Effect of Storage Humidity on Seed Longevity and Sowing Depth on Seed Germination of *Prosopsis africana* (Guill and Perr.) Taub

D. A. Agboola
Department of Biological Sciences, University of Agriculture, Abeokuta,
P. M. B. 2240, Abeokuta, Ogun State, Nigeria

Abstract

This paper discusses the effect of relative humidity during storage on seed longevity and sowing depth on germination of *Prosopsis africana* (Guill and Perr.) Taub seeds. Freshly collected and two-years old seeds were used for this experiment. Six levels of relative humidity (RH) values ranging from 22 and 100% were obtained by using water and saturated solutions of some chemicals in closed chambers at a temperature of 28 - 30°C. Sundrying did not change the initial moisture contents of fresh seed, while RH of 0 - 22% and 72.5 - 100% degraded the seeds resulting in a rapid loss of viability. Complete loss of viability occurred within 18 - 21 months at low RH regimes and 9 - 15 months at high RH regimes. Germination and emergence of seedlings were significantly favoured when seeds were sown at a sowing depth range of 2.6 cm.

সারসংক্ষেপ

আলোচ্য প্রবন্ধে *Prosopsis africana* (Guill and Perr.) Taub প্রজাতির বীজের অংকুরোদগমের উপর গুদামজাত অবস্থায় বীজের আপেক্ষিক আর্দ্রতা ও বপণের গভীরতার প্রভাব নিয়ে আলোচনা করা হয়েছে। পরীক্ষণটির জন্য সদ্য সংগৃহীত ও দু'বছর বয়সের বীজ ব্যবহার করা হয়। আবদ্ধ প্রকোষ্ঠে ২৮ - ৩০ সে তাপমাত্রার পানি ও সম্পৃক্ত রাসায়নিক দ্রবণের মিশ্রণে শতকরা ২২ - ১০০ ভাগের মধ্যে বিস্তৃত ছয় মাত্রার আপেক্ষিক আর্দ্রতা সৃষ্টি করা হয়। রৌদ্রে শুকানোতে সদ্য সংগৃহীত বীজের প্রারম্ভিক আর্দ্রতার কোন পরিবর্তন ঘটে না। কিন্তু শতকরা ০-২০ এবং ৭২.৫ - ১০০ ভাগ আপেক্ষিক আর্দ্রতা বীজের অংকুরোদগম ক্ষমতা নষ্ট করে দেয়। নিম্ন আপেক্ষিক আর্দ্রতায় ১৮ - ২১ মাসে এবং উচ্চ আপেক্ষিক আর্দ্রতায় ৯ -১৫ মাসের মধ্যে বীজের অংকুরোদগম ক্ষমতা সম্পূর্ণ নষ্ট হয়ে যায়। মাটির ২.৬ সে মি গভীরে রোপণের ফলে বীজের অংকুরোদগম ও চারা প্রস্ফুটিত হওয়ার হার উল্লেখযোগ্য পরিমাণে বৃদ্ধি পায়।

Key words : *Prosopsis africana*, seed storage, seed germination

Introduction

Prosopsis africana (Guill and Perr.) Taub is a leguminous tree. It is wild in the savanna regions of West Africa (Keay *et al.* 1964). In Nigeria, P. *africana* has been categorised as a 'lost', wild and endangered tree crop, and is threatened by extinction (Okafor 1993; Odunfa 1993). The seeds of *P. africana* are used by the natives in Nigeria to prepare "Okpehe", a fermented spice or soup condiment known for its high protein and fatty acid content (Sanni *et al.* 1993 a and b). The roots are used by the Yoruba tribe of the south-western part of Nigeria to prevenat tooth and gum decay. The hard wood gives good furniture, hoes, bows, pestles and mortars.

This important tree faces the regular savanna annual bush burning, exploitation and deforestation with reckless abandon and total disregard for replanting and reforestation (Beets 1989). This problem is compounded by is seed dormancy problems due to hard seed coat. Another problem is the inability of collected seeds to retain their viability while in storage (Olatoye 1968).

