Effect of different seed treatment methods on the germination of *Senna obtusifolia* in Sudan savanna ecosystem, Nigeria

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Abstract. Breaking seed dormancy is commonly practiced in phanerogamia for seedling production but is conducted in different forms depending on the type of seed coat and other factors that hinder successful seed germinability. It is against this background that laboratory germination test was conducted at the Agric. Chemical Laboratory of the Usmanu Danfodiyo University, Sokoto for 36 days period and determined 3 days soaking (86.66 %), 15 minutes hot water (96.67%) and 15 minutes chemical (H_2S0_4) (73.32%) methods as the best germination test for seed germinability of *S. obtusifolia*. The field experiment in turn revealed that germination percentages obtained were 51.11 % at fadama habitat and also 47.22% in *S. obtusifolia* at upland location. These were carried out to produce good young and matured leaves samples for nutritional chemical analysis. Therefore, the best methods determined were recommended for practice in the seedling production of the study species and it's allied.

Keywords: seed treatment, germination, *Senna obtusifolia*, Sudan savanna, laboratory experiment, field experiment.

1.0 INTRODUCTION

Senna obtusifolia (Sickle-Senna or Sickle-Pod) is part of the numerous important semi-wild plant species growing in the savanna region of Nigeria functioning as primary producer in the ecosystem. Hence, available literatures revealed that this plant species have not been domesticated on large scale, but grow largely in the wild as weeds (Bala, 2006). Synonymously known as *Cassia tora*, the plant was reported to be among the leafy vegetables that contribute to the rural women economy in some parts of the study area (Bello *et al.*, 2008). The contributions of the leaves as dietary food vegetables to the populace in the study area has made this species under study very popular in the local communities of Sudan savanna of Nigeria. This assertion was supported by Bulus *et al.* (2007) who indicated that almost everybody are now incorporating the non-conventional (wild) food plants in their diets, to provide not only nutrients but also in the traditional treatment for various ailments. Their leaves are cooked and eaten as vegetables by majority of the rural communities in the zone (Bello, *et al*, 2008). The flowers, fruits and seeds are also parts of the food and sometimes used as medicine for human consumption. This species is also used as fodder for animals. In addition, it provide shade and contribute to nutrient recycling in the soil and hence soil fertility The roots, stems and leaves are equally utilized for medicinal purposes while the dry stalks as source of fuel in addition to provision of habitat to micro fauna and supply of other tangible products to man (Evans, 1982). Evans (1982) reported that almost every part of any plant (root, stem, leaf, bark, flower, fruit and seed) is known to have one form of economic benefit or the other.

Available literature reported by Tukan *et al*. (1998) have revealed that over the last two decades, studies have shown that wild or semi-wild plants are nutritionally important because of high contents of vitamins, minerals, essential fatty acids and fibre contents. Some

of these plants also enhance taste and colour in diets (Bianco *et al.*, 1998). High protein content was also reported in some wild vegetables in Bostwana (Flyman and Afolayan, 2007).

It is against this background that the study was designed to investigate the effect of different methods of seed treatment on the germination of *S. occidentalis* and *S. obtusifolia.* This has become necessary to provide additional information on the seed germinability potentials of the selected wild plant in the study area so as to enhance it conservation and possibly domestication

2.0 MATERIALS AND METHODS

The study site was the agricultural chemical laboratory, Fadama land and upland locations in Usmanu Danfodiyo University, Sokoto located at the Northern part of Sokoto city in Wamakko local government area, Sokoto (05^0 10E - 05^0 12^1E longitude and latitude 13^0 04 0N – 13^0 06 40N). The altitude is 308m above sea level.

2.1 Seed collection

Seeds of *S. obtusifolia* (L.) were collected from plants growing wildly in the two habitats (fadama and upland). Fully ripe pods were collected by handpicking from parent plants. The pods were then crushed manually, and good seeds were sorted out, washed to removed dirt and other foreign materials, sun-dried and packed in large paper envelope separately, stored under metal cabinets at room temperature (28 ± 2^0C) using floatation method of extraction in which viable seeds sank to the bottom when soaked in water while the unviable or damaged ones floated (Abdullahi and Aliero, 2005; Dachung and Verinumbe, 2006).

