a	15.6a	18.0a	23.6a	31.3a
Mechanical					
Line 1	7.0ab	15.3a	19.0a	25.0a	31.6a
Line 2	7.0ab	16.6a	19.0a	25.6	31.7a
Line 3	8.0a	17.0a	20.6a	26.3a	32.6a
SE±	0.4	0.6	0.7	0.8268	0.8
Interaction G x M	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS= Not Significant

Table 5: Effect of GA₃/ Mechanical and dipping duration on stem girth of *Cassia*

Stem Girth (mm)					
Treatment Method	5WAS	7WAS	9WAS	11WAS	13WAS
Mechanical	0.2a	0.4a	0.5a	0.74a	0.8a
GA ₃	0.2a	0.3ab	0.5ab	0.6b	0.7b
Control	0.16b	0.3c	0.4b	0.6b	0.7b
SE±	0.01	0.01	0.01	0.02	0.02
Dipping Duration					
GA ₃					
10	0.2a	0.3ab	0.5ab	0.6b	0.7a
20	0.2a	0.4a	0.5a	0.7a	0.8a
30	0.2a	0.4ab	0.6a	0.7ab	0.8a
Mechanical					
Line 1	0.2a	0.4b	0.5a	0.7ab	0.8a
Line 2	0.2a	0.5a	0.5a	0.7a	0.90a
Line 3	0.3a	0.5a	0.6a	0.7a	0.9a

SE±	0.0	0.02	0.02	0.02	0.02
Interaction G x M	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS= Not Significant

Table 6: Effect of GA₃/ Mechanical and dipping duration on leave area of *Cassia fistula*

Treatment Method	Leave Area (cm ²)				
	5WAS	7WAS	9WAS	11WA S	13WA S
Mechanical	0.6.5a	16.3a	31.8a	61.4a	88.7a
GA ₃	0.12	15.1b	30.4a	54.9b	79.2b
Control	5.2b	10.6c	22.2b	41.0b	61.0c
SE±	0.1	0.4	0.9	1.7	2.3
Dipping Duration					
GA ₃					
0	5.2b	10.6c	22.1c	41.0d	61.0d
10	5.4b	13.8b	28.0b	51.0c	73.6c
20	6.5b	15.4a	31.1a	53.9b	79.9b
30	6.5a	16.0a	32.1a	59.7a	83.9a
Mechanical					
Line 1	5.9a	15.3a	28.7c	54.3c	84.1c
Line 2	6.8a	16.6a	31.7b	63.2b	85.0b
Line 3	6.9b	16.7b	35.0a	66.8a	97.1a
SE±	0.2	0.7	1.4	3.0	3.9
Interaction G x M	NS	NS	NS	NS	NS

Means followed by the same letter(s) in a column for the same factor are not significantly different at $P \leq 0.05$ by Duncan Multiple Range test (DMRT) NS= Not Significant