The cause of loss of viability in seeds has been studied by many workers (Harrington 1972; Agboola and Etejere 1991 a). This study aimed to investigate the effect of varying relative humidities and sowing depth on the longevity and germination of *P. africana* seeds. The results will serve as useful information on relative humidity values of seeds for storage without loss of viability, and sowing depth in of the seeds during planting.

Materials and methods

Collection, seed processing and determination of moisture content

Dried pods of *P. africana* were collected directly from underneath the diffuse tree stands after fruit fall in February, 1993. The place of collection was part of the savanna forest within the Campus of the University of Ilorin (8.32° N and 4.34° E) Nigeria. The methodology by FAO (1975) was adopted in processing the seeds. Extracted seeds were sundried for seven days so as to simulate the drying conditions for seeds under natural tropical environment. The temperature range of the environment was 30 - 34°C. The pods from which the seeds extracted were already dried and it was possible that the moisture contents of seeds would have been reduced to the optimum. Further sundrying was necessary to be sure that the moisture content was controlled to the optimum. Moisture contents of seeds were determined following Justice (1972).

Preparation of saturated solution for various relative humidity (RH) values.

Saturated solutions as suggested by Winston and Bates (1960) for the required RH in closed spaces at 28 - 30°C were prepared. Six values covering low and high RH of 22 - 100% were chosen and prepared with sodium nitrate (72.5% RH), calcium chloride (62% RH), lead nitrate + sodium nitrate (52.5% RH), ammonium nitrate + sodium nitrate (47% RH) and potassium acetate (22% RH). Distilled water was used to give 100% RH.

Seed storage, dormancy treatment and germination trials

Seeds were stored in desiccators in which the RH values are attained. All the desiccators were kept at 28 + 1°C. Seeds were pre-treated to release dormancy by subjecting them to concentrated sulphuric acid according to the methods of Agboola and Etejere (1991 b). Viability tests were performed using the tetrazolium chloride method of Moore (1973), while germination tests were

carried out in petri dishes according to the method of Agboola and Etejere (1991 b). Germination trials were carried out in five replicates using 25 seeds per replicate monthly for 24 months. All germination data in percentages were transformed to Arc sine square root and subjected to analysis of variance while the means compared by LSD test at P = 0.05

Effect of depth of sowing on seed germination

Twenty five seeds (already treated for dormancy) were sown (for a single depth regime) in sieved sterilized loamy soil contained in black polythene bags at six different soil depths of 0-2, 2-4, 5-6, 7-8, 9-10 and 11-15 cm. Soil depth was determined by placing a meter rule in the bags and measurement taken from the surface. Seeds were watered every two days. Five replicates of the set up were made. The experimental design was a complete randomized block one. Seedlings were counted and removed at daily intervals. Ungerminated seeds were dug up and tested for viability with triphenyl tetrazolium solution.

Results

The moisture content of seeds from fresh dry pods was 32.4% compared to 31.20% from sundried seeds. Hence, the moisture content of seeds prepared from fresh dried pods showed no significant difference from those sundried for seven days. It was observed that viability was significantly high (75 - 82%) when seeds were stored at 47 or 52.5% RH for 24 months (Figure 1). In the first 12 months of storage, seeds showed 62 - 78% germination under RH of 52.5 - 62% (Figure 1). More than 50% loss in viability was recorded within 3 - 6 months when seeds were stored under RH of 72.5 and 100% (Figure 1). It was observed that high RH of 72.5 and 100% and low RH of 22% did not favour longevity of *P. africana* seeds. For instance at RH of 22% complete loss of viability occurred about 18 - 21 months of storage (Figure 1) While at high RH of 72.5 - 100% complete loss of viability occurred within 9 - 15 months of storage. The tetrazolium test showed that all the ungerminated seeds from stored ones were no longer viable.