2.2 Seed dormancy test

Three (3) seed treatment methods were tried for the seeds of the plant and determined the best method that gives higher germination rate of the seeds under room temperature (28 ± 2^0C) in the laboratory before field sowing for the conduct of the field experiment of raising seedlings in beds. The methods are:

2.3 Water treatment

Viable seeds were placed in ordinary collected tap water under room temperature (28 ± 2^0C) for different time periods (treatments) ranging from one (1) day, 2 and 3 days. Seeds not soaked in water were the control. After soaking, the seeds were rinsed in running water and put in 12 petridishes measuring 9cm each, with soaked filter paper for germination. Each treatment was therefore replicated thrice, i.e. 10 seeds were soaked for each treatment and the control = 10 x 3 x 4 = 120 seeds (Dachung and Verinumbe, 2006).

2.4 Hot water treatment

Viable seeds were placed in muslin cloth and dipped in boiling water (in a beaker) and allowed to stand for 5 minutes**,** removed and cooled in tap water at room temperature (28 ± 2^0C). The seeds were placed in 12 petridishes measuring 9cm each, with soaked filter paper for germination. The same treatment was repeated for 10 and 15 minutes respectively replicated thrice. Untreated seeds not dipped in hot water were the control, 10 x 3 x 4 = 120 seeds per plant species (Aliero, 2004).

2.5 Acid treatment

Viable seeds were soaked in Sulphuric acid for periods of time, varying from 5, 10 and 15minutes respectively. The seeds were washed in several changes of water and placed in 12 petridishes of 9cm each, with soaked filter paper for germination at room temperature (28 ± 2^0C) (Younsheng and Sziklai, 1985). Each treatment was replicated thrice with untreated seeds as control.

All the treatments in the three methods were watered with distilled water at 12 hours interval daily according to the need, up to the end of the experiment (36 days).

2.6 Experimental design and site selection

The experimental design for this study was complete randomized block design (CRBD). 7/7meters fadama and upland sites were obtained at kwalkwalawa, and Usmanu Danfodiyo University Sokoto (UDUS), botanical garden and used for direct seeding planting in beds. The beds were watered twice (morning and evening) daily up to the end experimental period (36 days).

2.7 Beds preparation and layout

Three (3) beds were prepared for sowing the seeds of the study plant species. Cow dung manure was applied to each of the beds and mixed thoroughly before planting at each of the two locations (Fadama and upland) to enhance moisture retention in the beds. The size of each bed was 1.8/1.2 meters with 50cm spacing in between the beds for easy watering, thinning and sample collection.

2.8 Seed rate, planting and spacing

Viable seeds from the seed lot kept in metal cabinets in paper envelops for the study plant species were sorted out and planted in the beds at each of the two locations (Fadama and Upland). 24 holes in 6/4 rows were dug and planted at 1.5cm depth. 5 seeds per hole of 30cm inter and intra-row spacing was sown, giving a total of 120 seeds per bed sown.

2.9 Watering regimes and weeding

The beds planted with seeds were watered with watering cans twice daily for Five (5) weeks, and once daily for the next three (3) weeks until seeds become germinated. Weeding was regularly conducted based on the need.

3.0 Data analysis

Data collected for this study was collected on daily basis and expressed in percentages.

4.0 RESULTS

4.1 Laboratory experiment germination test results

The laboratory germination test results were reported based on ordinary water (soaking) treatment method; hot water treatment; and chemical (H_2So_4) treatment for the seeds of *S. obtusifolia* (Tables 1- 3) respectively as follows:

4.2 Ordinary water treatment

The results of control (unsoaked) control and that of 1 day treatments of the seeds of *S. obtusifolia* commenced germination on the 6th day after treatment but ceases on the 23rd day for control, 24th day for 2 & 3 days treatments and on 26th day for the 1 day treatment (Table 1). The highest daily % germination of 10.0% was observed in both the control and the 2 & 3

days treatments with highest % seed germinability of 86.67% in the 3 days treatment, followed by the 2 days treatment (70%), then 1 day treatment (63.33%) and the control was the least (53.33%).