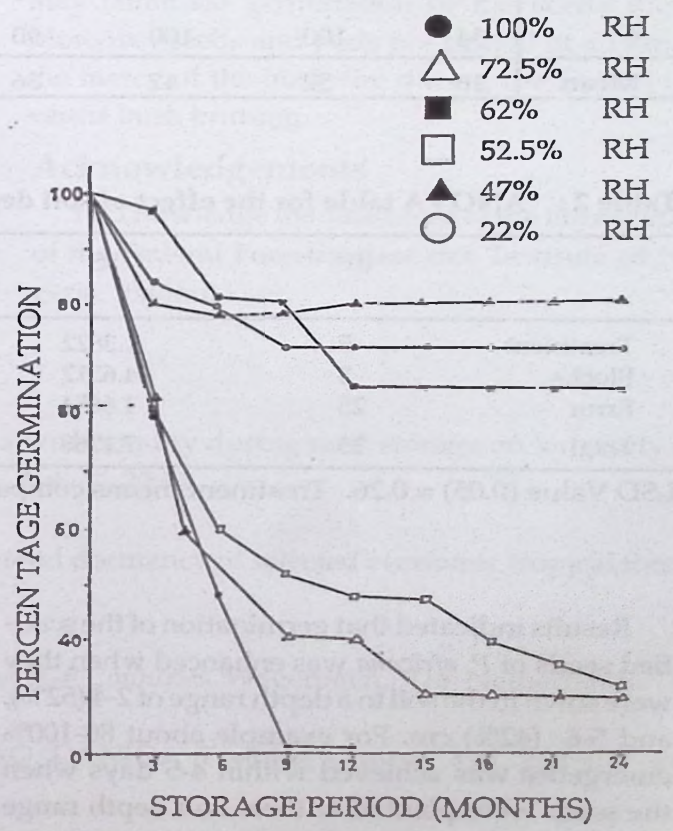

Figure 1 : Percentage germination of seeds of *Prosopsis africana* stored at various relative humidity values at 28 - 30°C. Each point is a mean of five replicates. LSDT at P = 0.05 is indicated.

Table 1 : The effect of soil depth on the germination of seeds of *Prosopsis africana* (Data are means of 5 replicates)

Days (replications)	Percentage of germination					
	Soil depth range (cm)					
	0 -2	2- 4	5 - 6	7- 8	9 - 10	11- 15
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	30	0	0	0	0
4	30	80	70	55	30	0
5	34	100	84	70	40	0
6	34	100	100	90	40	10
Mean	16	52	42	36	18	1.7

Table 2 : ANOVA table for the effect of soil depth on the germination of *Prosopsis africana* seeds.

	dF	SS	MS	F-ratio	Ftab (0.05)
Treatment	5	1.3822	0.2764	*5.93	
Blocks	5	4.6312	0.9262	*19.88	2.60
Error	25	1.6654	0.0466		
Total	35	7.1788			

LSD Value (0.05) = 0.26. Treatment means comparison : 52_a 42_b 36_c 18_d 16_e 1.7_f

Results indicated that germination of the scarified seeds of *P. africana* was enhanced when they were sown in the soil to a depth range of 2-4 (52%), and 5-6 (42%) cm. For example about 80-100% emergence was achieved within 4-5 days when the seed were planted at these soil depth range (Table 1). The percentage of germination was significantly affected when the seeds were sown in the soil depth range of 0 - 2 and 9 -15 cm. For example about 10-40% germination was observed within 4 - 6 days of planting the seeds in soil depth at 0 - 2 and 9 -15 cm (Table 1).

Discussion

The seeds of *P. africana* had dried to almost constant moisture content while still within the dry pods before and after fruit fall. This might have accounted for the negligible difference in moisture contents observed in the extracted and sundried seeds. One of the two main factors influencing seed longevity is seed moisture content (Harrington 1972).

The viability of most of the seeds was maintained for 24 months when stored under RH

values of 47 - 52.5% at 28-30°C. Viability was easily lost within 9 -15 months when seeds were stored between 22% and 72.5-100%. Halder and Gupta (1980) also made similar observation, while working on the effect of storage conditions on germination and internal biochemical changes in sunflower seeds in high and low relative humidity. The result of this study also agrees with seed germination of some tropical forest tree species (Agboola and Etejere 1991a).