4.3 Hot water treatment

Germination results of the seeds of *S. obtusifolia* (Table 2) had indicated that germination commenced only on the 7th day for the 10 minutes treatment, while 5 and 15 minutes treatments commenced on the 8th day and that of control commenced on the 9th day but ceases on 22nd day for all the treatments except that of 15 minutes treatment which ceases on the 23rd day with the highest daily % germination of 13.33% occurring in both the 5 & 15 minutes treatments. The highest % seed germinability of 96.65% was recorded at the 15 minutes treatment.

4.4 Chemical treatment method

Chemical (H_2So_4) treatment method results for the germination of the seed of *S. obtusifolia* indicated commencement of germination on the 4th day after treatment at 5 minutes treatment, followed by that of 10 minutes time interval, then 10 minutes and control on the 8th day after treatment (Table 3). Germination ceases on the 18thday for 10 minutes treatment, 19th day after treatment for the 5 minutes and on 22nd day for both the control and 15 minutes treatments. The highest daily % germination of 13.33% was recorded at 5, 10 and 15 minutes treatments. Highest % seed germinability of 73.32% was recorded at 15 minutes treatment, followed by 10 minutes (70%), then 5 minutes treatment (63.34%) and that of the control (46.66%) was the least.

Table 4.1: Cumulative Percentage (%) Germination of *S. obtusifolia* Seeds Treated at Different Times (Days) Using Ordinary Water (Soaking) Treatment Method.

Days After Treatment	Seed Treatment Times (Days)				
	Control	1 Days	2 Days	3 Days	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	3.33	3.33	0	0	
7	0	6.67	3.33	0	
8	3.33	6.67	6.67	3.33	
9	3.33	3.33	0	6.67	
10	3.33	6.67	10.0	6.67	
11	0	0	3.33	0	% Daily Germination
12	0	3.33	6.67	10.0	
13	10.0	6.67	10.0	6.67	
14	6.67	3.33	0	10.0	
15	6.67	6.67	3.33	10.0	
16	3.33	3.33	3.33	3.33	
17	3.33	0	3.33	0	
18	3.33	6.67	6.67	6.67	
19	0	0	3.33	3.33	
20	3.33	0	3.33	3.33	
21	0	0	3.33	3.33	
22	3.33	0	0	6.67	
23	0	3.33	0	3.33	
24	0	0	3.33	3.33	
25	0	0	0	0	
26	0	3.33	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	0	
36	0	0	0	0	
% Germination	53.31	63.33	70	86.66	

Table 4.2: Cumulative Percentage (%) Germination of *S. obtusifolia* Seeds Treated at Different Times (Days) Using Hot Water Treatment Method.

Days After Treatment	Seed Treatment Times (Minutes)				
	Control	5 Minutes	10 Minutes	15 Minutes	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	0	0	0	
5	0	0	0	0	
6	0	0	0	0	
7	0	0	3.33	0	% Daily Germination
8	0	6.67	6.67	13.33	
9	3.33	0	10.0	10.0	
10	3.33	10.0	3.33	0	
11	0	0	6.67	3.33	
12	3.33	3.33	10.0	10.0	
13	10.0	13.33	6.67	13.33	
14	0	0	0	6.67	
15	6.67	13.33	3.33	10.0	
16	0	0	10.0	13.33	
17	3.33	6.67	6.67	0	
18	3.33	6.67	6.67	10.0	
19	6.67	10.o	0	3.33	
20	0	0	0	0	
21	0	0	0	0	
22	3.33	3.33	6.67	0	
23	0	0	0	3.33	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	0	
36	0	0	0	0	
% Germin.	43.32	73.33	80.01	96.65	

Table 4.3: Cumulative Percentage (%) Germination of *S. obtusifolia* Seeds Treated at Different Times (Minutes) Using Chemical (H_2S0_4) Treatment Method