The results of this work supports the occurrence of diffuse *P. africana* stands in the savanna regions in Nigeria, where RH values are always low for most of the year. Maguire (1980) is of the opinion that changes in enzyme activities occur in storage that affect seed viability. The dehydrogenates and specific enzymes involved in respiratory function decline in storage while hydrolytic enzymes tend to increase in activity reflecting possible membrane deterioration.

Seed germination and of seedling emergence were significantly favoured when seeds were planted in soil depth range of 2 - 6 cm (Table 1). This study indicates that one of the factors militating against the successful seed germination in the tropical savanna is soil depth and litter in which the dropped seeds and fruits are buried. The cover of soil may debar some of the germination requirements such as light, O_2 etc., from getting to the seeds below the thick soil layer. Hence viable seeds may not germinate. However, the photon flux reaching the forest floor generates heat and hence may stimulate germination of the seeds there. Moreover seeds and pods not buried at all are at the mercy of the bush fire during the annual savanna bush burning.

Acknowledgements

I acknowledge the assistance of the library staff of the Federal Forestry Research Institute of Nigeria, Ibadan.

References

Agboola, D. A. and Etejere E. O. 1991a. Effect of relative humidity during seed storage on longevity of seeds of six tropical tree species. *Nigerian J. Bot.* 4 : 23 32.

Agboola, D. A. and Etejere, E. O. 1991 b. Studies on seed dormancy of selected economic tropical forest tree species. *Nigerian J . Bot* . 4 : 115 - 126.

Beets, W. G. 1989. *The Potential Role of Agroforestry in AGP Countries.* Wagenigen, The Netherlands.

FAO 1975. *Forest Seed Collection and Handling.* FAO/DANIDA Training Course, Vol. 2. Food and Agricultural Organization, Rome.

Halder, S and Gupta, K. 1980. Effect of storage of sunflower seeds in high and low relative humidity on solute leaching and internal biochemical changes. *Seed Science and Technology* 8 : 317-321.

Harrington, J. F. 1972. Seed storage and longevity. *In* : Kozlowski, T. T. (ed.) *Seed Biology (Physiological Ecology)* Academic Press Inc. N. Y. pp. 209 - 240.

Justice, O. C. 1972. Essentials of seeds testing. *In* : Kozlowski T. T. (ed.) *Seed Biology*. Vol. II Academic Press Inc. N. Y. pp. 302 - 352.

Keay, R. W. J., Onochie, C. F. A. and Stanfield, D. P. 1964. *The Nigerian Trees*. Nigerian National Press Ltd. Vol. 2. pp.188 - 189.

Maguire, J. D. 1980. Seed quality and germination. *In* : Khan A. A. (ed.) *The Physiology and Biochemistry of Seed Dormancy and Germination*. North Holland Co., New York. pp. 219 - 233.

Moore, R. P. 1973. *Tetrazolium Testing Practice and Guides*. Proceedings of Symposium IUFRO Group on Seed Problems, Vol. 1, Paper 4.

Odunfa, S. A. 1993. *Nigerian Lesser Crops and Technology*. Proceedings of the Conference on Lost Crops of Nigeria. University of Agriculture, Abeokuta, Nigeria. 3 : 155 - 163.

Okafor, J. C. 1993. *Lost Crops of Nigeria : An Overview. Proceedings of the Conference on Lost Crops of Nigeria*. University of Agriculture, Abeokuta . 3 : 432.

Olatoye, S. T. 1968. Seed storage and problems in Nigeria. *Proce, 9th Commonwealth Forestry Conference*. India, pp. 1-5.

Sanni, A. I., Lie, E. and Lindberg, A. M. 1993a. Fatty acid composition of *Prosopsis africana* and its fermented product Okpehe. *Chem. Mikrobiol., Technol. Lebensm* 15 (3/4) : 89 - 90.

Sanni, A. I., Lie, E. and Lindberg, A. M. 1993 b . Biochemical changes during production of Okpehe, a Nigerian soup condiment. *Chem. Mikrobiol. Technol. Lebensm* 15 (3/4) : 97 - 100.

Winston, P. W. and Bates, D. K. 1960 . Saturated solution for the control of humidity in biological researches. *Ecology* 14 (1) : 232 - 237.