Days After Treatment	Seed Treatment Times (Minutes)				
	Control	5 Minutes	10 Minutes	15 Minutes	
1	0	0	0	0	
2	0	0	0	0	
3	0	0	0	0	
4	0	3.33	0	0	
5	0	0	3.33	0	
6	0	0	0	0	
7	0	0	3.33	0	
8	6.67	6.67	6.67	3.33	
9	0	6.67	6.67	10.0	
10	0	0	10.0	0	
11	3.33	6.67	13.33	3.33	
12	10.0	16.67	0	13.33	
13	0	0	0	0	% Daily Germination
14	10.0	6.67	6.67	10.0	
15	0	6.67	6.67	10.0	
16	0	3.33	3.33	0	
17	6.67	0	3.33	6.67	
18	3.33	6.67	3.33	0	
19	0	3.33	3.33	3.33	
20	3.33	3.33	0	3.33	
21	0	0	0	6.67	
22	3.33	0	0	3.33	
23	0	0	0	0	
24	0	0	0	0	
25	0	0	0	0	
26	0	0	0	0	
27	0	0	0	0	
28	0	0	0	0	
29	0	0	0	0	
30	0	0	0	0	
31	0	0	0	0	
32	0	0	0	0	
33	0	0	0	0	
34	0	0	0	0	
35	0	0	0	0	
36	0	0	0	0	
% Germination	46.66	63.34	70	73.32	

4.5 Field experiment germination test results

From the results of laboratory experimental germination test, 15 minutes hot water treatment method gave the highest % seed germinability of 96.65% for the seed of *S. obtusifolia* (Table 2). Therefore, the best treatment method was used for treating the seeds of the study species for sowing in the field, for the period of 36 days and the results were presented in Tables 4 as follows:

4.6 Upland and fadama germination test results

The Table 4 had presented the germination test results of the field experiment for *S. obtusifolia* seeds treated at 15 minutes hot water treatment. Germination was presented as daily percentage germination and percentage germinability of the three replicate blocks of the study species. Germination of the seed of *S. obtusifolia* commenced germination just on the 3rd day after treatment and sowing but continued until the 20th day when it ceases with the highest daily percentage of 22.22% occurring only on the 5th day of the experimental period and 51.11% germinability (Table 4).

Similarly, germination of *S. obtusifolia* seeds commenced just on the 4th day after treatment and sowing with the highest daily percentage viability of 31.94% simultaneously on the same day and continued until the 20th day of the experiment when it ceases and the percentage viability of the seeds accounted for was 47.22% (Table 4).

Table 4.4: Cumulative Percentage (%) Germination of *S. obtusifolia* Seeds Sown at Upland and Fadama Locations, Treated at 15 Minutes Time Using Hot Water Treatment Method

Days After Sowing	UPLAND TREATMENT *S. obtusifolia*	FADAMA TREATMENT *S. obtusifolia*
1	0	0
2	0	0
3	0	1.39
4	31.94	16.67
5	1.39	22.22
6	18.06	16.67
7	22.22	13.89
8	19.44	18.06
9	22.22	18.06
10	18.06	15.28
11	16.67	16.67
12	16.67	12.50
13	11.11	16.67
14	20.83	16.67
15	13.89	18.06
16	5.56	13.06
17	4.17	13.89
18	5.56	16.67
19	2.78	13.89
20	5.56	8.33
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
31	0	0
32	0	0
33	0	0
34	0	0
35	0	0
36	0	0
% Germination	47.22	51.11

Daily % Germination

5.0 DISSCUSSION

5.1 Laboratory experiment: ordinary water treatment

The observation that the trend of the results (Tables 1) showed steady increase in the daily percentage germination and percentage germinability values from 1-3 days pretreatments in comparison with control treatment and statistically non- significant agreed with reports of Hossain *et al.* (2005); Eghoruba *et al.* (2005); and Feike *et al.* (2008) that seeds soaked in water overnight before planting showed highest seed germination in comparison with any method of breaking seeds dormancy in most plant species. This finding was supported by Anon (2008) report that soaking of seed in water is used to tackle all the different types of dormancy by modifying hard seeds coat, removing inhibitors and softening the seeds which ensures adequate absorption of water by the seeds. The continued increase in germination percentage due to increase in the number of days of pretreatment methods showed clearly the relevance of moisture increase to softening the hard seed coat of the study species, a reason why may be Awodola (1993) reported that soaking of seed in water is the most simplest widely used pre-germination treatments for breaking seed dormancy in the plant world. This finding implies that pretreatment of seeds with ordinary water before sowing increase germination percentage in the seeds of *S. obtusifolia* Thus, soaking of seeds in water is generally required for breaking dormancy in the seeds of *S. obtusifolia.*

5.2 Laboratory experiment: hot water treatment

The results of Tables 2 simultaneously observed to increase steadily from 5-15 minutes with hot water treatment in the daily percentage germination but non- significant statistically and higher than the control value largely in *S. obtusifolia* agreed with reports of Valenti *et al.* (1989); Mackay *et al.* (1995); Mackay *et al.* (1996) and Centenera *et al.* (1999) that seeds immersed in 1 - 10 times volume of boiling water (100 ^{0}C) improved germination, this might be a reason why 15 minutes hot water treatment for *S. obtusifolia* gave the highest germination percentage of 96.65%. The observation also agreed with finding of Duguma *et al. (*1988) that seeds treated with hot water at 100 ^{0}c increased germination with increasing ratio of seeds to water in comparison with control treatment. This is possibly a reason why control treatment percentage germinability for hot water treatment was quantitatively higher than 5 - 15 minutes treatment at 15 minutes periods being the best treatment for breaking seed dormancy for higher germination in *S. obtusifolia* seeds.

5.3 Laboratory experiment: chemical treatment

The findings of higher percentage germinability presented in Tables 3 as for 5, 10 and 15 minutes chemical treatment method in comparison with control even though the result is not significant statistically agreed with report of Anon (2008) that chemical scarification of seeds increase the percentage of seeds that germinate. The result also agreed with report of Moussa and Margolis (1998) that chemical treatment of hard seed coat facilitate and has increased the germination rate of many seeds with hard and water impermeable seed coats. This might be a reason why 15 minutes chemical treatment showed high germination rates than all the other treatments with control inclusive in *S. obtusifolia*. This finding implies that control and 15 minutes were the best chemical treatments for *S. obtusifolia* than all the other treatments as per chemical method.

5.4 Field experiment: fadama and upland habitats

The observation that at Fadama habitat, *S. obtusifolia* had quantitatively higher percentage germinability (51.11%) than that of Upland (47.22%) as in Table 4 disagreed with report of

Sasaki (1980) that hot water treatment was less effective for breaking seeds dormancy, rather it further confirmed that hot water treatment was successful medium for treating seeds of *S. obtusifolia* for direct sowing in to the soil at fadama location.

CONCLUSION

Results of laboratory experiment revealed that 15 minutes hot water treatment for *S. obtusifolia* seeds and 10 minutes chemical treatment method for *S. occidentalis* were the best methods which gave 96.67% and 90% percentage germinability. Field experiment in turn revealed 15.11% in *S. obtusifolia* and 45.78% in *S. occidentalis* at fadama habitat; and also 47.22% in *S. obtusifolia* and 35.56% in *S. occidentalis* at upland location but the required stands of the study species were obtained.

RECOMMENDATIONS

To amalgamate the findings of this research on seed germinability, growth parameters and nutrient elements concentration in the leaves of *S. obtusifolia* and *S. occidentalis* for gains of the study, the following were recommended:

For high germination of the seeds of the study species in the field, 15 minutes hot water treatment and 10 minutes chemical (H_2S0_4) treatment methods were recommended for the seeds of *S. obtusifolia* and *S. occidentalis* respectively.

Sowing the seeds of the study species in to the field should be carried out during the rainy season hence some seeds that failed to germinate during the dry season, germinated at the early rainy subseason in this study.

Therefore, cultivation of the study species at any subseason is hereby recommended to the farmers and for scientific research especially at fadama location.

For further study, similar research should be conducted on other similar species to bring out more of their potentials and advanced knowledge and hence for their conservation.

Acknowledgements

I am grateful to Mal. Ahmad Modi Bodinga, for his support, patience and kindness in the laboratory experiment. I am also thankful to Alhaji Muh'd Danige, Mal. Aliyu Jabo, Mal. Ahmad Muh'd Danige, Mal. Basiru Aliyu Kwalkwalawa, and late Mal Umaru Maigadina for their patience, assistance and support in ensuring the security of my experimental sites at both fadama and upland experimental sites. I wish to acknowledge the moral and financial support provided to me by the college management of Shehu Shagari College of Education, Sokoto, ETF for their research grants, and Sokoto State Scholarship Board.

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